Financing Constraints
and
Fixed-Term Employment Contracts[*]

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Abstract

This paper shows the interaction between financing constraints and the employment decisions of firms when both fixed-term and permanent employment contracts are available. We first present a dynamic model that shows the effects of both binding and expected financing constraints on employment decisions. Once calibrated, the model shows how fixed-term contracts may help firms to alleviate their financing constraints, and how these constraints affect employment dynamics. We then test the model on a sample of Italian firms. The results are consistent with the model and show that financially constrained firms tend to use a larger proportion of fixed-term contracts, and have a higher volatility of total employment with both types of contracts being more volatile among constrained firms.

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1   Introduction

The literature on financing constraints has investigated how financial restrictions may affect firm decisions. Most of the theoretical and empirical literature has analyzed fixed capital investment decisions.[1] However, there are very few studies on the effects of financing constraints on the employment policies of firms.[2] The payment of wages and firing costs makes hiring and firing sensitive to the financing constraints that firms face; moreover the dynamic nature of employment decisions make firms sensitive to future expected constraints. The aim of this paper is to propose and test empirically a new way of identifying the effects of financing constraints on the employment dynamics of firms by exploiting the different hiring and firing costs of fixed-term contracts and permanent contracts.

We consider the optimal dynamic employment policy of a firm that faces capital market imperfections when one type of labor (fixed-term contracts) is completely flexible and another type (permanent contracts) is subject to firing costs. We assume that the two types of labor are perfect substitutes but permanent employment is more productive.[3] This implies that a firm without financing constraints would hire permanent workers up to the point where expected firing costs are equal to the productivity gain with respect to temporary workers.

When firms face both significant labor market frictions and financial market inefficiencies, financing constraints amplify the effects of firing costs on hiring and firing decisions with important consequences. We show that the use of fixed-term workers may help to identify the differential effect of future expected financing problems as opposed to current ones on the real decisions of the firms. This is because the model predicts two opposite effects of financing frictions: on the one hand financing constraints increase the value of internally generated earnings, and thus increase the demand of the more productive permanent workers for those firms that are currently severely financially constrained but expect to be less so in the future. On the other hand future expected financing constraints make the firms more vulnerable to liquidity shocks, and increase both the expected volatility of employment and the demand

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[1]See Hubbard (1998) for a review of this literature.

[2]Exceptions are Nickell and Nicolitsas (1999), Smolny and Winker (1999) and Rendon (2005).

[3]This assumption is equivalent in the model to permanent workers having a higher productivity per unit of salary paid. We do not provide a microfoundation of this assumption. Nonetheless it arises endogenosly in more complex model where the skill of the workers is heterogeneous.

for the more flexible fixed-term workers.

In order to identify these two effects in the empirical data, we solve the model and calibrate a simulated industry that matches the employment dynamics and the volatility of profits of our empirical data. The simulated industry shows that the effect of future expected financing constraints strongly prevails, and as a result, financing constraints increase the use of fixed-term workers. Moreover the simulations show that financially constrained firms not only hire more fixed-term workers, but also use them to absorb a larger part of the total employment volatility, thereby reducing the volatility of permanent employment. These findings determine a set of robust predictions: 1) financing constraints are predicted to increase both the probability to employ fixed-term workers and the amount of fixed-term workers relative to permanent workers; 2) the positive effect of financing constraints on fixed-term employment is asymmetric, because it is much stronger for firms than increase employment than for firms that decrease it; 3) financing constraints increase the volatility of all types of employment but should increase relatively more the volatility of fixed-term employment than that of permanent employment.

These predictions are tested on a database of small and medium Italian manufacturing firms with balance sheet data from 1995 to 2000. This dataset represents a unique opportunity to verify the joint effect of firing costs, flexible employment contracts and financing imperfections on the labour demand of firms for several reasons: i) Italy is a country that traditionally has a very high labour protection.[4] At the same time flexible contracts have been gradually more available to Italian firms in the last 20 years, especially since a new type of fixed-term labour contract was introduced in the mid 1990s. Therefore our dataset is particularly well suited to analyze the effect of the introduction of a flexible labor contract in a heavily regulated environment. ii) The Italian financial system is traditionally underdeveloped. Italian firms face severe capital market imperfections that are only partially corrected by the availability of bank credit as the main source of external finance. iii) The dataset analyzed in this paper contains a unique combination of self-reported measures of financing constraints and information on fixed-term and permanent labor contracts.

The results from the empirical part confirm the predictions of the model of a

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[4]The OECD 1999 Employment outlook places Italy as the country with the third strictest employment protection legislation among OECD countries in the 1990s.

higher use of fixed-term contracts among constrained firms with a higher volatility of total employment. This higher volatility is partly a mechanical consequence of a higher use of fixed-term contracts (that are unconditionally more volatile) and partly the consequence of a higher volatility of both types of labour among constrained firms. However the empirical results are not precise enough to identify if this increase in volatility is higher for fixed-term contracts. Finally we show, as predicted by the model, that most of the differences between constrained and unconstrained firms are due to different hiring policies, while when firing, both types of firms seem very similar. All the results are robust to the inclusion of additional control variables, that take into account possible heterogeneity in the empirical data that is not present in the model. The results are also robust to using instrumental variables to correct for the potential endogeneity of the self-reported measure of financing constraints.

The paper is organized as follows: section 2 surveys the related literature. Section 3 illustrates the model. Section 4 presents the empirical analysis. Finally, section 5 concludes.

2 Related literature

The findings of this paper complement those in the literature on the effect of employment protection on employment dynamics (Bentolila and Bertola 1990, Bentolila and Saint Paul 1992, Hopenhayn and Rogerson 1993). In particular the issue of fixed-term labor contracts and their interaction with permanent contracts has attracted significant attention in the preexisting literature.[5] The European countries where both types of contracts coexist and where several labor reforms have been introduced constitute interesting natural experiments to test the effects of firing costs and labor market regulations. A significant number of articles have studied empirically the different country cases: Spain (Dolado et al, 2002; Alonso-Borrego et al 2005), France (Blanchard and Landier, 2002) and Italy (Kugler and Pica 2004) among many others. All of these papers explore the changes in volatility of employment, the effect of fixed-term contracts on unemployment and the relative use of fixed-term versus permanent contracts. In general they show how fixed-term workers absorb a higher

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[5]Dolado et al (2002) and Saint Paul (1996) provide a good survey of the relevant theoretical literature on the topic.

share of the volatility of output but they find ambiguous effects on whether their introduction increased or decreased unemployment. However these papers do not take into account the possible influence of financing constraints. The contribution of this paper is to show not only that financing constraints are an important determinant of fixed-term employment, but also that the interactions between financing frictions and firing costs are important to understand the employment dynamics of firms.

This paper is also related to the literature about the effect of financial imperfections on the labor demand of firms (Nickell and Nicolitsas 1999, Smolny, and Winker 1999, Benito and Hernando 2003). These papers explore at the empirical level the relationship between financing constraints and total employment. In general, they show how the presence of financing constrains may deter hiring. The added value of this paper comes from exploring the interaction between financing constraints, firing costs, and the joint dynamics of fixed-term and permanent employment contracts. That is, in contrast with the previous literature we explicitly model the existence of both types of contracts and show how the presence of financing constraints affects their use. We develop a theoretical model that analyzes the interactions between financial problems and firing costs on the labor demand of firms. The advantage of our approach is that our calibrated structural model provides several clear and unambiguous predictions about the effect of financing constraints on the trade off between permanent and fixed-term labor contracts. In this sense our article can be considered as a bridge between the two strands of the literature mentioned above.[6]

This paper also contributes to the recent literature that investigates new ways of testing for the effect of capital market imperfections at firm level (Almeida and Campello 2005, Whited 2005, Hennessy, Levy, and Whited 2006, Hennessy and Whited 2006, Caggese 2006). In contrast to these papers, that study the effect of financing frictions on fixed and working capital investment decisions, we focus on the effect on employment decisions. Moreover we show that the interactions between financing frictions and employment decisions are helpful to distinguish the effect of current financing problems from the effect of future expected financing constraints. This is important, because even tough theoretical models show that future expected

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[6]Another paper that follows a similar approach is Rendon (2005). The author uses a simulation procedure and compares the effect, on fixed investment and job creation, of relaxing financing constraints as opposed to relaxing labour market rigidities.

financing frictions should affect today's investment decision, virtually all the existing literature does not distinguish this effect from the effect on current financing problems. In contrast our theoretical and empirical results show that while financing constraints are binding for a small fraction of firms at any point in time, future expected financing constraints are a very important determinant of the decisions to hire fixed-term workers.

3 The model

3.1 Setup

We consider a risk neutral firm that maximizes the discounted flow of dividends:

$$V_t \left(l_t^p, \theta_t, a_t \right) = \max_{l_{t+1}^p, l_{t+1}^f, b_t} d_t + \frac{1}{R} E_t \left[V_{t+1} \left(l_{t+1}^p, \theta_{t+1}, a_{t+1} \right) \right] \quad (1)$$

Where $V_t \left(l_t^p, \theta_t, a_t \right)$ is the total discounted value of the firm at time t and d_t are dividends. The gross discount rate is $R = 1 + r$, where r is the market net interest rate.

The state variables that determine the situation of a firm at any given point in time are: the stock of permanent employment contracts at the beginning of the period l_t^p; the value of the net cash flow (from operations and maybe financial assets) of the firm at the beginning of the period a_t and a stochastic productivity parameter $\theta_t \in \{\theta_1, ..., \theta_N\}$ where $\infty > \theta_N > ... > \theta_1 > 0$. We assume that θ_t follows a first order Markow process with transition probability $\Gamma \left(\theta'/\theta \right)$.

The decision variables of the firm are as follows: l_{t+1}^p and l_{t+1}^f are the amount of permanent and fixed-term labour contracts respectively; b_t is the face value of one period debt borrowed in period t. If negative, it indicates that the firm is a net lender.

The firm uses a concave technology in labor input with a degree of returns to scale equal to α :

$$y_t = \theta_t \left(l_t^p + \rho l_t^f \right)^\alpha \quad (2)$$

$$0 < \rho < 1; \ 0 < \alpha < 1$$

ρ is the parameter representing the relative productivity differential between fixed-term and permanent workers. For simplicity we assume that permanent and fixed-term contracts are perfect substitutes and are paid the same wage, normalized to one.

They differ in that permanent workers are more skilled, but they can be fired only by paying a fixed cost F. Fixed term workers can be fired without restrictions but are relatively less productive than permanent workers. The assumption of identical wages for fixed and temporary workers is just a normalization. Appendix 1 shows that l_t^p and l_t^f can be interpreted as the wage cost of permanent and fixed-term workers in terms of monetary units. It also shows that ρ can be interpreted as the productivity differential of one unit of wage paid to fixed-term workers with respect to one unit of wage paid to permanent workers. In other words, the assumption about $\rho < 1$ only implies that the difference in productivity between the two types of contracts is not fully compensated by a wage differential. The timing of the model is as follows:

Time t					Time t+1
l_t^p, l_t^f currently employed	Debt b_{t-1}	a_t is determined.	b_t, l_{t+1}^p and l_{t+1}^f	
θ_t, y_t are realized.	is repaid	b_t/R borrowed.	are determined.	

At the beginning of period t the firm has a stock of permanent and fixed-term workers equal to l_t^p and l_t^f respectively. The firm observes θ_t, realizes revenues y_t and repays the debt b_{t-1}. The dynamics of the net assets of the firm can therefore be expressed as

$$a_t = y_t - b_{t-1} \tag{3}$$

After production the contract of fixed-term workers ends, and their net hiring in period t is equal to l_{t+1}^f. On the contrary permanent workers leave the firm at an exogenous separation rate δ. The firm uses financial wealth a_t plus new borrowing b_t to pay dividends and wages. The budget constraint is the following:

$$d_t + l_{t+1}^p + l_{t+1}^f - F i_t^p S_t = a_t + \frac{b_t}{R} \tag{4}$$

where $F > 0$ represents the cost of terminating the contract of one permanent worker. i_t^p is the gross hiring of permanent workers that can be expressed as $i_t^p = l_{t+1}^p - (1 - \delta) l_t^p$. In order to measure firing costs, we define S_t as an indicator function that is equal to one when i_t^p is negative. Therefore $-F i_t^p S_t$ is non negative and is the total amount of firing costs paid by the firm in period t. If the firm does not pay the firing cost then $S_t = 0$, and i_t^p cannot be negative. Therefore i_t^p is constrained by the following condition:

$$(1 - S_t) i_t^P \geq 0 \tag{5}$$

Financing imperfections are present in the form of constraints to external financing. The first constraint is the non negativity of dividends, or in other words that firms cannot issue new equity:

$$d_t \geq 0 \tag{6}$$

The second constraint is an upper bound on b_t that implies that firms have a borrowing limit.

$$b_t \leq \overline{b} \tag{7}$$

This constraint imposes some exogenous credit rationing to the firm, but the existing theoretical literature has offered various reasons for its existence.[7]

We add the Lagrange multipliers ϕ_t and λ_t to constraints (6) and (7). Moreover without loss of generality we define $(1 + \phi_t) \mu_t$ as the multiplier of constraint (5). We use equation (4) to substitute d_t in equation (1), and we derive the first order conditions of the problem with respect to b_t, l_{t+1}^f and l_{t+1}^p as follows:

$$1 + \phi_t = R\lambda_t + E_t \left(1 + \phi_{t+1}\right) \tag{8}$$

Equation (8) is the first order condition for b_t. For the following analysis it is useful to solve it forward:

$$\phi_t = R \sum_{j=0}^{\infty} E_t \left(\lambda_{t+j}\right) \tag{9}$$

Equation (9) shows that ϕ_t is equal to the sum of the current and future costs of a binding financing constraint. Therefore the shadow cost of one additional unit of external finance is equal to $1 + \phi_t$. As long as $\phi_t > 0$, then the return from investing earnings inside the firm is higher than r, and the firm does not distributes dividends, so that $d_t = 0$.

$$\frac{1}{R} E_t \left\{ \left(1 + \phi_{t+1}\right) \frac{\partial y_{t+1}}{\partial l_{t+1}^f} \right\} = 1 + \phi_t \tag{10}$$

$$\frac{\partial y_{t+1}}{\partial l_{t+1}^f} \equiv \rho \alpha \theta_t \left(l_t^p + \rho l_t^f \right)^{\alpha-1} \tag{11}$$

Equation (10) is the first order condition for l_{t+1}^f. It holds with equality when the firm hires a positive amount of fixed-term workers. It shows that the expected

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[7]See for example Siglitz and Weiss (1981) or Ausubel (1991).

marginal return of fixed-term workers must be equal to their opportunity cost.

$$\frac{1}{R} E_t \left[\left(1 + \phi_{t+1}\right) \frac{\partial y_{t+1}}{\partial l_{t+1}^p} \right] = (1 + \phi_t) - (1 + \phi_t) \Omega_t + c E_t \left[\left(1 + \phi_{t+1}\right) \Omega_{t+1} \right] \qquad (12)$$

$$\frac{\partial y_{t+1}}{\partial l_{t+1}^p} \equiv \alpha \theta_t \left(l_t^p + \rho l_t^f \right)^{\alpha - 1} \qquad (13)$$

$$\Omega_t \equiv S_t F + (1 - S_t) \mu_t \qquad (14)$$

$$c \equiv \frac{1}{R} (1 - \delta) \qquad (15)$$

Equation (12) is the first order condition for l_{t+1}^p. It always holds with equality, because the assumption about the non-negativity of θ_t and the absence of fixed costs of production imply that it is always optimal to employ a positive number of permanent workers. The term Ω_t is positive when the firm decides to fire or to hoard the excess permanent workers. Therefore the term $E_t \left\{ \left(1 + \phi_{t+1}\right) \Omega_{t+1} \right\}$ is the future expected cost of firing or hoarding permanent workers. Finally, we combine together equations (4) and (7) and we define the maximum investment capacity of the firm as follows:

$$d_t + l_{t+1}^p + l_{t+1}^f - F i_t^p S_t \leq a_t + \frac{\overline{b}}{R} \qquad (16)$$

When the financing constraint is not binding then $\lambda_t = 0$. In this case equation (9) determines ϕ_t, and equations (10) and (12) determine l_{t+1}^p and l_{t+1}^f. When the financing constraint is binding then equation (16) holds with equality, and together with equations (8), (10) and (12) it determines λ_t, ϕ_t, l_{t+1}^p and l_{t+1}^f. λ_t indirectly affects equations (10) and (12) by increasing the shadow value of money ϕ_t.

Because of the presence of the firing cost, it is useful to analyze the solution of the model separately the case in which the firm has excess employment from the case in which the firm has not excess employment.

3.2 Employment decision when the firm has excess employment

The firm has an excess of employment when the amount of permanent workers currently employed in the firm is inefficiently high. In this case the firm may choose either to hoard or to fire these workers. Intuitively if the amount of excess workers is relatively small, the firm may choose to hoard all of them, because they may be

needed in the future if the firm's prospects improve. Alternatively, if the amount of excess workers is large, it may be necessary to fire some of them.

More formally, let's denote with $\widehat{l}^p_{t+1}$ the demand of permanent workers that would be optimal if firing costs were absent in period t but present from period $t+1$ onwards. If the productivity shock is negative and l^p_t is large then the optimal amount of permanent workers is lower than the amount of currently employed workers: $\widehat{l}^p_{t+1} < (1-\delta) l^p_t$. Because of the presence of firing costs, the firm can either hoard workers and keep $l^p_{t+1} = (1-\delta) l^p_t$, or fire them and pay the fixed cost F. In the former case $S_t = 0$ and $\Omega_t = \mu_t > 0$. In the latter case $S_t = 1$, $\mu_t = 0$ and $\Omega_t = F$.

The decision to hoard or to fire the marginal worker depends on the magnitude of μ_t relative to F. μ_t measures the cost of hoarding a marginal worker, and it is decreasing in the distance between the optimal unconstrained level of permanent workers and the actual level of workers. That is, as $\widehat{l}^p_{t+1}$ converges to $(1-\delta) l^p_t$ then μ_t converges to zero. Therefore it exists a value of $\widehat{l}^p_{t+1}$ sufficiently close to $(1-\delta) l^p_t$ such that μ_t is smaller than F, and the firm chooses $S_t = 0$ and $l^p_{t+1} = (1-\delta) l^p_t$. The difference $l^p_{t-1} - \widehat{l}^p_{t+1}$ can be interpreted as labour hoarding. Given the value of l^p_{t-1}, it is possible to solve equation (10) for l^f_{t+1}. If the resulting l^f_{t+1} is positive, it measures the optimal hiring of fixed-term workers. If it is negative, the optimal hiring of fixed-term workers is zero.

The smaller are θ_t and $\widehat{l}^p_{t+1}$, the larger becomes the difference $(1-\delta) l^p_t - \widehat{l}^p_{t+1}$ and the cost μ_t to hoard the marginal worker. Therefore eventually $F < \mu_t$, and it becomes optimal to fire workers. In this case $S_t = 1$ and $\widehat{l}^p_{t+1} < l^p_{t+1} < (1-\delta) l^p_t$. l^p_{t+1} is determined so that the firm is indifferent between firing or hoarding the marginal fired worker. This implies that μ_t is bounded above by the value of F. The difference $(1-\delta) l^p_t - l^p_{t+1}$ is the amount of fired workers, while the difference $l^p_{t+1} - \widehat{l}^p_{t+1}$ is the amount of hoarded workers. In this case $l^f_{t+1} = 0$, because it is always optimal to fire fixed-term workers first.

3.3 Employment decision when the firm does not have an excess of employment

In this case $S_t = \mu_t = \Omega_t = 0$, and the firm has also to decide on the optimal mix between the hiring of permanent and fixed-term workers. This decision depends on a trade off. Permanent workers are more productive, but also costly to fire. Therefore

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a firm prefers to hire permanent workers if it expects that the probability to fire them in the future is low. The key factor in this decisions is the value of the term $E_t(\Omega_{t+1})$, the expected costs of firing and hoarding permanent workers in the future. The discussion in section 3.2 makes it clear that $E_t(\Omega_{t+1})$ increases in l^p_{t+1}. This is because the higher is l^p_{t+1}, the more likely it is that the firm will have to hoard or to fire permanent workers in the future. This is formalized in the following proposition:

Proposition 1 *Conditional on θ_t and a_t, $E_t(\Omega_{t+1})$ is a continuous and weakly increasing function of l^p_{t+1}:*

$$E_t\left(\Omega_{t+1} \mid l^p_{t+1} = 0\right) = 0 \qquad \frac{\partial E_t(\Omega_{t+1})}{\partial l^p_{t+1}} \geq 0$$

For a proof, see Appendix 2. For a hiring firm l^p_{t+1} and l^f_{t+1} are jointly determined by the following two conditions:

$$E_t\left\{\left(1 + \phi_{t+1}\right)\frac{\partial y_{t+1}}{\partial l^f_{t+1}}\right\} = R\left(1 + \phi_t\right) \tag{17}$$

$$E_t\left\{\left(1 + \phi_{t+1}\right)\frac{\partial y_{t+1}}{\partial l^p_{t+1}}\right\} - cE_t\left\{\left(1 + \phi_{t+1}\right)\Omega_{t+1}\right\} = R\left(1 + \phi_t\right) \tag{18}$$

Equation (17) simply rearranges equation (10). Equation (18) is derived from equation (12) evaluated for $\mu_t = 0$ and $S_t = 0$. Equations (17) and (18) determine the optimal mix between fixed-term and permanent workers for a hiring firm. The right hand side is the same for both equations because, as shown in Appendix 1, the amount of labour can be interpreted as measured in wage units. It follows that to hire permanent workers is more profitable than to hire fixed-term workers if:

$$E_t\left\{\left(1 + \phi_{t+1}\right)\frac{\partial y_{t+1}}{\partial l^p_{t+1}}\right\} - cE_t\left\{\left(1 + \phi_{t+1}\right)\Omega_{t+1}\right\} > E_t\left\{\left(1 + \phi_{t+1}\right)\frac{\partial y_{t+1}}{\partial l^f_{t+1}}\right\} \tag{19}$$

We use equations (11) and (10) in (19) to rearrange equation (19) as follows:

$$\frac{cE_t\left\{\left(1 + \phi_{t+1}\right)\Omega_{t+1}\right\}}{1 + \phi_t} < R\frac{1 - \rho}{\rho} \tag{20}$$

Condition (20) has an intuitive interpretation. The right hand side is the marginal productivity gain from the hiring of one additional permanent workers instead of one

additional fixed-term worker. The left hand side is the expected marginal firing costs. Therefore a firm that wants to hire one marginal worker will:

$$\begin{aligned}
\text{hire a permanent worker if} \quad & \frac{cE_t\left\{\left(1+\phi_{t+1}\right)\Omega_{t+1}\right\}}{1+\phi_t} < R\frac{1-\rho}{\rho} \\
\text{hire a fixed-term worker if} \quad & \frac{cE_t\left\{\left(1+\phi_{t+1}\right)\Omega_{t+1}\right\}}{1+\phi_t} > R\frac{1-\rho}{\rho}
\end{aligned} \tag{21}$$

Proposition 1 and condition (21) imply that $l^p_{t+1} = 0$ cannot be optimal, because the firm prefers to hire permanent workers when its employment level is so low that it does not expect to fire them in the future. But as l^p_{t+1} increases, $E_t\left(\Omega_{t+1}\right)$ increases, until equation (20) is satisfied with equality. It follows that the optimal level of permanent workers corresponds to the value of $E_t\left\{\left(1+\phi_{t+1}\right)\Omega_{t+1}\right\}$ that satisfies equation (20) holding with equality:

$$\frac{cE_t\left\{\left(1+\phi_{t+1}\right)\Omega_{t+1}\right\}}{1+\phi_t} = R\frac{1-\rho}{\rho} \tag{22}$$

Once the level of permanent workers ensures that equation (22) is satisfied, any additional hiring is directed towards fixed-term workers.

3.4 Financing constraints and the optimal mix between fixed-term and permanent workers.

The effect of financing constraints on the employment of fixed-term versus permanent workers is in general ambiguous, because of two opposite effects: on the one hand financing constraints increase the value of internally generated earning for the firm, and thus increase the demand of the more productive permanent workers. We call firms in which this effect predominates as "type A" firms. On the other hand financing constraints make the firm more vulnerable to liquidity shocks, and increase both the expected volatility of employment and the demand for the more flexible fixed-term workers. We call firms in which this effect predominates as "type B" firms.

In order to understand how these two effects work, consider first a type A firm. this may be a small firm that has profitable opportunities and would like to invest and grow, but it faces financing constraints and can only invest up to the amount of internal funds available. In other words, this firm is currently financially constrained, but it expects to make profits and grow over time. The model predicts that such a

firm may hire a smaller fraction of fixed-term workers relative to permanent workers with respect to a similar firm that does not face financing constraints. The reason is that the more a firm is financially constrained the higher is the expected return from reinvesting earnings, the more valuable is the higher productivity of permanent workers. Moreover this firm expects to generate profits, accumulate earnings and grow in size, and it does not expect to fire such workers in the near future.

Second, consider now a type B firm. This may be a larger and more mature firm that is currently generating profits. This firm faces financing frictions but is not currently financially constrained, because it has a sufficient level of internal funds to finance current operations. The model predicts that this firm may hire a larger fraction of fixed-term workers relative to permanent workers, with respect to a similar firm that does not have financing constraints. In order to understand this result, suppose that this firm chooses to hire permanent workers, but afterwards a negative and persistent reduction in productivity (for example an economic downturn) generates losses and reduces its financial wealth. In this case financing constraints have a very negative effect on the firm. First, they may imply that the firm cannot borrow to finance the payment of the wages. In other words, the firm may be forced to fire some permanent workers even though it would be more efficient to hoard them. Second, firing such workers has an higher opportunity cost, because internal funds become more valuable as financial wealth decreases and financing constraints become more intense. This amplification effect between financing constraints and expected firing costs increases ex ante the incentive to hire fixed-term rather than permanent workers. In other words, a firm that is afraid of future financing constraints values more the flexibility of fixed-term workers with respect to a firm that does not face financing frictions. The relative importance of these two effects determines whether, on aggregate, financing constraints lead to a higher or lower use of fixed-term contracts.

More formally, the effect of financing constraints on the optimal ratio between fixed-term and permanent workers can be studied by focusing on the equilibrium condition (22). We can rearrange it as follows:

$$A_t \left[E_t \left(\Omega_{t+1} \right) + B_t \right] = R \frac{1 - \rho}{\rho} \tag{23}$$

Where:

$$A_t \equiv c \frac{E_t \left(1 + \phi_{t+1} \right)}{1 + \phi_t} \quad \text{and} \quad B_t \equiv \frac{cov \left(\phi_{t+1}, \Omega_{t+1} \right)}{E_t \left(1 + \phi_{t+1} \right)}$$

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Equation (23) shows that financing constraints have two counteracting effects on the optimal hiring of a firm. The term A_t summarizes the effect of a currently binding financing constraint. The term B_t summarizes the effect of future expected financing constraints. The term A_t increases in $\frac{E_t\left(1+\phi_{t+1}\right)}{1+\phi_t}$, which is the ratio between the expected shadow value of money in period $t+1$ and the shadow value of money in period t. When the firm is not currently constrained ($\lambda_t = 0$), then $\frac{E_t\left(1+\phi_{t+1}\right)}{1+\phi_t} = 1$. Conversely $\frac{E_t\left(1+\phi_{t+1}\right)}{1+\phi_t}$ decreases the higher is the intensity of current financing constraints relative to future expected financing constraints. In this case the value of $E_t\left(\Omega_{t+1}\right)$ that satisfies equation (23) is larger, and the optimal ratio $\frac{l_{t+1}^F}{l_{t+1}^P}$ is smaller. Therefore the term A_t reflects the fact that the benefits of permanent workers in terms of their higher productivity are received immediately, while the expected firing costs will be paid in the future. When financing difficulties are stronger today than they are expected to be in the future, the net present value of the benefits of permanent workers increase relative to the net present value of their costs.

The sign of the effect of future expected constraints B depends on the sign of the covariance between the expected shadow value of money and the expected costs of firing permanent workers. This covariance is positive when the firm expects that, in case financing conditions will worsen in the future, it will become very costly to fire or to hoard permanent workers. The larger is B_t, the smaller is the value of $E_t\left(\Omega_{t+1}\right)$ that satisfies equation (23), the larger is the ratio $\frac{l_{t+1}^F}{l_{t+1}^P}$.

3.5 Predictions

The above discussion suggests that the interactions between financing constraints, firing costs, and the hiring of fixed-term and permanent workers may help to identify the effect of financing constraints on the dynamics of firm employment.

We expect the presence of financing frictions to reduce the use of fixed-term workers when the term A_t is large relative to B_t for most firms. In other words, when financing frictions only affect small and young growing firms, that are financially constrained today but expect to be less so in the future. Instead we expected financing frictions to increase the use of fixed-term workers when B_t is large relative to A_t for most firms. In this case, even though few firms are severely financially constrained, all firms may enter cyclical phases of high intensity of financing constraints, and therefore

they hire fixed-term workers in order to reduce the costs of future expected financing problems.

In order to estimate which of the two effects dominates empirically, we use the following strategy. First, we calibrate the parameters of the model to match the moments estimated from our sample of Italian firms. We focus on the statistics that are key to determine the two effects above, such as the volatility of employment, the volatility of revenues, the average fraction of fixed-term over permanent workers and the average fraction of constrained firms. Second, we simulate the artificial industry and we evaluate the effect of financing constraints on employment dynamics. Third, we use the simulation results to derive several predictions about the employment dynamics of financially constrained versus unconstrained firms, that can be verified with the empirical data.[8]

3.6 Calibration

We solve the model and simulate the activity of many artificial firms, in order to derive testable implications about the effects of financing constraints on the employment dynamics of the firms. The calibration of the parameters matches the volatility of employment and the volatility of revenues of our sample of Italian firms.

In order to allow the simulated industry to match the key features of the empirical data, we introduce two changes in the basic model illustrated in the previous section: i) with an exogenous probability $1 - \gamma$ the firm's technology becomes useless, the firm is liquidated and the value of the assets is distributed as dividends. We assume that a liquidated firm does not have to pay the firing costs for the permanent workers, so that equation (1) is modified as follows:

$$V_t \left(l_t^p, \theta_t, a_t\right) = \max_{l_{t+1}^p, l_{t+1}^f, b_t} \gamma d_t + (1 - \gamma) a_t + \frac{1}{R} E_t \left[V_{t+1} \left(l_{t+1}^p, \theta_{t+1}, a_{t+1}\right)\right] \qquad (24)$$

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[8]It is important to notice that some simplifying assumptions of our model may induce to over-estimate the magnitude of the term A_t and underestimate the positive effect of financing frictions on the use of fixed term workers. More specifically two additional effects not present in the model may be at work: i) the higher productivity of permanent workers may depend on their own human capital investment directed to build up job specific skills. In this case the gain in productivity may not be immediate and take time to materialize; ii) permanent workers may be more skilled workers that are more difficult to recruit, thus they are subject to an additional hiring cost. Therefore, in equilibrium, their higher productivity repays gradually the higher costs spent filling the vacancy. Both effects reduce the attractiveness of permanent workers for constrained firms, because they delay the net productivity gain from using permanent workers.

This exogenous exit probability is necessary in order to generate a simulated industry in which a fraction of firms is financially constrained in equilibrium. If $\gamma = 1$ and firms are infinitely lived then they eventually accumulate enough wealth to become unconstrained, and the simulated industry always converges to a stationary distribution of financially unconstrained firms, no matter how tight the borrowing constraint (7) is; ii) we model the idiosyncratic shock θ_t as a combination of a persistent and an i.i.d. shock (in the remainder of the paper we include the subscript i to indicate the $i - th$ firm):

$$\theta_t = \theta_t^I \theta_{i,t}^P \tag{25}$$

where $\theta_{i,t}^P$ is a persistent shock:

$$\begin{aligned} &\ln \theta_{i,t}^P = \upsilon \ln \theta_{i,t-1}^P + \varepsilon_{i,t}^P \quad \text{where } 0 < \upsilon < 1 \\ &\text{and} \qquad\qquad\qquad\qquad \varepsilon_{i,t}^P \sim iid\left(0, \sigma_P^2\right) \text{ for all } i \end{aligned} \tag{26}$$

and $\theta_{i,t}^I$ as an i.i.d. shock:

$$\ln \theta_{i,t}^I = \varepsilon_{i,t}^I \tag{27}$$

$$\varepsilon_{i,t}^I \sim iid\left(0, \sigma_I^2\right) \text{ for all } i \tag{28}$$

The persistent shock θ^P is necessary to match the dynamics of employment. The i.i.d. shock θ^I matches the volatility of revenues. Both shocks are important because they allow the simulated firms to have realistic dynamics of both employment and financial wealth. If we only allow for the persistent shock θ^P (by setting $\sigma_I^2 = 0$) then we cannot match the wealth dynamics observed in the data, because simulated firms would have too low volatility of revenues and also would almost never realize negative net income, which instead is realized in 24% of the firm-year observations in the sample.

One possible shortcoming of the model is that we assume the shock θ to be stationary, while the productivity of the firms in our empirical data may be non stationary. However, we argue that this is not likely to be a problem in interpreting the results of the model and the empirical analysis, for at least three reasons. First, the time series dimension of the empirical data is very short, and therefore nonstationarity is not likely to significantly bias the empirical results. Second, in the model the shock $\theta_{i,t}^P$ is stationary but very persistent, and the entry-exit of firms generate growth dynamics very similar to the dynamics observed in the data, because all firms are created

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small, and conditional on surviving they increase in size and become less financially constrained. In fact the simulated industry matches well the average growth rate of employment at the firm level observed in the data. Third, in Appendix 3 we illustrate in detail the implications of assuming a non stationary shock θ. We show that the predictions of the model regarding the optimal ratio between fixed-term and permanent workers are not affected by this change, while the effect on the other predictions of the model is likely to be small and accounted for by the control variables included in the empirical analysis in the next section.

The parameters are calibrated as follows: $r = 0.03$, corresponding to 3% interest rate; α, the return to scale parameter, is equal to 0.95; ρ matches the average fraction of fixed-term to permanent workers; δ corresponds to an exogenous separation rate of 2.2% permanent workers per year. F matches the average job destruction rate, which includes voluntary separations, firing of permanent contracts and expiration of fixed-term contracts; υ and σ_P match the average and the standard deviation of the ratio of gross hiring over total employment; σ_I matches the standard deviation of the sales/assets ratio. γ matches the average age of the firms in the sample. Table 1 summarizes the parameters choices, and shows that the model matches the empirical moments reasonably well.

Table 1 about here

3.7 Simulation results

We use the solution of the model to simulate 100.000 firm-year observations. We sort firms into groups of more financially constrained firms using the average value of the Lagrangian multiplier $\overline{\lambda}_i = \sum_{i=1}^{T_i} \lambda_{i,t}$. Where T_i is the number of years of operation of firm i and $\lambda_{i,t}$ measures the shadow cost of a binding financing constraint for firm i in period t. In the benchmark case we consider as constrained the group of firms with the 33% higher value of $\overline{\lambda}_i$, and as unconstrained the complementary group of firms. The average value of ϕ_t, the premium in the shadow value of money for the firm, is equal to 9.5% for the constrained sample and 2.0% for the complementary sample.

The first two columns in Table 2 illustrate the employment dynamics of the constrained firms and the complementary group. The third column shows the difference

across groups. The statistics are computed following the same method used in Table 1, by pooling all the observations in each group. This method is justified by the fact that in the simulations all firms are ex ante identical and operate the same technology. Nonetheless in the fourth column we show the percentage difference across groups when the statistics are instead computed on a balanced sample of simulated firms, following a procedure analogous to the procedure used on the empirical data in the next section. The comparison of the last two columns of Table 2 shows that the qualitative predictions of the model do not depend on the specific method used to compute the statistics.

Table 2 compares the volatility of total employment and of permanent and fixed-term workers for the group of most constrained firms and the complementary sample. The firms in the two groups differ both in their average size and in their average use of the two contracts. Therefore volatilities are computed as coefficients of variation, following the same procedure that will be used in the empirical section. Moreover the coefficient of variation of fixed-term workers is computed conditional on having a positive amount of such workers. This way we distinguish the probability to hire fixed-term workers from the volatility of fixed-term workers conditional on them being currently used by the firms. The table also reports the volatility of fixed-term and permanent workers as scaled by total employment.

Table 2 shows that constrained firms have an higher volatility of permanent workers than the complementary sample. On the one hand constrained firms are more likely to hoard rather than to fire permanent workers. This should reduce the volatility of permanent employment. On the other hand constrained firms change employment in response to a liquidity shock that changes financial wealth and the investment capacity of the firm, while unconstrained firms are not sensitive to changes in financial wealth. This effect increases the volatility of permanent workers, and it dominates on the previous effect.

More importantly, constrained firms hire more fixed-term workers. This is because future expected financing constraints matter in the simulated industry, and as a consequence fixed-term employment is mostly used by financially fragile firms, that are either constrained or will be financially constrained in the future conditional on a negative shock. Moreover, fixed-term employment is also substantially more volatile for constrained firms. It follows that while permanent employment is only 6.4% more

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volatile, total employment is 16% more volatile for constrained firms than for the complementary sample.

Table 2 about here

Table 3 illustrates the sensitivity of the model's predictions to different criteria to select the group of financially constrained firms. It shows that the narrower is the definition of financially constrained firms, the larger are the difference between constrained and unconstrained firms. More importantly, the qualitative predictions of the model are confirmed for all the different sample splitting criteria.

Table 3 about here

Table 4 estimates the average ratio between fixed-term and permanent workers for firms that increase or decrease employment. These expanding firms are identified by the dummy $hire_{it}$, which is equal to 1 if the firm i increases employment from period $t-1$ to period t and is equal to zero otherwise. Moreover contracting firms are identified by the dummy $fire_{it}$, which is equal to 1 if the firm i decreased employment from period $t-1$ to period t and is equal to zero otherwise. This dummy variable is called "fire" for simplicity, because firms can reduce employment not only by firing, but also by reducing fixed-term employment or by not replacing voluntary separations in permanent employment. The results show that the difference between financially constrained and unconstrained firms is almost entirely driven by the behaviour of firms that increase employment. For example among firms that do not hire the average ratio *Fixed term workers/Permanent workers* is equal to 2.4% and 2% for the 20% most constrained firms and the complementary sample respectively. Conversely for the firms that hire these ratios are equal to 11.3% and 7% respectively.[9] This latter difference is high because financially constrained firms use more intensely fixed workers especially during expansion phases. The intuition is as follows: an expanding firm that faces future expected financing constraints has an higher probability to be forced to cut investment and employment in the future conditional on a negative liquidity shock. As a consequence such a firm relies much more on fixed-term workers than an unconstrained firms.

[9]The constant is equal to zero because in the simulated sample the only firms that keep employment constant over time are very wealthy firms that never hire fixed term workers.

Tables 2, 3 and 4 show that financially constrained firms hire more fixed-term workers than unconstrained firms, and that their employment is more volatile. It is a well know result in the employment literature that the presence of fixed-term workers increases the volatility of employment, because it increases the ability of the firm to change employment policy in response to exogenous shocks.[10].

In this respect the added value of our model is to show that financing constraints are an important determinant of the decision to hire fixed-term workers in the first place. Moreover our model also shows that not only financially constrained firms hire more fixed-term workers, but also that conditional on hiring such workers their fixed-term employment is more volatile than the fixed-term employment of the unconstrained firms. In other words, the positive effect of financing constraints on employment volatility is stronger for fixed-term employment than for permanent employment.

This result may in principle depend on two distinct factors. On the one hand it may be that financing constraints affect the volatility of fixed-term workers much more than the volatility of permanent workers. On the other hand it may be that financially constrained firms have a much more volatile employment even in the absence of fixed-term employment, because they are more sensitive to liquidity shocks.

Table 4 about here

Tables 5 and 6 investigate more in depth on the relationship between financing constraints and the hiring of fixed-term workers. They compare employment dynamics in two industries. One is the industry with the benchmark parameters. The other is identical to the first, except that it does not allow for the presence of fixed-term workers.[11] Table 5 shows that the presence of fixed-term contracts increases volatility of employment in the industry by around 5%. This number is small because the average amount of fixed-term workers is relatively small (around 4%) in the bench-

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[10]See Bentolila and Saint Paul (1992) for a general theoretical explanation of this effect. See also Garcia-Serrano (1998) and Amuedo-Dorantes and Malo (2005) among others for some empirical evidence.

[11]Because the model is in partial equilibrium, the simulated industry without fixed term workers is an imprecise calibration of the equilibrium that would prevail in the real industry if fixed workers were not available. Nonetheless the bias is relatively small because the total amount of workers in the industries with and without fixed term workers is nearly identical, as the intruduction of fixed term workers increase both average job creation and job destruction by a similar amount.

mark calibration. Interestingly, the introduction of fixed-term contracts reduces the volatility of permanent employment by 8% for constrained firms, while it does not affect such volatility for the complementary sample. This difference is quite striking, given that both groups of firms hire a significant amount of fixed-term workers. The introduction of fixed-term workers reduces the volatility of permanent workers because it allows constrained firms to use fixed-term workers to absorb the fluctuations in employment induced by financing frictions. This also explains why average firing costs decrease by almost 50% for constrained firms after the introduction of fixed-term contract, while they decrease only by 20% for unconstrained firms. The consequence is that without fixed-term workers permanent employment is 15% more volatile for more constrained firms than for the complementary sample. Conversely with fixed-term workers is only 6% more volatile. Therefore financially constrained firms not only hire more fixed-term workers, but also make them absorb a larger part of the total employment volatility, thereby reducing the volatility of permanent workers.

Table 5 about here

Table 6 shows the elasticity of employment dynamics to a change in the borrowing limit. It compares the industries with and without fixed-term workers. The results show that relaxing the borrowing limit has a much greater effect in the industry without fixed-term workers. A 1% increase in the borrowing limit reduces the fraction of constrained firms by 0.36% in the industry without fixed-term workers and only by 0.12% in the industry with fixed-term workers. Moreover it reduces the volatility of employment by 3.5% in the industry with fixed-term workers and by 20% in the industry without fixed-term workers. Therefore the presence of fixed-term workers provides additional flexibility to the employment decisions of the firms and reduces the impact of financing frictions on them.

Table 6 also shows that an increase in borrowing capacity reduces the volatility of fixed-term workers, but it increases the ratio of fixed-term over permanent workers. **Figure (...)** shows that the increase in the ratio depends on two counteracting effects. On the one hand the increase in borrowing capacity reduces expected financing constraints of more wealthy and less constrained firms, and reduces their fixed-term employment. On the other hand it increases the ability of constrained firms to hire

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fixed-term workers following a positive productivity shock. The second effect dominates in equilibrium for the parameter values of the benchmark calibration, but as the borrowing capacity of firms further increase the second effect eventually dominates, and the ratio between fixed-term and permanent workers decrease in the intensity of financing constraints.

Table 6 about here

4   Empirical Analysis

The results illustrated in the previous section allow us to formulate the following predictions regarding the empirical relationship between financing frictions and employment dynamics:

i) Both the probability to hire fixed-term workers and the amount of fixed-term workers relative to permanent workers are higher for more financially constrained firms.

ii) The higher use of fixed-term workers among constrained firms is almost entirely due to constrained firms hiring more fixed-term workers when they increase employment.

iii) Total employment, permanent employment and especially fixed-term employment are more volatile for more financially constrained firms than for the other firms.

This section verifies these predictions on the empirical data, and is divided in four parts. Section 4.1 describes the data and variables used; section 4.2 explores the validity of the financing constraint measure used later on and shows the first stage of the instrumental variables approach used later on; finally section 4.3 tests the predictions of our theoretical model.

4.1   Data and Specification

To test the empirical predictions of the model we use the dataset of the Mediocredito Centrale surveys. The dataset contains a representative sample of Small and Medium Italian manufacturing firms. It is an incomplete panel with two main sources of information gathered in two different surveys:

i) Yearly balance sheet data and profit and loss statements from 1989 to 2000.

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ii) Qualitative information from four surveys conducted in 1992, 1995, 1998 and 2001. Each survey reports information about the activity of the firm in the three previous years.

The availability of both information about the firm accounts and qualitative answers in the surveys makes this dataset very useful to study how the perceptions and expectations that a firm has affect investment and production decisions.[12] Each survey is conducted on a representative sample of the population of small and medium manufacturing firms (smaller than 500 employees). The samples are selected balancing the criterion of randomness with the one of continuity. The firms in each survey contain three consecutive years of data. After the third year 2/3 of the sample is replaced and the new sample is then kept for the three following years.

For the analysis of this paper we restrict our sample to the last 6 years of the dataset (1995-2000). This is because of two main reasons. First, a new type of fixed-term contracts became regulated and started to be widely used in the second half of the 90s. Second, detailed information about all the different types of employment is only available in the 1998 and 2001 surveys. We also restrict ourselves to firms with 10 or more workers, as the regulation for permanent workers of smaller firms differs in Italy and makes it much easier to fire permanent workers for them. We also drop firms that were subject to a merger, acquisition or firms that split due to spin-offs or divestitures. That leaves us with 18783 firm-year observations in which we have valid information about the use of fixed-term and permanent contracts.[13]

This dataset is particularly well suited for our analysis for several reasons: in the first place the introduction of fixed-term contracts in Italy means the coexistence of two different contractual agreements that have very different firing costs. This matches exactly the situation described in our theoretical model. At the same time, the database is a representative sample of manufacturing firms of different industries and sizes, with detailed information about a number of aspects of the firm as well as direct questions that try to elicit the existence of financing constraints affecting a

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[12]Examples of papers that use the Mediocredito Centrale survey in this spirit are Basile, Giunta and Nugent (2003), Piga (2002) and Angelini and Generale (2006)

[13]80% of the firms appear in the sample for 3 consecutive years and 15% for 6 consecutive years, the rest have different number of observations because the firms were created during the sample time or because some firm-year observations are dropped due to outlier cutting or missing values in the dependent or independent variables.

particular firm.

The calibration of the model predicts a differential use of fixed-term and permanent contracts depending on whether firms are financially constrained or not. To test these predictions we run different regressions in which the dependent variables are: the ratio of fixed-term workers over total employment $ratio_{it}$; the coefficient of variation of total employment $cvemployment_{it}$ measured as the standard deviation of $ratio_{it}$ calculated over a three year window that coincides with each wave and divided over the mean of $ratio_{it}$ on that same period.[14] We also use as additional dependent variables the coefficient of variation of the number of fixed-term contracts $cvfixedterm_i$ and the coefficient of variation of permanent contracts $cvpermanent_i$. Given that there are several firms that use zero fixed-term contracts in two or three years of a three year "window", these coefficients of variation would not be appropriate measures if we used such a short period.[15] For this reason these two last variables are calculated across all six years and therefore they only vary cross sectionally.

Our independent variables of interest are related to the financing constraints that the firm faces. To construct our main measure of financing constraints we consider the questions in the Survey where each firm is asked:

i) Whether it had a loan application turned down recently.

ii) Whether it desires more credit at the market interest rate.

iii) Whether it would be willing to pay an higher interest rate than the market rate in order to obtain credit.

These questions are asked only in the 1998 and the 2001 surveys, which refer to the activity in period 1995-1997 and 1998-2000 respectively.

We use this information to construct our main measure of financing constraints $self\ declared_{it}$, which takes value 1 for period t if firm i declares to have any of the problems (i) to (iii) and takes value zero otherwise. According to this measure 16%

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[14]Therefore $cvemployment_{it}$ varies cross sectionally and takes two different values along time for the 1995-1997 period and the 1998-2000 period.

[15]For firms with all observations equal to zero, the coefficient of variation is not defined. For firms with two observations equal to zero and a positive one have a coefficient of variation of 1.73 regardless of the value of their only positive observation. This is a quite high value and could be artificially driving the results if we used a three year window.

of the firms declare to be financially constrained.[16] [17]

Given that firm size is a major determinant of financing constraints, with smaller firms facing higher problems when it comes to getting additional funding, we also use as an alternative measure of financing constraints the size of the firm. For that we construct a dummy variable $small_{it}$ that takes value one if assets are smaller than 5700 million lira.[18] This threshold splits the sample roughly in two equal parts.

We include in all the regressions a number of control variables to account for possible heterogeneities between firms that are not present in the theoretical model. The first control variable is $fixed\ capital_{it}$ that is constructed as fixed assets of the firm divided by the number of employees and controls for the fact that the model abstracts from the different intensities of labour versus fixed capital. The second control variable, $sdsales_{it}$ is the standard deviation of the sales of the firm calculated over a three year window that coincides with each survey wave and corrects for the heterogeneity of the productivity shock across firms. Finally we include $growth\ assets_{it}$ which is the annual growth rate of assets calculated year by year. Appendix 3 shows that this variable controls for the effect of possible non-stationarities. We also include in all the regressions year and sector dummies.[19] The qualitative results of the regressions are robust to the exclusion of the set of control variables from the balance sheet.[20]

To summarize this section, a generic specification of the regressions in this empirical part can be written as:

$$y_{it} = \gamma\ constrained_{it} + \beta\ X_{it} + d_s + d_t + \varepsilon_{it}$$

Where y_{it} is one of the variables that measure fixed-term contracts use, volatility of employment or the volatility of each type of contract, $constrained_{it}$ is either the $small_{it}$ variable or the $self\ declared_{it}$ measure that is occasionally instrumented as explained in the next section, d_s and d_t are year and sector dummies and βX_{it} is a vector of controls composed by $fixed\ capital_{it}$, $sdsales_{it}$ and $growth\ assets_{it}$.

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[16]We drop from the sample 55 firm-observations that do not respond to any of the questions. They represent less than 0.3% of the total observations. The distribution of non-respondents to each question is as follows: question i) 8%, question ii) 0.4% and question iii) 15%

[17]The cross sectional standard deviation of the $self\ declared_{it}$ variable is 0.36 and its time series standard deviation is 0.096.

[18]5700 million lira correspond to $2.94m according to December 1999 exchange rates.

[19]Sectors defined as 2 digit ATECO91 classification.

[20]. This is shown in Appendix 4, where we report the coefficients of all the regressions excluding all the control variables except the year and sector dummies.

Table 7 shows the summary statistics for the different variables used in the rest of the paper and for firms in which *self declared$_{it}$* takes value 1. All the variables calculated as ratios are subject to the presence of outliers whenever the denominator is abnormally small. For this reason, we drop the observations corresponding to the top 1% of each of these variables (top and bottom 1% when the variable is not constrained to be positive) when calculating the statistics of Table 7 and whenever they are used in a regression.

Table 7 about here

The ratio of fixed-term workers to permanent workers is 3.9% for all firms and 4.9% for firms that declare to be constrained, so this unconditional analysis is consistent with the predictions of an higher use of fixed-term contracts among constrained firms.[21] It also shows that constrained firms are smaller, and have a higher volatility of total employment. In the following sections we first provide evidence that the measure of financing constraints is related to effective financing restrictions faced by firms. We then test the predictions of the model with respect to financing constraints and the use of fixed-term employment contracts.

4.2   Validation of the Financing Constraints Measure

In this section we show how the *self declared$_{it}$* measure of financing constraints relates with other indirect measures of financing frictions. The reason for this analysis is twofold. In the first place, we want to assess the validity of the direct information about the financing problems of the firms as a reliable measure of financing constraints. In the second place we will use some of these indirect measures of financing constraints as instrumental variables that correct for potential measurement errors in the qualitative questions regarding financing constraints.[22] For this purpose we run a regression in which the dependent variable is the financing constraints variable

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[21]The OECD reports an average amount of fixed term workers in Italy of 7.5% in 1995 and 11% in 2000. This is higher than in our sample, which only includes manufacturing firms, while fixed term workers are more prominent in the services sector. It is important to note that this is a relatively high growth period in Italy, with an average annual GDP growth rate of 1.9% that lead to a small reduction of unemployment rates (11.2% in 1995 vs 10.1 in 2000)

[22]It is important to remark here that the more qualitative data about self-declared financing constraints and the quantitative balance sheet data come from different surveys, so measurement errors are less likely to be correlated between surveys.

(*self declared$_{it}$*) and the independent variables are as follows: The first variable used measures the coverage ratio of interest payments *coverage$_{it}$*, calculated according to the following formula: $coverage_{it} = (\pi_{i,t} - i_{i,t})/(\pi_{i,t} + i_{i,t})$ where $\pi_{i,t}$ is profits before interest and taxes and $i_{i,t}$ is interest paid on debt. The variable takes value zero whenever the ratio is negative.[23] The second variable used reflects the net liquid assets of the firm *liquid assets$_{it}$* measured as bank deposits and cash divided by total assets. The relationship of this measure with the existence of financing constraints is controversial. In general, firms with more liquid assets are less likely to be financially constrained; however it is also known that firms occasionally hoard liquidity when they expect future negative liquidity shocks that could be correlated with financing constraints.[24] We take an agnostic view and investigate its linear effect on the total sample. The next variable used is a measure of financial development at a regional level *findev$_i$*. This variable is calculated in Guiso, Zingales and Sapienza (2004) and it measures the likelihood that a consumer bank loan is denied in different Italian regions. The measured is "inverted" and normalized, so that a value of zero indicates the highest probability of denial and that the maximum possible value is 0.56. We also include a number of variables that capture the reputation of the firm and the possible existence of relationship lending. These are a dummy variable that reflects whether the main office of the main lending bank of the firm is located in the same region as the headquarters of the firm *main region$_i$*; the natural logarithm of the number of banks that the firm uses *number of banks$_{it}$*; the log of the age (in years) of the firm *age$_{it}$*; the log of the length (in years) of the relationship with the main bank of the firm *age relation$_{it}$*, and the share of loans that the main bank has *share main$_{it}$*.

We add three control variables, the logarithm of firm assets *assets$_{it}$*, leverage measured as total debt over total assets *leverage$_{it}$*, and the change in stocks and work in progress *stock$_{it}$*. These variables should jointly capture the size and level of activity of the firm. Finally, we include as additional control variables, the same ones that we use in section 4.3 (*fixed capital$_{it}$*, *sdsales$_{it}$* and *growth assets$_{it}$*) and sector specific year dummies to saturate the intercept of the regression at a sector-year level.

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[23]Note that this is not the standard definition of a coverage ratio, which is normally defined as interest payments over profits before interest payments. The qualitative results using the more standard variable are qualitatively similar to the ones obtained here, but we find that our variable is also a good measure of financing constraints while being more stable and having less extreme values.

[24]See for example Almeida and Campello 2005.

Even though the *self declared*$_{it}$ variable takes only values zero or one, we run a standard linear regression to make it comparable with the instrumental variables approach that we use later on. Nevertheless the results are qualitatively very similar if we use a logit regression.

The results can be seen in the first column of Table 8. Firms with higher coverage ratio, higher net liquid assets, more financial development in their region and those with a headquarters in the same region as the headquarters of their main bank are less likely to be financially constrained. The results on these four variables are sizeable and highly significant. These variables are the ones that will be used in the next section as instruments to correct for potential answering biases in the *self declared*$_{it}$ variable. The coefficients of the variables relative to reputation and relationship banking are also significant and take values that are consistent with some of the ideas in the relationship banking literature. A higher number of banks makes the firm more likely to be constrained. On the contrary, older firms and the ones with a longer bank relationship are also less likely to be constrained. It is beyond the scope of this paper to investigate the extent of relationship lending in Italy. Readers may find interesting the article by Detragiache, Garella and Guiso (2000) that does a more thorough analysis using this same dataset.[25] Total leverage is negatively correlated with financing constraints, indicating that firms with less financing constraints in equilibrium do borrow more. Larger firms are also less financially constrained. This is a well known result and, for this reason, we use the size of the firm as an alternative measure of financing constraints. The growth rate of assets yields insignificant results and the accumulation of stocks, that often indicates a negative sales shock, is related to more financing constraints.

Table 8 about here

The model makes predictions about how employment decisions are related to the perceived financing constraints of firms. In this sense, the *self declared*$_{it}$ variable seems ideal as a proxy for $\overline{\lambda_i}$, the average intensity of financing constraints for firm i in the simulated industry. However firms could have an incentive to overstate or understate their financing constraints. We control for this problem with an instrumental variable technique.

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[25]See also Boot (2000), Elyasiani and Goldberg (2004) and Ongena and Smith (2000).

Instrumenting the financing constraints variable has the advantage of correcting for measurement errors and other potential endogeneity problems. However, it also means losing some information about financing constraints that is not contained in the observable variables used as instruments. Being able to use direct qualitative information is precisely one of the main advantages of using the $self\ declared_{it}$ measure with respect to other measures used in the literature.[26] Therefore one can see the instrumental variable approach as complementary to using the $self\ declared_{it}$ variable without instrumenting. The results in section 4.3 are robust to both specifications and reinforce each other.

The second column of Table 8 is the first stage of the instrumental variable regressions used in section 4.3, the excluded instruments are $coverage_{it-1}$, $liquid\ assets_{it-1}$, $main\ region_i$ and $findev_i$. The instruments that are time varying are lagged one period to reduce the possible effect of omitted variables affecting simultaneously the instruments and the dependent variable in the second stage. The R-squared of the excluded instruments is 4.4% which is relatively high considering that the total r-squared of the first-stage regression is 5.8%. The f-test of the joint significance of the omitted variables yields a value of 231.

One possible concern with respect to the $self\ declared_{it}$ measure is that it could be correlated with the productivity shocks that the firm faces. If these productivity shocks affect the financing constraints that the firm faces through the channels included in the model (i.e. changes in the employment policies of firms induced by productivity shocks), this should not be a problem, as the calibration of the model makes predictions taking into account this potential reverse causality. However, one potential problem could be the presence in the constrained sample of distressed and poor performing firms. These firms may declare to be constrained simply because the banks judge them to be too risky and refuse them additional lending, even in the absence of any financing friction. We control for the potential bias induced by these firms in two ways: i) we include regressions where we use only the cross sectional instruments $main\ region_i$ and $findev_i$. These instruments have the advantage that

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[26]Papers like Kaplan and Zingales (1997) and Fazzari, Hubbard and Petersen (1998) use objective balance sheet measures to construct indices as measures of financing constraints. In this respect the IV regressions used here can be seen as similar to their approach, using a financing constraints index that is a weighted measure of $coverage_{it-1}$, $liquid\ assets_{it-1}$, $main\ region_i$ and $findev_i$ with the weights that produce the best possible match with the $self\ declared_{it}$ measure in an OLS regression.

they are uncorrelated with any firm specific shock. The results of the first stage using these instruments are reported in column 3 of Table 8. They have a lower explanatory power than the full set of instruments with a partial r-squared of the omitted instruments of 1.8% and a total r-squared of 3.1%. Still, the f-test of the joint significance of the omitted instruments has a value of 158 which indicates quite a strong relationship. ii) In Appendix 4 we report the main coefficients of all the regressions estimated on a sample that excludes the worst performing firms. These are identified as the firms that simultaneously belong to the bottom 5% quantile of the *liquid assets*$_{it}$ variable and the bottom 5% quantile of the ratio of profit over assets. The results are robust to this exclusion and show that they are not driven by poor performing firms that declare to be financially constrained.[27]

Once we have established the validity of our main measure of financing constraints, we proceed, in the next section, to test the main predictions of the model.

4.3   Results

The first prediction of the model, that financially constrained firms hire a larger proportion of fixed-term employment with respect to permanent employment, is tested in Table 9. The ratio of fixed-term workers to permanent workers is regressed with respect to different measures of financing constraints, namely: a dummy variable that takes value one if the firm is small (column 1), the *self declared*$_{it}$ measure that captures the financing constraints that firms declare in the survey (column 2), the *self declared*$_{it}$ measure instrumented using *coverage*$_{it-1}$, *liquid assets*$_{it-1}$, *main region*$_i$ and *findev*$_i$ as instruments (column 3), and finally, the *self declared*$_{it}$ measure instrumented using only the cross sectional instruments *main region*$_i$ and *findev*$_i$ (column 4). All the regressions include as control variables the volatility of sales, the amount of capital per worker, the yearly change in the assets of the firm, year and sector dummies.

Table 9 about here

The results in Table 9 show that smaller firms tend to use 1% more fixed-term contracts than larger firms. The results also point out in the same direction when

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[27]The same result is obtained if we raise the threshold to exclude firms to 10% or 20%,

using the *self declared*$_{it}$ measure and the instrumented versions of it, with uses of fixed-term contracts that range from 0.5% higher to 6% higher. This effect is statistically significant in all the regressions and also economically sizeable, given that the average use of fixed-term contracts in the sample is around 4%. This result strongly supports the main prediction of the model, that fixed-term workers should be hired mostly by firms more subject to financing constraints. The model predicts that this happens because constrained firms use fixed-term contracts as a buffer that protects them against the cost of firing or hoarding permanent workers in the future, conditional to a negative shock. The model also predicts that financially constrained firms should have a significantly higher volatility of total employment. This prediction is tested in Table 10. The dependent variable is the coefficient of variation of total employment, calculated on a three year window that coincides with each of the two waves of the six year period studied. The independent variables follow the same pattern as in Table 9.

Table 10 about here

The results show that smaller firms (column 1) have a smaller volatility of total employment. This goes against the predictions of the model, although the coefficient is only statistically significant at a 90% level and economically not very sizeable with smaller firms having a 0.1% lower employment volatility. A potential reason for this result is that problems of indivisibility (workers can only be fired one by one and not in fractions of a worker) may make a large proportion of the smaller firms of the sample keep a constant amount of workers throughout a three year window, while it is quite rare for larger firms to have a constant amount of workers for three consecutive years. If we exclude from the sample firms with coefficient of variation of total employment equal to zero , the coefficient for small firms becomes positive and significant at a 99% level with employment being 1.3% more volatile in small firms than in larger ones.[28]

Columns 2 to 4 show that the firms that declare themselves as constrained have a higher volatility of employment than unconstrained firms. The effect is very significant both in statistical terms and in terms of economic impact. Firms that declare to be financially constrained have a higher volatility of total employment of 1.3% up to

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[28]This regression is not reported, but all the details are available from the authors upon request.

5% more depending on the specification. This is a large difference, given that the coefficient of variation of total employment for the full sample is 5.7%.

The identification in tables 9 and 10 relies both on cross-sectional and time series variation, given that we use sector dummies but not firm specific fixed effects. Auxiliary regressions with standard firm fixed-effects and between groups estimators at a firm level show that, in fact, an important part of the effect is due to cross sectional variation.

This higher volatility of total employment is partly a direct consequence of a higher use of fixed-term workers. The unconditional coefficient of variation of fixed-term workers is a full order of magnitude higher than the coefficient of variation of permanent workers, so a higher use of fixed-term contracts among constrained firms would mechanically imply a higher volatility of employment even if constrained and unconstrained firms were identical in terms of the volatility of each type of employment. However, the model predicts a higher individual volatility of each type of contract among constrained firms. To explore further this issue, in Table 11 we disentangle the effect of financing constraints on the volatility of each of the different types of employment. Columns 1 and 2 correspond to the dummy variable that distinguishes small firms, columns 3 and 4 to the *self declared*$_{it}$ measure. In the bottom section of the table, columns 5 and 6 correspond to the instrumented *self declared*$_{it}$ variable using the full set of instruments, and columns 7 and 8 using only cross sectional instruments. Odd (even) columns have as dependent variable the coefficient of variation of fixed-term (permanent) employment. The coefficient of variation is not defined for firms that have zero workers of a particular type throughout the calculation period, it is also poorly defined when there is only one period with non-zero fixed-term workers. To minimize the effect of these firms, the coefficient of variation is calculated over the whole sample. Therefore, these are cross sectional measures and for this reason we perform between groups estimations. Still, the presence of firms with zero fixed-term workers throughout the sample is important. To avoid that the difference in results could be driven by a different sample in each regression, we restrict each sample to firms that have a valid observation in both the coefficient of variation of fixed-term employment and permanent employment.

Table 11 about here

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The results in column 1 show that fixed-term contracts are more volatile among firms that are small and therefore more prone to experience financing constraints. The point estimate of the coefficient of variation of permanent contracts in column 2 is also positive, but a full order of magnitude smaller, and also, statistically not different from zero. The results in columns 3 and 4 show that firms that declare to be financially constrained have a higher volatility of permanent-employment. The point estimate of the volatility of fixed-term contracts is positive and larger than the point estimate for permanent contracts, but the coefficient is not statistically significant. This same pattern is repeated in columns 5 and 6. Finally columns 7 and 8 yield results that are too imprecise. Overall, the results in Table 11 show that the higher volatility of total employment among constrained firms identified in Table 10 is due to both types of contracts being more volatile for constrained firms. The table also has some suggestive evidence showing that a larger share of this effect may be due to the higher volatility of fixed-term workers, but the results in this respect are relatively weak.

The model also predicts that the number of firms using zero fixed-term contracts should be higher among firms that are unconstrained. This prediction constitutes an important test of the validity of the model, because the presence of a large share of firms that do not hire fixed-term workers is a constant feature of our sample. The simulated industry also shows a large average share of firms with zero fixed-term workers, quite similar to the one observed in the data despite this statistic is not explicitly matched in the calibration of the model.

To test this prediction, in Table 12 we show probit regressions where the dependent variable $non\ zeroFT_{it}$ is equal to 1 if the firm i used any fixed-term contracts in period t and is equal to zero otherwise. In column 1 the independent variables are $self\ declared_{it}$ and the same controls as in the previous regressions. In column 2 we add, as an additional control, the log of assets for firm i in period t.

Table 12 about here

The results show a higher likelihood of using fixed-term contracts among constrained firms. The result is robust to the inclusion of the log of total assets as an additional control. However, the control variable that measures the size of the firm indicates that large firms are also more likely to use fixed-term contracts. The

number of zero fixed-term workers may be negatively related to size because of an indivisibility problem that is unrelated to financing constraints. This is because it is more likely that in a large firm there is at least one particular task that requires a temporary worker and therefore a fixed-term contract is used. Also, large firms are normally multi plant, while smaller firms are more likely to be single plant. Therefore the likelihood that at least one plant of a large firm hires some fixed-term workers may be higher than the likelihood for a single plant small firm.

Columns 3 and 4 in Table 12 perform the same regressions as columns 1 and 2, but restricting the sample to observations in which the firms increased their level of total employment with respect to the previous year. The reason for this specification is related to the prediction of the model that constrained and unconstrained firms should behave differently when hiring and firing. The results show that conditional on hiring constrained firms are much more likely to hire fixed-term workers than unconstrained firms. This result can be interpreted in relationship with expression (21) that shows that, if we consider the hiring decision as a sequential one, all firms start hiring permanent workers and, at some point they start hiring fixed-term workers. However, constrained firms tend to hire fixed-term workers earlier than unconstrained ones. When firing, all firms start firing their permanent workers and, if necessary, they fire permanent workers once they have fired all the temporary ones.

The model also predicts that most of the difference in the hiring behaviour of constrained versus unconstrained firms is driven by the behaviour of hiring firms (see table 4). In order to test this prediction in Table 13 we introduce dummy variables that splits the sample between firms that have hired additional workers over the last year ($hire_{it}$), firms that have reduced their amount of workers from the previous year ($fire_{it}$) and firms that keep the same amount of total employment as in the previous year ($neutral_{it}$). We then interact these dummy variables with the $self\ declared_{it}$ variable to see the different effect of financing constraints in each situation. In this regression also the control variable $growth\ assets_{it}$ is interacted with the three employment dummies, because we want to distinguish the behaviour driven by changes in employment from the behaviour driven by changes in the total assets of the firm.

Columns 1 and 2 include only firms that either hire or fire, columns 3 and 4 include also firms that neither hire or fire. Odd columns show the regressions using

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self declared$_{it}$ as the explanatory variable, while even columns show the regressions where *self declared*$_{it}$ is instrumented using the full set of financial variables. These instruments are also interacted with the dummy variables *hire*$_{it}$, *fire*$_{it}$, *neutral*$_{it}$ to give more flexibility to the first stage of the regression.

Table 13 about here

The results confirm the prediction that most of the effect of constrained firms using a higher amount of fixed-term workers is the result of these firms using them more when they are hiring new workers. This result is consistent across all four specifications, with a large and statistically significant effect. However, we do not find a significant empirical difference in the use of fixed-term workers of constrained firms that are not hiring additional workers.

The coefficient of *hire*$_{it}$ is not statistically significant, while the coefficient *fire*$_{it}$ is significantly negative in columns 1 and 2. In the simulated regressions in table 4 these coefficients represent the average ratio of fixed-term over permanent workers for unconstrained firms that increase and reduce employment. However in table 13 the same coefficients have to be interpreted as deviations from the constant and the average effect implicit in all the other control variables and year and sector dummies. Therefore in this case the relevant prediction of the model is the fact that *hire*$_{it}$ should be significantly bigger than the coefficient on $fire_{it}$. One reason why the results do not show a statistically significant difference is that there is not enough variation within year and sector to estimate these variables with precision.[29]

The overall picture from the empirical results shows that financially constrained firms use a higher fraction of fixed-term contracts and have a higher volatility of total employment. The higher volatility of total employment is partly due to the unconditional higher volatility of fixed-term workers, but also to the fact that conditional on being financially constrained, both fixed-term contracts and permanent contracts are more volatile. Constrained firms use fixed-term contracts more often, and most of the difference in the usage of fixed-term workers by constrained and unconstrained

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[29]In fact a less saturated regression similar to the one in column 1 but withour year and sector dummies yields very precise estimates with a coefficient for *hire*$_{it}$ of 0.040 and a coefficient for *fire*$_{it}$ of 0.028, being these coefficients statistically different from each other. Similar results apply to less saturated versions of the other specifications. Details are available upon request.

firms is explained by the firms that increase employment. These results confirm the predictions of the calibrated model.

5   Conclusions

We propose a model to study the firing and hiring decisions of firms in the presence of financing constraints and dual labour markets in which both fixed-term contracts and permanent contracts coexist. The model shows that financial market imperfections increase expected firing costs, thus making permanent contracts implicitly more expensive. In the presence of financing constraints a larger share of output fluctuations is absorbed by fixed-term contracts, that also represent a larger proportion of total employment.

We calibrate the model using a representative sample of Italian firms, and we simulate an artificial industry with many heterogeneous firms. First, we use these simulations to derive robust predictions about the relationship between financing constraints and employment decisions of firms, to be tested on the empirical sample. Second, we analyze the effect on the simulated industry of relaxing the borrowing constraints and of introducing fixed-term workers in an industry where only permanent workers were available. We show that the introduction of fixed-term contracts allows firms to better absorb productivity fluctuations, making them less likely to be financially constrained. Moreover financially constrained firms not only hire more fixed-term workers, but also use them to absorb a larger part of total employment volatility. The consequence is that the introduction of fixed-term contracts makes permanent contracts of financially constrained firms less volatile then before.

We test the predictions of the model on our sample of Italian manufacturing firms. We consider several different measures of financing constraints: i) the size of firm; ii) a "self-declared" measure of financing constraints that is constructed using the direct qualitative information available in the Mediocredito survey; iii) an instrumented version of this measure. We use as instruments both firm financial variables and a measure of regional financial development. The estimation results confirm the predictions of the model. In particular financially constrained firms have a larger proportion of fixed-term contracts and a higher volatility of total employment. Both types of contract are more volatile among constrained firms.

Our results shed some light on the role of fixed-term contracts in absorbing productivity shocks in the presence of financing constraints. The firing costs associated to permanent contracts make them less likely to absorb employment fluctuations due to productivity shocks. We show that the presence of financing constraints emphasizes this effect not only by increasing the usage of fixed-term workers, but also by making fixed-term contracts more volatile.

The paper is also an interesting step forward in understanding how do financing constraints affect the real activity of firms. Previous literature has mainly concentrated on the effect of financing constraints on fixed capital investment. We instead focus on the employment decision of firms. Importantly, we show that the interactions between financing frictions and employment decisions allow us to distinguish between the effect of current financing problems of firms from the effect of future expected financing constraints. The theoretical and empirical results of the paper confirm that, while a small fraction of firms is currently financially constrained at any point in time, future expected financing constraints matter for a much larger fraction of firms, and are in important factor in determining employment decisions.

The policy implications of our results are interesting. The introduction of fixed-term contracts helps firms to reduce their exposure to financing constraints, and makes total employment of financially constrained firms more volatile but permanent employment less volatile. Policies that relax financing constraints that firms face will have a positive impact on the stability of total employment and in particular on fixed-term contracts. Therefore policies that aim to reduce the financing constraints face by firms not only would decrease job instability in general, but would also help to close the gap in terms of job instability between fixed-term and permanent contracts.

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6   Appendix 1

In this section we show that the normalization of wages of both fixed-term and permanent workers being equal to one is without loss of generality and simply indicates that the amount of labour force of each type is measured in the model in monetary units.

Suppose a more general model in which labour is measured in worked hours and we allow for a different hourly wage for fixed-term workers w^f and permanent workers w^p with both wages being constant over time.

Let l'^p_t and l'^f_t denote the number of total hours worked by permanent and fixed-term workers respectively. Following the same structure as in expressions (2) and (4) The production function in which labour is measured in hours can be expressed as:

$$y_t = \theta'_t \left(l'^p_t + \rho' l'^f_t \right)^\alpha \quad \text{with} \quad 0 < \rho' < 1; \ 0 < \alpha < 1$$

Where ρ' measures the difference in productivity per hour worked of each type of contract and θ'_t the productivity level per hour of permanent labour worked. The parameter α is the measure of returns of scale and is identical to the one in expressions (2). The budget constraint if the firm can be written as:

$$d_t + w^p l'^p_{t+1} + w^f l'^f_{t+1} - F i^p_t S_t = a_t + \frac{b_t}{R} \tag{29}$$

We introduce the following changes of variables: $l^p_t = w^p l'^p_t$ and $l^f_t = w^f l'^f_t$, that indicate that labour is now measured in total monetary units paid and not in worked hours. The new budget constraint is therefore identical to the one of expression (4). The production function becomes:

$$y_t = \theta'_t \left(\frac{l^p_t}{w^p} + \rho' \frac{l^f_t}{w^f} \right)^\alpha \quad \text{or equivalently} \quad y_t = \frac{\theta'_t}{w^{p\alpha}} \left(l^p_t + \rho' \frac{w^p}{w^f} l^f_t \right)^\alpha \tag{30}$$

Now we can introduce two further changes of variable $\theta_t = \frac{\theta'_t}{w^{p\alpha}}$ and $\rho = \rho' \frac{w^p}{w^f}$ to reach expression (2), in which the productivity parameter θ_t is re-scaled to reflect productivity per unit of pay of a permanent worker and ρ reflects the productivity differential between fixed-term and permanent workers net of their wage differential. Recall that the model requires that $\rho = \rho' \frac{w^p}{w^f}$ is smaller than one. There are several combinations of wages and productivity that can achieve this result. For example

fixed-term and permanent workers could be equally productive per hour, but fixed-term workers may require a wage differential to compensate for a higher job instability. Another possibility would be that fixed-term workers are paid less than permanent workers due to labour market frictions and they are less productive per hour worked, with the productivity differential being larger than the wage differential. This second possibility is the most likely one in the Italian case, given that the unconditional wage ratio $\frac{w^p}{w^f}$ is 1.35 according to the OECD.[30]

7   Appendix 2

In this section we illustrate a proof of proposition 1.

Using the definition of Ω_t in equation (13),we define $E_t\left(\Omega_{t+1}\right)$ as follows:

$$E_t\left(\Omega_{t+1}\right) = E_t\left[\left(F - \mu_{t+1}\right)S_{t+1}\right] + E_t\left(\mu_{t+1}\right)$$

Conditional on a_t and l_{t+1}^p, the realization of the shock θ_{t+1} determines a_{t+1} and the policy functions $\mu_{t+1}\left(\theta_{t+1} \mid a_t, l_{t+1}^p\right)$, $S_{t+1}\left(\theta_{t+1} \mid a_t, l_{t+1}^p\right)$ and $l_{t+2}^p\left(\theta_{t+1} \mid a_t, l_{t+1}^p\right)$. Therefore the value of $E_t\left(\Omega_{t+1}\right)$ can be defined as follows:

$$E_t\left(\Omega_{t+1}\right) = \sum_{j=1}^{N}\Gamma\left(\theta_{t+1}/\theta_t\right)\left\{\left[F - \mu_{t+1}\left(\theta_{t+1} \mid a_t, l_{t+1}^p\right)\right]S_{t+1}\left(\theta_{t+1} \mid a_t, l_{t+1}^p\right) + \mu_{t+1}\left(\theta_{t+1} \mid a_t, l_{t+1}^p\right)\right\}$$

(31)

Moreover we define θ_A as the minimum value of θ_{t+1} such that the firm hires more permanent workers and θ_B as the minimum value of θ_{t+1} such that the firm does not fire permanent workers. Assuming that $A > B > 1$, equation (31) can be defined as follows:

$$E_t\left(\Omega_{t+1}\right) = F\sum_{j=1}^{B-1}\Gamma\left(\theta_{t+1}/\theta_t\right) + \sum_{j=B}^{A-1}\Gamma\left(\theta_{t+1}/\theta_t\right)\mu_{t+1}\left(\theta_{t+1} \mid a_t, l_{t+1}^p\right) \qquad (32)$$

We can use equation (??) to interpret the effect of l_{t+1}^p on $E_t\left(\Omega_{t+1}\right)$. we define $\widehat{l}_{t+2}^p\left(\theta_{t+1} \mid a_t\right)$ as the optimal amount of permanent workers in period $t+1$ if the firing costs do not apply in that period only. The assumptions about the production function imply that $\widehat{l}_{t+2}^p$ is increasing in θ_{t+1},and that $\widehat{l}_{t+2}^p\left(\theta_1 \mid a_t\right) > 0$. Suppose now $l_{t+1}^p = 0$. In this case $A = B = 1$ and $E_t\left(\Omega_{t+1}\right)$. As l_{t+1}^p increases, eventually $(1-\delta)l_{t+1}^p$ becomes larger than $\widehat{l}_{t+2}^p\left(\theta_1 \mid a_t\right)$ and A becomes larger than 1. This implies that $E_t\left(\Omega_{t+1}\right)$ becomes positive and equal to $\sum_{j=1}^{A}\Gamma\left(\theta_{t+1}/\theta_t\right)\mu_{t+1}\left(\theta_{t+1} \mid a_t, l_{t+1}^p\right)$. As l_{t+1}^p further increases, there are Four possibilities:

i) A and B does not change. In this case $E_t\left(\Omega_{t+1}\right)$ increases because

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$\sum_{j=1}^{A} \Gamma\left(\theta_{t+1}/\theta_t\right) \mu_{t+1}\left(\theta_{t+1} \mid a_t, l_{t+1}^p\right)$ increases in l_{t+1}^p, due to the fact that μ_{t+1} increases.

ii) A increases, B does not change. In this case $E_t\left(\Omega_{t+1}\right)$ increases. The effect described in (i) is still at work. In addition now μ_{t+1} for a wider range of values of θ

iii) B increases, A does not change. In this case $E_t\left(\Omega_{t+1}\right)$ increases. The effect described in (i) is still at work. In addition now for some values of θ the firm fires the workers. Conditional on these outcomes $E_t\left(\Omega_{t+1}\right)$ increases by F rather than by $\mu_{t+1}\left(\theta_{t+1} \mid a_t, l_{t+1}^p\right)$. Since F is the upper bound to μ, this increases $E_t\left(\Omega_{t+1}\right)$.

iv) Both A and B increase. In this case the effects described in (i), (ii) and (iii) are contemporaneously at work, and $E_t\left(\Omega_{t+1}\right)$ increases.

This proves proposition I.

8   Appendix 3

In this section we briefly describe a version of the model with a non stationary productivity shock. First, we rewrite the production function as follows:

$$y_t = \overline{\theta}_t^{\,1-\alpha}\left(l_t^p + \rho l_t^f\right)^{\alpha} \qquad (33)$$
$$0 < \rho < 1; \ 0 < \alpha < 1$$

where:

$$\overline{\theta}_t \equiv \theta_t^{\frac{1}{1-\alpha}}$$

Then we assume that the productivity shock θ_t is non stationary:

$$\log \theta_t = \log \theta_{t-1} + \log \varepsilon_t$$

Where ε_t is a stationary and persistent stochastic process. It follows that also $\overline{\theta}_t$ is a non stationary stochastic process:

$$\log \overline{\theta}_t = \log \overline{\theta}_t + \frac{1}{1-\alpha} \log \varepsilon_t$$

Therefore:

$$\frac{\overline{\theta}_t}{\overline{\theta}_{t-1}} = \varepsilon_t^{\frac{1}{1-\alpha}}$$

By dividing both sides of equation (33) by $\overline{\theta}_{t-1}$, we obtain a stationary transformation of the productivity function:

$$\widehat{y}_t = \varepsilon_t \left(\widehat{l}_t^p + \rho \widehat{l}_t^f\right)^{\alpha} \qquad (34)$$

$$\widehat{y}_t \equiv \frac{y_t}{\overline{\theta}_{t-1}}; \ \widehat{l}_t^p \equiv \frac{l_t^p}{\overline{\theta}_{t-1}}; \widehat{l}_t^f \equiv \frac{\widehat{l}_t^f}{\overline{\theta}_{t-1}}$$

Therefore the firm's problem can be reformulated in terms of stationary variables:

$$V_t \left(\widehat{l}_t^p, \varepsilon_t, \widehat{a}_t \right) = \max_{\widehat{l}_{t+1}^p, \widehat{l}_{t+1}^f, \widehat{b}_t} \widehat{d}_t + \frac{1}{R} E_t \left[V_{t+1} \left(\widehat{l}_{t+1}^p, \varepsilon_{t+1}, \widehat{a}_{t+1} \right) \right] \tag{35}$$

This transformed problem can be solved in the same way as the original problem, and yields similar predictions. Importantly, the key prediction of the model hold true for both the original and the transformed variables. For instance, the optimal ratio between the transformed variables predicted by the model, $\widehat{l}_t^f / \widehat{l}_t^p$, is by construction also equal to the optimal ratio between the original variables, l_t^f / l_t^p.

Moreover also the predictions about the volatility of employment for constrained and unconstrained firms are likely to be robust to the presence of a non-stationary shock. As an illustration, consider the following approximation of the average value of $\widehat{l}_t^f$:

$$\overline{\widehat{l}_t^f} = \sum_{t=1}^{T} \frac{l_t^f}{T} \left(\frac{1}{\overline{\theta}_{t-1}} \right) \approx \left(1/\overline{\overline{\theta}} \right) \sum_{t=1}^{T} \frac{l_t^f}{T} \tag{36}$$

Where $\overline{\widehat{l}_t^f}$ is the average value of $\widehat{l}_t^f$ for a generic firm, and $\overline{\overline{\theta}}$ is the average value of $\overline{\theta}_t$ during the sample period. Under this approximation, it follows that the coefficient of variation of $\widehat{l}_t^f$ is the same as the coefficient of variation of the original variable l_t^f. This approximation is reasonable when we interpret our empirical data, because the sample period is very short. Nonetheless it is the less accurate the more θ_t grows or shrinks during the sample period for a firm. In order to control for this problem, in the empirical section we include the growth of assets for the firm as a regressor in the estimations of the coefficients of variation, and we show that the main results are not sensitive to the inclusion or exclusion of this

variable.

9 Appendix 4

In this section we show the coefficients of the main regresions in the text excluding the additional control variables or excluding firms that belong simultaneously to the 5% bottom quantile of net liquid assets and profits over assets.

Coefficients of regressions on the constraint variables
excluding all the control variables except year and sector dummies

Independent Variable	Dependent Variable				
	$ratio_{it}$	$cvemployment_{it}$	$cvpermanent_i$	$cvfixedterm_i$	non zeroFT$_{it}$
dummy if small$_{it}$	0.0086***	-0.0021**	0.0049	0.0867**	-
	[0.0020]	[0.0010]	[0.0048]	[0.0419]	
self declared$_{it}$	0.0069***	0.0135***	0.0190***	0.0126	0.1270***
	[0.0027]	[0.0010]	[0.0051]	[0.0435]	[0.0356]
self declared$_{it}$	0.0265**	0.0469***	0.0743***	0.1892	-
(full IV)	[0.0124]	[0.0058]	[0.0209]	[0.1737]	
self declared$_{it}$	0.0551***	0.0396***	0.0236***	0.1589	-
(cross sectional IV)	[0.0191]	[0..0099]	[0.0432]	[0.3623]	

Coefficients of regressions on the constraint variables
excluding firms that belong simultaneously to the 5% bottom quantile
of netliquidassets and profits overassets

Independent Variable	Dependent Variable				
	$ratio_{it}$	$cvemployment_{it}$	$cvpermanent_i$	$cvfixedterm_i$	non zeroFT$_{it}$
dummy if small$_{it}$	0.0066***	-0.0038***	-0.0004	0.0720*	-
	[0.0019]	[0.0010]	[0.0049]	[0.0420]	
self declared$_{it}$	0.0056***	0.0134***	0.0222***	0.0348	0.1137***
	[0.0024]	[0.0012]	[0.0054]	[0.0469]	[0.0355]
self declared$_{it}$	0.0233*	0.0468***	0.0755***	0.1208	-
(full IV)	[0.0125]	[0.0058]	[0.0232]	[0.1968]	
self declared$_{it}$	0.0529***	0.0397***	-0.0465	0.2952	-
(cross sectional IV)	[0.0192]	[0..0099]	[0.0485]	[0.4086]	

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10 Tables and Figures

Table 1: Calibration

	Parameter values	Empirical restriction	Matched moments	
			Data	Model
r	0.03	Real interest rate	0.03	0.03
α	0.95	Returns to scale	0.95	0.95
ρ	0.985395	Average ratio (fixed-term/permanent)	0.038	0.040
δ	0.022	Retirement of permanent workers	0.022	0.022
υ	0.92	average(gross hiring/employment)	0.102	0.084
σ_P	0.032	std(hiring/employment)	0.175	0.183
σ_I	0.22	Std.(sales/assets)	0.283	0.239
$\overline{b}$	0.13*	% of financially constrained observations	16%	14.5%
F	0.10**	Average job destruction rate	0.084	0.078
γ	0.96	Average age	24	25
		Other moments	Data	Model
		Average net profits/sales ratio	0.42%	0.62%
		% of firms with no fixed-term workers	67%	78%

* The value of $\overline{b}$ is measured as a fraction of the average employment cost for one simulated firm. ** the firing cost F is expressed as a fraction of the yearly wage.

Table 2: Predictions of the Model.

	Constrained	Unconstrained	% diff.	% diff. from a simulated panel of firms*
Fixed term workers / Permanent workers	0.055	0.033	67%	148%
st. dev. employment / employment	0.291	0.250	16%	12%
st. dev. permanent workers / employment	0.254	0.239	6.4%	2.4%
st. dev. fixed-term workers / employment	0.092	0.068	36%	36%
st. dev. permanent workers / perm. workers	0.266	0.244	8.8%	3.1%
st. dev. fixed-term workers / f.t. workers	0.528	0.391	35%	24%
% of firms with no fixed-term workers	68%	82%	-17%	-16%
% of firing of permanent workers	0.35%	0.80%		
% of hoarding of permanent workers	12.9%	12.5%		

*These differences refer to a simulated balanced panel of firms. We calculate each statistic for 6 years of data for each firm. This panel is sampled so that the average age of the firms is the same as the average age in the full sample and in th empirical data. Then we calculate the percentage difference between the cross sectional averages in the statistics for the constrained and the complementary sample.

Table 3: Different selection of the constrained group.

	$\frac{\textit{Fixed term workers}}{\textit{Permanent workers}}$	$\frac{\textit{st. dev. empl.}}{\textit{empl.}}$	$\frac{\textit{st. dev. perm. w.}}{\textit{employment}}$	$\frac{\textit{st. dev. f.t. w.}}{\textit{employment}}$
20% most constrained firms	0.057	0.2933	0.2473	0.098
Complementary sample	0.035	0.2484	0.2371	0.070
33% most c. firms (benchmark)	0.055	0.2913	0.2548	0.092
Complementary sample	0.033	0.2508	0.2394	0.068
50% most constrained firms	0.051	0.2841	0.2563	0.088
Complementary sample	0.029	0.2586	0.2470	0.066
66% most constrained firms	0.047	0.2738	0.2528	0.082
Complementary sample	0.027	0.2578	0.2462	0.062

Table 4: Differential Effect on Employment Volatilites

Dependent variable: $\frac{\textit{Fixed term workers}}{\textit{Permanent workers}}$

	$D_{it} = 1$ for 20% most constrained firms	$D_{it} = 1$ for 33% most constrained firms	$D_{it} = 1$ for 50% most constrained firms	$D_{it} = 1$ for 66% most constrained firms
constant	0.000	0.000	0.000	0.000
hire$_{it}$ * D_{it}	0.043	0.047	0.050	0.053
fire$_{it}$* D_{it}	0.004	0.008	0.009	0.009
hire$_{it}$	0.070	0.064	0.057	0.048
fire$_{it}$	0.021	0.019	0.017	0.016
R-squared	0.17	0.18	0.19	0.18

Table 5: Effect of the introduction of fixed term workers

	All firms			Constr. firms			Compl. sample		
fixed-term workers available	yes	no	%Δ	yes	no	%Δ	yes	no	%Δ
Average value of ϕ_t	0.045	0.040	12.5	0.096	0.083	15.6	0.020	0.018	11.1
st. dev. employment / employment	0.270	0.257	5.1	0.291	0.277	5.1	0.251	0.240	4.6
st. dev. permanent workers / employment	0.254	0.257	-1.1	0.255	0.277	-7.9	0.239	0.240	-0.4
% of firing of permanent workers	0.65	0.92	-29	0.35	0.66	-47	0.80	1.06	-24.5
% of hoarding of permanent workers	12.57	13.74	-8.5	12.9	15.0	-14	12.5	13.1	-4.6

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Table 6: Elasticity of employment to the borrowing limit

	All firms		Constr.		Compl. s.	
fixed-term workers available	yes	no	yes	no	yes	no
Statistic	Elasticity with respect to $\bar{b}$					
fraction of financially constrained firms	-0.127	-0.364				
Fixed term workers / Permanent workers	0.064	n.a.	0.215	n.a.	-0.064	n.a.
st. dev. employment / employment	-0.035	-0.200	-0.111	-0.329	0.028	-0.093
st. dev. permanent workers / employment	-0.033	n.a.	-0.109	n.a.	0.026	n.a.
st. dev. fixed-term workers/fixed-term workers	-0.210	n.a.	-0.328	n.a.	-0.164	n.a.
% of firing of permanent workers	-0.010	0.023	-0.070	0.307	0.015	-0.065
% of hoarding of permanent workers	-0.070	0.092	-0.167	0.035	-0.017	0.125
% of firms with no f.t. workers	0.045	n.a.	0.050	n.a.	0.043	n.a.

Table 7: Summary Statistics

	All firms			self declared$_{it}$=1		
variable	Mean	Median	Std Dev	Mean	Median	Std Dev
ratio$_{it}$	0.039	0	0.117	0.050	0.000	0.133
cv(employment)$_{it}$	0.057	0.035	0.082	0.074	0.047	0.097
cv(fixed-term)$_i$	0.671	0.469	0.708	0.661	0.469	0.680
cv(permanent)$_i$	0.071	0.043	0.102	0.084	0.056	0.103
self declared$_{it}$	0.16	0.00	0.37	1	1	0
fixed capital$_{it}$	59.2	36.2	91.8	59.6	35.9	78.7
sd (sales)$_{it}$	8114	1168	42077	3534	1043	8938
leverage$_{it}$	0.376	0.405	0.257	0.394	0.433	0.274
assets$_{it}$	9.12	8.89	1.36	8.88	8.74	1.18
Non zero fixed-term$_{it}$	0.346	0	0.495	0.406	0	0.491
Growth assets$_{it}$	0.095	0.064	0.212	0.102	0.065	0.218
Return on Assets$_{it}$	0.043	0.025	0.083	0.015	0.012	0.076

Table 8: Financing Constraints Variable

	1	2	3
	Justify	First Stage IV	First Stage IV2
coverage$_{it}^{\diamondsuit}$	-0.086***	-0.094***	
	[0.005]	[0.004]	
liquid assets$_{it}^{\diamondsuit}$	-0.122***	-0.032***	
	[0.020]	[0.009]	
findev$_i$	-0.003***	-0.003***	-0.004***
	[0.0002]	[0.0002]	[0.0002]
main region$_i$	-0.036***	-0.034***	-0.034***
	[0.006]	[0.005]	[0.006]
number of banks$_{it}$	0.030***		
	[0.006]		
age$_{it}$	-0.005		
	[0.004]		
age relation$_{it}$	-0.010***		
	[0.003]		
share main$_{it}$	0.0005***		
	[0.0001]		
leverage$_{it}$	-0.086***		
	[0.021]		
assets$_{it}$	-0.029***		
	[0.003]		
stock$_{it}$	0.113**		
	[0.054]		
fixed capital$_{it}$		-0.0001***	-0.00003
		[0.00003]	[0.00003]
sdsales$_{it}$		-4.0E-07***	-4.0E-07***
		[7.0E-08]	[7.2E-08]
growth in totalassets		-0.00007	-0.00002
		[0.0004]	[0.0001]
Observations	15731	19389	19396
R-squared	0.071	0.060	0.031
R-squared of ommitted instruments		0.046	0.016
F-test of joint signifficance ommitted instruments		231***	158***

Standard errors in brackets* significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable is self declared that takes value 1 if the firm declares to be constrained zero otherwise. Variables with superindex $\diamondsuit$ are lagged one period in columns 2 and 3. Independent variables are: .small - value one if assets are smaller than 5700 million lira; fixed capital - fixed assets of the firm divided by the number of employees; sdsales - standard deviation of the sales of the firm; growth assets – annual growth rate of assets; coverage - profits minus interest paid on debt over profits plus interest rate paid; liquid assets - bank deposits and cash over total assets; findev regional financial development; number of banks - number of banks that the firm uses; age - the log of the age (in years) of the firm ; age relation- the log of the length (in years) of the relationship with the main bank; share main- share of loans of the main bank; assets - logarithm of firm assets; growsales - dummy if sales grew over the last year; leverage - total debt over total assets; stock - change in stocks and work in progress; year and sector dummies included in all the regressions.

Table 9: Financing Constraints and Relative Use of Fixed-Term Contracts

	1	2	3	4
	size	self declared$_{it}$	self declared$_{it}$ IV	self declared$_{it}$ IV2
dummy if constrained	0.010***	0.005**	0.031**	0.058***
	[0.002]	[0.003]	[0.012]	[0.019]
fixed capital$_{it}$	-0.00001	-0.00002**	-0.00002**	-0.00002**
	[0.00001]	[0.00001]	[0.00001]	[0.00001]
sdsales$_{it}$	1.1E-7***	1.1E-7***	1.1E-7***	1.2E-7***
	[2E-8]	[2E-8]	[2E-8]	[2E-8]
growth in totalassets	0.019***	-0.00006	0.017***	0.0160***
	[0.004]	[0.0004]	[0.004]	[0.004]
Observations	11697	9429	11695	11697
R-squared	0.109	0.104	0.099	0.073

Standard errors in brackets* significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable is the ratio of fixed-term workers to total workers, the dummy if constrained corresponds with .small that takes value one if assets are smaller than 5700 million lira in column one and the self declared that takes value 1 if the firm declares to be constrained zero otherwise in columns 2 to 4. Other independent variables are: fixed capital - fixed assets of the firm divided by the number of employees; sdsales - standard deviation of the sales of the firm; growth assets – annual growth rate of assets. Column 3 includes all all the instrumental variables and column 4 only the cross sectional ones; year and sector dummies included in all the regressions.

Table 10: Financing Constraints and Employment Volatility

	1	2	3	4
	size	self declared$_{it}$	self declared$_{it}$ IV	self declared$_{it}$ IV2
dummy if constrained	-0.002*	0.014***	0.050***	0.040***
	[0.001]	[0.001]	[0.006]	[0.009]
fixed capital$_{it}$	0.00002***	0.00002***	0.00002***	0.00002***
	[6.0E-5]	[6.0E-5]	[6.0E-5]	[6.0E-5]
sdsales$_{it}$	3E-7**	3E-7***	5E-7***	5E-7***
	[1E-7]	[1E-7]	[1E-7]	[1E-7]
growth in totalassets	0.024***	0.024***	0.023***	0.024***
	[0.002]	[0.002]	[0.002]	[0.002]
Observations	18783	18783	18779	18783
R-squared	0.017	0.023	0.028	0.005

Standard errors in brackets* significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable is the coefficient of variation of total employment. The dummy if constrained corresponds with .small that takes value one if assets are smaller than 5700 million lira in column one and the self declared that takes value 1 if the firm declares to be constrained zero otherwise in columns 2 to 4. Other independent variables are: fixed capital - fixed assets of the firm divided by the number of employees; sdsales - standard deviation of the sales of the firm; growth assets – annual growth rate of assets. Column 3 includes all all the instrumental variables and column 4 only the cross sectional ones; year and sector (defined as 2 digit ATECO91 classification) dummies included in all the regressions.

Table 11: Differential Effect on Employment Volatilites

	1	2	3	4
	cv FT	cv Perm	cv FT	cv Perm
dummy if constrained$_{it}$	0.089**	0.004	0.024	0.019***
	[0.041]	[0.004]	[0.042]	[0.005]
fixed capital$_{it}$	-0.0001	-2.3E-5	-0.0003	-0.00001
	[0.0003]	[0.00003]	[0.0003]	[0.00003]
sdsales$_{it}$	-1.2E-7	-1E-8	-1.8E-7	-2E-8
	[3.5E-7]	[4E-8]	[3.5E-7]	[4E-8]
growth in totalassets	-0.256**	0.062***	-0.276**	0.057***
	[0.121]	[0.014]	[0.122]	[0.014]
Observations	5580	5580	5580	5580
Number of firms	1765	1765	1765	1765
R-squared	0.120	0.039	0.118	0.046

	5	6	7	8
	cv FT IV	cv Perm IV	cv FT IV2	cv Perm IV2
dummy if constrained$_{it}$	0.153	0.083***	0.018	-0.033
	[0.170]	[0.021]	[0.356]	[0.044]
fixed capital$_{it}$	-0.0003	-0.00003	-0.0003	-8.9E-6
	[0.0003]	[0.00004]	[0.0003]	[0.00004]
sdsales$_{it}$	-1.2E-7	-5E-8	-1.9E-7	-1E-8
	[3.6E-7]	[4E-8]	[3.6E-7]	[5E-8]
growth in totalassets	-0.304**	0.044***	-0.276*	0.069***
	[0.127]	[0.016]	[0.143]	[0.017]
Observations	5578	5578	5580	5580
Number of firms	1765	1765	1765	1765
R-squared	0.113	0.015	0.027	0.002

Standard errors in brackets* significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variables are the coefficient of variation of fixed-term and permanent employment. The dummy if constrained corresponds with .small that takes value one if assets are smaller than 5700 million lira in column one and the self declared that takes value 1 if the firm declares to be constrained zero otherwise in columns 2 to 4. Other independent variables are: fixed capital - fixed assets of the firm divided by the number of employees; sdsales - standard deviation of the sales of the firm; growth assets – annual growth rate of assets. Column 3 includes all the instrumental variables and column 4 only the cross sectional ones; year and sector dummies included in all the regressions.

Table 12: Likelihood of Unsing Fixed-Term Contracts (probit)

	1	2	3	4
	non zeroFT$_{it}$			
self declared$_{it}$	0.107***	0.133***	0.198***	0.220***
	[0.034]	[0.035]	[0.060]	[0.060]
fixed capital$_{it}$	-0.0007	-0.001***	-0.0007**	-0.001***
	[0.0002]	[0.0002]	[0.0003]	[0.0004]
sdsales$_{it}$	2.5E-6***	9.4E-7***	2.7E-6***	1.5E-6***
	[3.6E-7]	[3.3E-7]	[5.2E-7]	[5.6E-7]
growth in totalassets	0.216***	0.178***	0.171*	0.163
	[0.060]	[0.061]	[0.103]	[0.103]
log of total assets		0.138***		0.088***
		[0.012]		[0.019]
Observations	11819	11819	4097	4097

Standard errors in brackets* significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable is a dummy variable that takes value one if the firm has non-zero fixed-term workers. The dummy if constrained corresponds with .small that takes value one if assets are smaller than 5700 million lira in column one and the self declared that takes value 1 if the firm declares to be constrained zero otherwise in columns 2 to 4. Other independent variables are: fixed capital - fixed assets of the firm divided by the number of employees; sdsales - standard deviation of the sales of the firm; growth assets – annual growth rate of assets. Column 3 includes all all the instrumental variables and column 4 only the cross sectional ones; year and sector dummies included in all the regressions.

Table 13: Effect When Hiring or Reducing Total Employment

	1	2	3	4
	Ratio	Ratio IV	Ratio	Ratio IV
hire * self declared$_{it}$	0.012***	0.077***	0.012***	0.079***
	[0.004]	[0.0221]	[0.004]	[0.023]
fire * self declared$_{it}$	0.003	-0.004	0.002	-0.003
	[0.006]	[0.030]	[0.006]	[0.030]
neutral * self declared$_{it}$			-0.0003	0.010
			[0.005]	[0.021]
hire	0.003	-0.015	0.018	0.013
	[0.068]	[0.076]	[0.070]	[0.074]
fire	-0.00004**	-0.00005**	0.007	0.012
	[0.00002]	[0.00002]	[0.070]	[0.076]
neutral			0.011	0.014
			[0.070]	[0.074]
fixed capital$_{it}$			-0.00003**	-0.00003**
			[0.00001]	[0.00001]
sdsales$_{it}$	1.3E-6***	1.4E-6***	1.1E-6***	1.2E-6***
	[2E-7]	[3E-7]	[2E-7]	[2E-7]
hire * growth assets$_{it}$	0.013*	0.009	0.012	0.008
	[0.007]	[0.007]	[0.007]	[0.008]
fire* growth assets$_{it}$	-0.009	-0.009	-0.010	-0.009
	[0.010]	[0.010]	[0.011]	[0.011]
neutral * growth assets$_{it}$			0.019**	0.019**
			[0.009]	[0.009]
Observations	6123	6118	9395	9388
R-squared	0.218	0.194	0.215	0.193

Standard errors in brackets* significant at 10%; ** significant at 5%; *** significant at 1%. Dependent variable is the ratio of fixed-term workers to total workers, the dummy if constrained corresponds with .small that takes value one if assets are smaller than 5700 million lira in column one and the self declared that takes value 1 if the firm declares to be constrained zero otherwise in columns 2 to 4. Hire, fire, neutral, are dummy variables that take value one if over the past year the firm is firing workers, hiring or keeping the same amount of workers respectively. Other independent variables are: fixed capital - fixed assets of the firm divided by the number of employees; sdsales - standard deviation of the sales of the firm; growth assets – annual growth rate of assets. Column 3 includes all all the instrumental variables and column 4 only the cross sectional ones; year and sector dummies included in all the regressions.