

Centre de Referència en Economia Analítica

Barcelona Economics Working Paper Series

Working Paper n° 266

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Employment Contracts**

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October 14, 2005

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14th October 2005

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Abstract

The aim of this paper is to identify the effect of financing constraints on the employment decisions of firms. We present a theoretical model that determines the optimal use of fixed term and permanent contracts in the presence of financing constraints. We then estimate the effect of financing constraints on the dynamics of fixed-term employment contracts versus permanent employment contracts for a sample of Italian manufacturing 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 that the relative volatility of fixed term employment versus permanent employment is higher among them. As a consequence, the volatility of total employment is also significantly higher for financially constrained firms than for financially unconstrained ones.

*The authors thank Maria Guadalupe, Maia Guell, Barbara Petrongolo and Ernesto Villanueva for their valuable comments and suggestions. All errors are, of course, the authors own responsibility.

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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 dynamic nature of employment decisions makes them sensitive to financing constraints that firms face or may expect in the future. 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 productive³. 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, the interactions between financing constraints and firing costs amplify their effects on hiring and firing decisions, with important consequences. We show that a firm with a binding financing constraint has a higher opportunity cost of firing permanent workers than a financially unconstrained firm. This discourages the hiring of permanent workers and gives incentives for the use of fixed-term contracts. Therefore, financially constrained firms will hire relatively more fixed-term workers than it would otherwise be optimal in the absence of financing imperfections. But fixed-term contracts can be costlessly terminated if the firm receives a negative productivity shock. This means that financially constrained firms will also exhibit an

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

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

³This 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 endogenously in more complex model where the skill of the workers is heterogeneous.

higher volatility of total employment. The consequence is that if both labor market frictions and financing constraints affect a consistent share of firms in an economy, the volatility of employment will increase after the introduction of fixed term contracts.

The predictions of the model are then 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. The OECD 1999 Employment outlook places Italy as the country with the third strictest employment protection legislation among OECD countries in the 1990s. 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 flexible labor contract in a heavily regulated environment. ii) The Italian financial system is traditionally underdeveloped (as an illustration, the market capitalization of the Milan Stock Exchange is several times smaller than the market capitalization of the stock markets of the other large European countries). Italian firms thus 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 show that financially constrained firms rely more on fixed-term contracts, and that the volatility of fixed-term employment is much higher, than in financially unconstrained firms. Moreover, firms' employment policy reacts to productivity shocks differently depending on their degree of financing constraints: firms that face capital market imperfections show a positive correlation between a productivity shock and fixed-term contracts as a share of total employment, while firms that do not face such imperfections behave in the opposite way.

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

the conclusions.

2 Related literature

The findings of this paper are of interest to 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. Dolado et al (2002) and Saint Paul (1996) provide a good survey of the relevant theoretical literature on the topic. 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 and the relative use of fixed-term versus permanent contracts. However, their approach does not take into account the possible influence of financing constraints.⁴

This paper is 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. 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 previous papers we explicitly model the existence of both types of contracts and show how does the presence of financing constraints affect their use. In this sense our article can be considered as a bridge between the two strands of the literature mentioned above.⁵

⁴Kugler and Pica 2004 explore the interaction between the introduction of fixed term contracts and entry regulation. As long as financing constraints can restrict the entry of new firms, these two issues are related although we model the hiring and firing decisions of existing firms.

⁵Another 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

We develop a theoretical model that analyses the interactions between financial problems and firing costs on the labor demand of firms. The advantage of our approach is that our 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.

We test these predictions using a dataset that has explicit measures of financing constraints, and find empirical support for them. Our results show how financing constraints may both encourage the use of fixed-term contracts relative to permanent contracts and increase the volatility of total employment of a firm. Therefore this paper shows that employment dynamics can be useful to identify the presence of firm financing constraints. In this sense, the article 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 2004, Caggese 2004).

3 The model

3.1 Setup

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

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

Where $V_t(l_{t-1}^p, \theta_t, a_t)$ 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. l_t^p and l_t^f are respectively the stock of permanent and fixed-term employment contracts. The parameter θ_t is a stationary stochastic process representing the productivity shock. The face value of one period debt contracted during period t is measured by b_t . If negative, it indicates that the firm is a net lender. Finally a_t is the value of the net cash flow (from operations and maybe financial assets) of the firm at the beginning of period t . It can be seen as the total financial wealth of the firm after production and debt repayment, so the level of assets of the firm after production can

constraints as opposed to relaxing labour market rigidities.

be expressed as:

$$a_t = \theta_{t-1} \left(l_{t-1}^p + \rho l_{t-1}^f \right)^\alpha - b_{t-1} \quad (2)$$

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

The firm uses a concave technology in labor input. l_t^f is the stock of fixed-term labor contracts. For simplicity we assume that permanent and fixed-term contracts are perfect substitutes and are paid the same wage. The difference is that permanent workers are more skilled, but they can be fired only by paying a fixed cost F .⁶ Fixed term workers can be fired without restrictions but are less productive (ρ is smaller than 1). The timing of the model is the following: at the beginning of period t the firm has a net financial wealth of a_t and a stock of permanent workers equal to $(1 - \delta) l_{t-1}^p$, because permanent workers leave the firm at an exogenous separation rate δ . The firm observes θ_t and decides about new borrowing, dividends payments and employment. The employment decision is summarized in the gross hiring of fixed-term workers i_t^f and permanent workers i_t^p :

$$i_t^p = l_t^p - (1 - \delta) l_{t-1}^p \quad (3)$$

$$i_t^f = l_t^f \quad (4)$$

The budget constraint is as follows:

$$d_t + w l_t^p + w l_t^f - F i_t^p S_t = a_t + \frac{b_t}{R} \quad (5)$$

With

$$F > 0; S_t = \begin{cases} 1 & \text{if } i_t^p < 0 \\ 0 & \text{otherwise} \end{cases} \quad (6)$$

⁶The assumption of identical wages for fixed and temporary workers is a normalization. Any combination of productivities and wages that makes one efficiency unit of labour more expensive from fixed term workers would be equivalent.

Fixed-term workers fully separate from the firm at the end of the period, and therefore hiring coincides with the stock of fixed-term workers. Instead firing permanent workers has a cost F per worker. That is, $F i_t^p S_t$ is negative if $i_t^p < 0$ and zero otherwise. 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:

$$d_t \geq 0 \tag{7}$$

The second constraint is an upper bound on b_t that implies that firms have a borrowing limit. This constraint imposes some exogenous credit rationing to the firm, but existing theoretical literature has offered various reasons for its existence.⁷

$$b_t \leq \bar{b} \tag{8}$$

We add the Lagrange multipliers ϕ_t and λ_t respectively to constraints (7) and (8) and use (5) to substitute d_t in (1). The first order conditions of the problem with respect to b_t and l_t^f are respectively:

$$\frac{1 + \phi_t}{R} - \lambda_t - \frac{1}{R} E_t (1 + \phi_{t+1}) = 0 \tag{9}$$

$$-(1 + \phi_t) w + \frac{1}{R} E_t \left[(1 + \phi_{t+1}) \rho \alpha \theta_t \left(l_t^p + \rho l_t^f \right)^{\alpha-1} \right] = 0$$

Regarding permanent contracts, let's call $l_t^{p*} = l^p(l_{t-1}^p, \theta_t, a_t)$ the optimal amount of permanent contracts at time t . If $l_t^{p*} \geq (1 - \delta) l_{t-1}^p$ then l_t^p satisfies the following first order condition:

$$-(1 + \phi_t) w + \frac{1}{R} E_t \left\{ (1 + \phi_{t+1}) \left[\alpha \theta_t \left(l_t^p + \rho l_t^f \right)^{\alpha-1} - (1 - \delta) F \left(S_{t+1} + \frac{\partial S_{t+1}}{\partial i_{t+1}} \right) \right] \right\} = 0$$

If $l_t^{p*} < (1 - \delta) l_{t-1}^p$, then the linear fixed cost is paid and l_t^p satisfies the following condition:

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

$$-(1 + \phi_t) [w - F] + \frac{1}{R} E_t \left\{ (1 + \phi_{t+1}) \left[\alpha \theta_t \left(l_t^p + \rho l_t^f \right)^{\alpha-1} - (1 - \delta) F \left(S_{t+1} + \frac{\partial S_{t+1}}{\partial i_{t+1}} \right) \right] \right\} = 0$$

To analyze the influence of financing constraints on firms hiring behavior we analyze separately the case where financing constraints are not binding nor expected with respect to the case where financing constraints are expected and occasionally binding. For the following analysis it is useful to solve equation (9) forward:

$$\phi_t = R \sum_{j=0}^{\infty} E_t (\lambda_{t+j}) \quad (10)$$

Where the shadow cost of one additional unit of external finance is equal to $1 + \phi_t$. Equation (10) shows that ϕ_t is equal to the sum of the current and future cost of a binding financing constraint. As long as $\phi_t > 0$, then the firm does not distribute dividends, and $d_t = 0$.

3.2 The case without financing constraints

Let's assume that the net financial wealth of the firm a_t is very large, so that the firm is never financially constrained ($\lambda_{t+j} = 0$ for all $j \geq 0$). If the firm receives a negative productivity shock, it will reduce the hiring of fixed-term contracts. If the shock is small, it will not be necessary to fire also permanent workers. Then $i_t^p = l_t^p - (1 - \delta) l_{t-1}^p \geq 0$ and l_t^f satisfies the following condition:

$$\alpha \theta_t \left[(1 - \delta) l_{t-1}^p + \rho l_t^f \right]^{\alpha-1} = \frac{Rw}{\rho} \quad (11)$$

The firm decides instead to fire also permanent workers ($i_t^p < 0$) when the negative productivity shock is very large, so that $l_t^p = (1 - \delta) l_{t-1}^p$ is an inefficiently high amount of labor input, and the efficiency loss caused by keeping employed the marginal permanent worker is bigger than the firing cost F . In this case $l_t^f = 0$ and l_t^p is determined by the following condition:

$$\alpha \theta_t (l_t^p)^{\alpha-1} = Rw - F \left[1 - (1 - \delta) E_t \left(\frac{\partial S_{t+1}}{\partial i_t} + S_{t+1} \right) \right] \quad (12)$$

The term $(1 - \delta) FE_t \left(\frac{\partial S_{t+1}}{\partial i_t} + S_{t+1} \right)$ represents future expected firing costs. Since the productivity shock is stationary, it is very likely that such expected costs are smaller than F , so that the term in square brackets in equation (12) is positive. This together with the comparison between equations (11) and (12) implies that $l_t^f = 0$ and $l_t^p > 0$ are the optimal labor choices.

If the productivity shock is positive and the firm is hiring then l_t^f and l_t^p are jointly determined by the two following two conditions:

$$\alpha \theta_t \left[l_{t-1}^p + \rho l_t^f \right]^{\alpha-1} = \frac{Rw}{\rho} \quad (13)$$

$$\alpha \theta_t \left(l_t^p + \rho l_t^f \right)^{\alpha-1} = Rw + (1 - \delta) FE_t \left(\frac{\partial S_{t+1}}{\partial i_{t+1}} + S_{t+1} \right) \quad (14)$$

If the firm has no permanent workers, then there are no expected firing costs and $E_t \left(\frac{\partial S_{t+1}}{\partial i_{t+1}} + S_{t+1} \right) = 0$. In this case the right hand side of equation (13) is larger than the right hand side of equation (14). Therefore such firm will initially hire only permanent workers. But the term $(1 - \delta) FE_t \left[\frac{\partial S_{t+1}}{\partial i_{t+1}} + S_{t+1} \right]$ increases in l_t^p , and if fixed costs F is large enough relative to ρ , it will be optimal to start hiring also fixed-term contracts before reaching the optimal employment level in the firm. The optimal mix l_t^f/l_t^p will increase in F , in uncertainty (volatility of θ_t) and in ρ . Small negative shocks will be completely absorbed by changes in fixed-term contracts, while large shocks will be absorbed by both a fall in fixed-term and permanent contracts.

3.3 The financing constraints case:

We can now concentrate on the case of interest and solve for the optimal hiring and firing decisions of the firm in the presence of financing constraints. It is useful to describe the optimality conditions of the problem by distinguishing two cases:

Case 1: The financing constraint is not currently binding ($\lambda_t = 0$), but it may be binding in the future with a positive probability ($\phi_t > 0$). Conditional on a negative shock the analysis does not differ from the previous case of no financing constraints. Conditional on a positive shock l_t^f and l_t^p are jointly determined by the two following conditions:

$$\alpha \theta_t \left(l_t^p + \rho l_t^f \right)^{\alpha-1} = \frac{Rw}{\rho} \quad (15)$$

$$\alpha \theta_t \left(l_t^p + \rho l_t^f \right)^{\alpha-1} = Rw + (1 - \delta) E_t \left[(1 + \phi_{t+1}) F \left(S_{t+1} + \frac{\partial S_{t+1}}{\partial i_{t+1}} \right) \right] \quad (16)$$

By comparing equations (12) and (16) it is clear that future expected financing constraint increase expected firing costs. This effect is represented by the term $(1 + \phi_{t+1})$, that multiplies $F \left(S_{t+1} + \frac{\partial S_{t+1}}{\partial i_{t+1}} \right)$, and implies that the more a firm expects to be financially constrained in the future, the less incentives it has to hire permanent workers. If firms on average find it optimal to hire a mix of permanent and fixed-term workers, then it follows that an increase in $E_t(\phi_{t+1})$ increases the ratio of fixed-term to permanent contracts.

The intuition is the following: suppose that the firm hires permanent workers today, because productivity is high. If productivity drops in the future, then these workers become redundant. The firm can maintain them in place, but labor hoarding is very costly for a financially constrained firm. Or it can fire them, but also firing is more costly, because of the higher shadow value of financial resources for the firm. These future expected costs will discourage the hiring of permanent workers for a firm that faces future expected financing imperfections.

Case 2: The financing constraint is currently binding ($\lambda_t > 0$). This may happen because after a negative shock the firm faces negative profits that reduce its net financial wealth a_t . As a consequence, the financing constraint becomes binding and the firm may need to reduce employment. In this case it will first reduce the fixed-term employment. This may be enough to satisfy the budget constraint, so that l_t^f is determined by the budget constraint evaluated at $l_t^p = (1 - \delta) l_{t-1}^p$, $d_t = 0$, $b_t = \bar{b}$ and $i_t^p = 0$:

$$w l_t^f = a_t + \frac{\bar{b}}{R} - (1 - \delta) w l_{t-1}^p \quad (17)$$

But if a_t is small enough, then equation (17) cannot be satisfied with a non-negative amount of fixed-term contracts. In this case l_t^p is determined by the budget

constraint evaluated at $b_t = \bar{b}$, $l_t^f = 0$, $d_t = 0$ and $i_t^p < 0$:

$$wl_t^p = a_t + \frac{\bar{b}}{R} + Fi_t^p S_t \quad (18)$$

Equation (18) determined the most damaging case for the firm, in which it is forced to pay the firing cost F when its financial resources are already scarce. Consider instead the case in which the firm faces a positive shock and wants to hire workers, but is constrained by the borrowing limit because a_t is low. In this case l_t^f , l_t^p and λ_t are jointly determined by the following conditions:

$$w(l_t^p + l_t^f) = a_t + \frac{\bar{b}}{R} \quad (19)$$

$$\alpha\theta_t(l_t^p + \rho l_t^f)^{\alpha-1} = \frac{R\lambda_t + 1 + E_t(\phi_{t+1})}{1 + E_t(\phi_{t+1})} \frac{Rw}{\rho} \quad (20)$$

$$\alpha\theta_t(l_t^p + \rho l_t^f)^{\alpha-1} = \frac{R\lambda_t + 1 + E_t(\phi_{t+1})}{1 + E_t(\phi_{t+1})} Rw + (1 - \delta) E_t \left[(1 + \phi_{t+1}) F \left(S_{t+1} + \frac{\partial S_{t+1}}{\partial i_{t+1}} \right) \right] \quad (21)$$

Also in this case equations (20) and (21) determine the optimal ratio between fixed-term and permanent workers. The presence of the shadow cost of financing constraints λ_t increases the current component of the marginal cost of labor. But at the same time, as long as the productivity shock is persistent but mean reverting, when λ_t increases also $E_t(\phi_{t+1})$ increases. The implication is that the financially constrained firm that wants to hire new workers will be discouraged by future expected financing constraints and firing costs to hire permanent workers.

3.4 Summary of the predictions of the model

The analysis in sections 2.1-2.4 shows that the interactions between firing costs and financing constraints have several unambiguous predictions that can be tested using empirical data. With respect to a financially unconstrained firm, an otherwise identical firm that faces financing imperfections:

prediction 1) has an higher ratio of fixed-term to permanent workers.

prediction 2) Has a higher sensitivity of the fixed-term/permanent employment ratio to the productivity shocks.

prediction 3) Has a higher variance of total employment.

Predictions 1 and 2 follow directly from the discussion in sections 2.2 and 2.3. The more a firm expects to be financially constrained in the future, the less it will be willing to hire permanent workers, and it will prefer the higher flexibility of fixed-term workers. This implies that the ratio of fixed-term workers with respect to permanent workers will be increasing in the intensity of financing constraints.

prediction 3 follows from two distinct effects: i) after a negative shock a financially constrained firms will on average fire an higher fraction of its labor force because it will employ relatively more fixed-term workers with respect to a financially unconstrained firms. ii) A financially constrained firm may be forced to fire permanent workers after a negative shock, while a financially unconstrained firm is able to borrow more and to keep the permanent workers, thus avoiding the firing costs associated with such layoffs.

4 Empirical Analysis

This section is divided in four parts parts. Section 4.1 describes the data and variables used; in Section 4.2 we show a statistical analysis of the differences between financially constrained and unconstrained firms in terms of different employment ratios, the third part that corresponds to Section 4.3 presents cross sectional regressions regarding the influence of financing constraints on employment ratios and volatilities. Finally, Section 4.4 shows a panel data analysis of the evolution of different employment ratios whenever firms experience temporary liquidity shocks.

4.1 Data Description

In order to test the empirical predictions of the model we use the dataset of the Mediocredito Centrale surveys.⁸ The dataset contains a representative sample of Small and Medium Italian manufacturing firms in an incomplete panel with two main sources of information:

- i) yearly balance sheet data and profit and loss statements from 1989 to 2000.
- ii) Qualitative information from four surveys conducted in 1992, 1995, 1998 and 2001.

Each survey is conducted on a sample representative 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 three years.

Given that a new type of fixed-term contracts became regulated and started to be widely used from 1995 onwards, we restrict our sample to the last 6 years of the dataset. That leaves us with 11024 firm-year observations. The complete panel of firms with six years of balance sheet data and qualitative information from both the 1998 and 2001 surveys contains 420 firms and a total of 2520 observations.

This dataset is particularly well suited to our analysis for several reasons: In the first place the introduction of fixed-term contracts in Italy meant the coexistence of two different contractual agreements that had very different firing costs. At the same time, the database is a representative sample of manufacturing firms of different industries and sizes, with detailed data about a number of aspects of the firm as well as direct questions that try to elicit the existence of financing constraints affecting a particular firm. The dataset contains balance sheet data, profit and loss statements, and a detailed description of the structure of firm employment by type of contract and skill level and qualitative questions that investigate a number of issues. Among other qualitative questions, each firm is asked:

- i) whether it had a loan application turned down recently.

⁸Examples of published papers that use the Mediocredito Centrale survey are Basile, Giunta and Nugent (2003) and Piga (2002).

ii) Whether it did not ask for a loan for fear of their application being turned down.

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

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

These questions were asked only in the 1998 and the 2001 surveys, which refer respectively to the activity in period 1995-1997 and 1998-2000. We select firms into likely financially constrained groups using questions iii) and iv). This choice is motivated by the fact that very few firms responded positively to questions i) and ii), and almost none did that without also answer positively to either question iii) or iv).

We use this information to construct a series of financing constraints measures. The first one $self\ declared_{it}$ takes value 1 for period t if firm i declared problem (iii) or problem (iv), in any of the two surveys and takes value zero otherwise. The second one $self\ declared_i^*$ is a cross sectional version of the previous one and takes value one for all periods if the $self\ declared_{it}$ variable takes value one for firm i at least once throughout the whole sample and it is equal to 0 otherwise. The variable $self\ declared_i^*$ takes value 1 in 29% of the firms in the sample. Table 0 shows the summary statistics for the different variables used in the rest of the paper for the full panel and for firms in which $self\ declared_i^*$ takes value 1.

Table 1: Summary Statistics

Variable	All firms			self declared _i [*] =1		
	Mean	Standard Deviation	Median	Mean	Standard Deviation	Median
Sales	46248.16	211463.50	10000	20722.85	46453.03	8500
Fixed Term Employees	4.11	44.67	0	2.30512	6.85	0
Permanent Employees	116.41	325.45	35	64.98	101.40	30
Net liquid assets	1786.35	31597.19	590	34.33	7345.50	209.09
Everconstrained	0.19	0.40	0	1	0	1

The variables $self\ declared_i$ and $self\ declared_i^*$ could be affected by contemporaneous shocks that the firm may be facing and these, in turn, could be affecting the hiring and firing policies that firms face. This means that we could run into endogeneity

problems whenever we regress contemporaneous employment variables with respect to the *self declared_{it}* and *self declared_i** variables. To avoid this potential endogeneity we also run instrumental variable regressions in which the variables that measure financing constraints are predictions of the self declared ones using only lagged variables. Among these variables *self declared_{it}^{pred}* and *self declared_{it}^{* pred}* are dummy variables that predict the original ones using discriminant analysis. The variable *propensity* is a continuous prediction of *self declared_{it}* using a linear probability model. To calculate the Propensity variable we first run a regression of the Self Declared_{it} measure where the independent variables are all lagged one period. The lagged variables used are net liquid assets over total assets, investment over total assets and number of employees over total assets. We then compute the expected probability of each firm facing financing constraints for all the relevant sample periods to construct the Propensity variable which is a function of lagged variables only. This should solve the endogeneity problems associated with the co-determination of financing constraints and hiring decisions by potential omitted variables.

Using self declared measures of financing constraints may also be subject to biases if respondents tend to underestimate or overestimate their financing constraints. To get additional reassurance that these biases are not driving our results we construct a cross sectional measure of financing constraints that are revealed by the accounts of the firm. To do so we first measure the net liquid assets of the firm, Then we construct a dummy variable named liquid assets that takes value 0 if the firm has on average throughout the whole sample more than 40% of its assets in cash or liquid assets and zero otherwise. According to this measure we consider that a firm that has liquid assets of more than 40% over total assets cannot be considered as constrained, this is probably a quite conservative measure of financing constraints, but it almost guarantees that firms with such levels of liquid assets are unconstrained.

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 include size in most of our regressions. Whenever size is included as a dependent variable we use total assets and whenever it is used as a dummy variable or to split the sample we classify firms as large/unconstrained if assets are larger than 5700

million lira⁹ (2.94 million euro). This is the threshold that splits the sample roughly in two equal parts.

4.2 Statistical Analysis

In this section we construct cross sectional measures of the level and volatility of fixed-term employment and permanent employment and we relate them to the cross sectional measures of financing constraints and to size measures of the firms. According to the size criterion we name the larger firms in the sample as unconstrained.

Columns (1) and (2) contain the statistics for firms that are constrained or unconstrained respectively, according to the *self declared*^{*} financing constraints variable. Columns (3) and (4) perform the same analysis but splitting the sample according to the level of liquid assets and finally columns (5) and (6) split the sample according to firm size.

Table 2: Statistical Analysis

Variable	self declared [*]		Liquid Assets		Size	
	Constrained	Unconstrained	Constrained	Unconstrained	Constrained	Unconstrained
	(1)	(2)	(3)	(4)	(5)	(6)
(1) mean $\frac{\sigma_{ft}}{\sigma_p}$	0.22 [*]	0.19 [*]	0.20	0.21	0.22 [*]	0.19 [*]
(2) 75% $\frac{\sigma_{ft}}{\sigma_p}$	0.28 ^{**}	0.19 ^{**}	0.26 [*]	0.22 [*]	0.26 ^{**}	0.19 ^{**}
(3) mean $\frac{\mu_{ft}}{\mu_p}$	0.045 ^{**}	0.038 ^{**}	0.042	0.043	0.050 ^{**}	0.036 ^{**}
(4) 75% $\frac{\mu_{ft}}{\mu_p}$	0.056 [*]	0.044 [*]	0.051 [*]	0.058 [*]	0.066 ^{**}	0.037 ^{**}

$\frac{\sigma_{ft}}{\sigma_p}$ is the average ratio of the standard deviation of fixed term employment to the standard deviation of permanent employment; $\frac{\mu_{ft}}{\mu_p}$ is the average ratio of the average fixed term employment to the average permanent employment. * indicates that the difference in means (or medians) between constrained and unconstrained firms is significant at a 95% confidence interval. ** Indicates that difference is significant at 99% confidence interval. 75% indicates the third quartile of the distribution.

Table 1 shows how the volatility of fixed-term employment with respect to the volatility of permanent employment tends to be higher in constrained firms than in

⁹5700 million lira correspond to \$2.94m according to December 1999 exchange rates.

unconstrained firms for the self declared and the size measure, while the average ratio is statistically not higher for financially constrained firms when using the liquidity based measure of financing constraints. With respect to the average use of the two different types of contracts, the evidence when we concentrate on the mean of the ratio is again that self declared measures of financing constraints and size yield a positive and significant effect of financing constraints on the relative use of fixed-term contracts with respect to permanent contracts. While on the liquidity based measure of financing constraints it seems that the more financially constrained firms use less fixed-term contracts. The difference, being statistically significant is economically rather small.

Overall, when firms are split according to the self declared* and Size criterion of financing constraints, financially constrained firms tend to use more fixed-term contracts and the relative volatility of these contracts is higher. The Liquid Assets criterion leads to inconclusive results.

4.3 Employment Ratios and Financing Constraints

In this section we perform cross sectional regressions in which the dependent variables are either the ratio of the standard deviations of fixed-term employment versus permanent employment, the ratio of fixed-term employment over permanent employment and the standard deviation of employment.

In Table 2 we show the results of regressions on the full panel that contains 420 observations per year.

Controls include sector dummies (a 3 digit ATECO92 classification¹⁰), total assets, [*total assets squared-but this is not in the table*] and the standard deviation of firm sales. The dependent variables are the same ones as in the previous section. The variables of interest are again the measures of financing constraints. The *Self-Declared** and *Liquid Assets* variables and a new variable, *Propensity*, that is the result of predicting the self declared financing constraints using lagged variables only. The role of introducing the *Propensity* is to avoid any potential endogeneity problems

¹⁰ATECO 92 "Classificazione delle attività economiche" is a standard four digit industrial classification.

that could arise from the simultaneous determination of financing constraints and employment ratios. Given that the *Propensity* is totally predetermined by variables that are lagged one period, this endogeneity problem is reduced.

Table 3: Regressions, Complete Panel

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	sdratio	sdratio	sdratio	meanratio	meanratio	meanratio	sdoccupa	sdoccupa	sdoccupa
Self-Declared	0.0627			0.0104			1.1801		
	[2.65]***			[1.38]			[2.29]**		
Liquid Assets		0.0928			0.0068			-0.5656	
		[3.42]***			[0.78]			[0.95]	
Propensity			0.578			.0829			14.708
			[2.08]**			[0.97]			[1.76]*
totalassets	1.573E-07	-1.422E-07	-1.11e-07	-6.277E-08	-9.209E-08	-4.92e-08	3.720E-04	3.726E-04	0.001
	[0.35]	[0.32]	[0.19]	[0.42]	[0.62]	[0.26]	[33.28]***	[32.99]***	[30.09]***
sdfattur	-1.528E-06	-1.505E-06	-1.28e-06	-1.734E-07	-1.708E-07	-1.79E-07	-2.384E-05	-2.386E-05	-6.59E-05
	[2.56]**	[2.53]**	[1.67]*	[0.90]	[0.89]	[0.76]	[1.53]	[1.52]	[2.44]**
Observations	1928	1928	1290	1963	1963	1307	1962	1962	1298
R-squared	0.05	0.05	0.06	0.05	0.05	0.06	0.42	0.41	0.52

Absolute value of t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

The results in table 3 show that once controlling for other factors, firms that declare financing constraints have a significantly higher relative volatility of fixed term employment (column 1). It also shows that the standard deviation of total employment is higher among constrained firms (column 7). These results are consistent with the model prediction of fixed-term contracts being more volatile in financially constrained firms than in unconstrained firms after controlling for observables. The results regarding liquid assets as a measure of financing constraints are statistically significant for the ratio of standard deviations and take the right sign (column 2). However, the results are insignificant with respect to the other two variables. With respect to the propensity measure, the results show a higher volatility of fixed-term contracts versus permanent contracts among constrained firms (column 3) and a higher volatility of total employment (column 9).

The coefficients associated with the size of firms are only significant with respect

to the standard deviation of total employment, showing that larger firms have larger volatility of total employment when measured as standard deviation.

The next table shows the same set of regressions on the full sample of firms that constitutes an incomplete panel.

Table 4: Regressions, Full Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	sdratio	sdratio	sdratio	meanratio	meanratio	meanratio	sdoccupa	sdoccupa	sdoccupa
Self Declared [*]	0.0250			0.0035			0.6804		
	[2.68]***			[1.79]*			[4.74]***		
Liquid Assets		0.0053			-0.0019			2.0144	
		[0.52]			[0.95]			[14.26]***	
Propensity			0.201			0.0138			30.957
			[1.96]*			[0.59]			[10.17]***
totalassets	-4.957E-08	-5.289E-08	-7.535E-08	-2.507E-08	-2.527E-08	-1.34e-08	3.931E-05	3.854E-05	5.092E-05
	[1.56]	[1.67]*	[1.92]*	[3.56]***	[3.59]***	[1.57]	[37.06]***	[36.44]***	[16.01]***
sdfattur	4.047E-07	3.919E-07	3.640E-07	1.678E-07	1.683E-07	5.97e-08	8.208E-05	7.945E-05	1.913E-04
	[2.19]**	[2.12]**	[2.26]**	[5.89]***	[5.90]***	[.088]	[18.39]***	[17.84]***	[17.75]***
Observations	12438	12438	6152	16700	16700	7655	25351	25350	8949
R-squared	0.01	0.01	0.02	0.06	0.06	0.05	0.16	0.16	0.24

Absolute value of t statistics in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

The results with respect to the total sample show again that the *self reported*^{*} measure of financing constraints has a positive and significant effect on the ratio of the standard deviations of the two types of employment. Relative to permanent employment, fixed-term employment is more volatile in constrained firms than in unconstrained ones. Furthermore columns 4 and 7 show that constrained firms use a higher proportion of fixed-term contracts and have a higher volatility of total employment. When we concentrate on the liquid assets measure of financing constraints, we also see that the volatility of total employment is higher among constrained firms. The results relative to this measure are inconclusive with respect to the ratio of volatilities or the relative use of each type of contract.

Finally the propensity measure yields again significant results in this second set

of regressions with the complete panel, showing that constrained firms have a higher volatility of fixed-term contracts versus permanent contracts (column 3) and a larger overall volatility of employment (column 9).

The coefficients of the size variable show that, conditional on the financing constraints variables, larger firms use a lower proportion of fixed-term contracts and have a larger variance of total employment. They also show that the standard deviations of fixed-term versus permanent contracts is lower among larger firms, although the result is only statistically significant when used in conjunction with the liquid assets measure of financing constraints. Size itself can be seen as one of the major factors of financing constraints, so these results are also consistent with some of the predictions of the model.

In the next table we split the analysis of the volatility of employment by analyzing separately the volatility of fixed-term employment and permanent employment. This is an interesting dimension because our model predicts that employment should be more volatile in constrained than unconstrained firms once controlling for other factors, and that a large fraction of this additional volatility should be borne by flexible workers.

Table 5: Differential Impact on Standard Deviations

	(1)	(2)	(3)	(4)	(5)	(6)
	sdfterm	sdpermanent	sdfterm	sdpermanent	sdfterm	sdpermanent
Self Declared [*]	0.2900	0.7527				
	[6.12]***	[4.07]***				
Liquid Assets			0.3163	1.7989		
			[6.38]***	[9.29]***		
propensity					3.59	26.97
					[5.12]***	[9.06]***
totalassets	7.348E-07	4.107E-05	6.570E-07	4.006E-05	-3.458E-07	3.552E-05
	[3.81]***	[31.98]***	[3.40]***	[31.21]***	[1.26]	[16.04]***
sdfattur	1.815E-05	6.988E-05	1.774E-05	6.862E-05	1.438E-05	6.374E-05
	[16.28]***	[14.25]***	[15.89]***	[14.01]***	[12.59]***	[9.62]***
Relative effect of constraints $\frac{\beta}{\sigma}$	0.42	0.15	0.45	0.36	5.20	5.52
Observations	16207	16240	16207	16240	7511	7509
R-squared	0.05	0.17	0.06	0.17	0.06	0.18

Absolute value of t statistics in brackets

All regressions include 2digit sector dummies

* significant at 10%; ** significant at 5%; *** significant at 1%

The results show how the effect of financing constraints on the volatility of employment is consistent throughout both types of employment. Constrained firms tend to adjust employment more often as seen in the previous section and this higher volatility can be observed both in fixed-term and permanent employment. However, in proportional terms, the effect is larger among fixed-term workers than among permanent workers. Even though the effect is more important in absolute terms for the permanent workers, this is a normal outcome when we take into account that the amount of permanent workers is much larger than the total amount of fixed-term workers. Once we take into account that the average standard deviation of fixed-term employment and permanent employment is 0.69 and 4.88 respectively the relative size of the estimated coefficients is much larger for fixed-term contracts than permanent

ones.¹¹ For convenience, the relative effect of financing constraints is calculated in the row entitled $\frac{\beta}{\sigma}$, where we show the relative increase in volatility of a financially constrained firm with respect to a financially unconstrained one according to each of the criteria used to determine financing constraints. For example the coefficients in columns 1 and 2 show that fixed-term employment in constrained firms is 42% more volatile than in unconstrained firms, while permanent employment is only 15% more volatile. The results in columns 3 and 4 show that in constrained firms fixed-term employment is 45% more volatile and permanent employment is 36% more volatile. This results are consistent with the prediction of the model where in constrained firms a larger share of the employment adjustment is born by fixed-term contracts. The results with respect to the Propensity measure are large as shown in Tables 2 and 3, but do not seem to show a differential impact on fixed-term versus permanent contracts. In relative terms, an increase in 10% of the propensity to be constrained makes fixed-term contracts 52% more volatile and permanent contracts 55% more volatile.

Overall, the results throughout this section show how constrained firms use a larger proportion of fixed-term contracts over total employment. Constrained firms have a larger volatility of total employment and among them, the proportion of this volatility that is absorbed by fixed-term contracts is larger.

4.4 Response of employment to productivity shocks

So far we have used either purely cross sectional analysis or pure time series analysis. In this section we exploit the panel dimension of the dataset to test prediction 2 of the model: *ceteris paribus*, a positive productivity shock increases fixed-term contracts relative to permanent contracts, more so for a firm that faces capital markets imperfections than for one that does not. The prediction is more ambiguous regarding a negative shock. In this case both financially constrained and unconstrained firms will fire fixed-term workers. Regarding permanent workers, on the one hand a firm that has a financing constraint currently binding may be forced to fire them. On the

¹¹Standard deviations calculated after dropping the same outliers as in the regression.

other hand a firm that is currently unconstrained but may become constrained in the future may prefer labor hoarding to the payment of the firing costs.

In order to test this prediction, we run the following regressions:

$$\text{regression 1: } \frac{l_{i,t}^f}{l_{i,t}^{tot}} = a_i + d_t + \beta tft_{i,t} + \varepsilon_{i,t} \quad (22)$$

$$\text{regression 2: } \frac{l_{i,t}^f}{l_{i,t}^{tot}} = a_i + d_t + \beta^{pos} tft_{i,t}^{pos} + \beta^{neg} tft_{i,t}^{neg} + \varepsilon_{i,t} \quad (23)$$

Where the variable $l_{i,t}^{tot}$ is the total employment the end of period t and the variable $l_{i,t}^f$ corresponds to the amount of fixed-term contracts at the end of period t . Therefore the dependent variable in equations (22) and (23) is the ratio of fixed-term to total employment in period t . As independent variable we use $tft_{i,t}$, which measures the productivity shock during period t . The other two variables are $tft_{i,t}^{pos}$ and $tft_{i,t}^{neg}$ where $tft_{i,t}^{pos}$ equals $tft_{i,t}$ whenever $tft_{i,t}$ is positive and takes value zero otherwise. While $tft_{i,t}^{neg}$ equals $tft_{i,t}$ whenever $tft_{i,t}$ is negative and takes value zero otherwise. Finally we also include firm specific fixed effects a_i and time dummies d_t .

We use the ratio between fixed-term contracts and total employment, that is bounded between 0 and 1, rather than the ratio between fixed-term and permanent contracts to get additional stability in the regression. The productivity shock variable is computed as a Solow residual. We first estimate the coefficients of a production function that includes fixed capital, variable capital and labour among the input factors. We use the estimated elasticities to compute the Solow residual. $tft_{i,t}$ is the component of the Solow residual that is not determined by firm, year and sector fixed effects. In order to control for the endogeneity of $tft_{i,t}$, we estimate equations (22) and (23) using the System GMM estimation method proposed by Blundell and Bond (1998). In both cases we restrict the analysis to a subset of firms of the balanced sample with a sufficiently long time series of accounting data to allow the estimation of the productivity shock. We expect the coefficient β to be positive for firms that face financing imperfections and zero or negative for the other firms. If β is found to be greater than zero, then this positive correlation should be stronger conditional on a positive productivity shock than on a negative productivity shock. In order to verify

this hypothesis in table 6 we estimate equations (22) and (23) separately for firms with Self Declared*=0 and with Self Declared*=1. To control for possible endogeneity problems we also estimate the two equations separately using the variable “Predicted Self Declared*”. This variable is equal to one if the discriminant analysis assigns to the firm a probability to be financially constrained higher than a certain threshold, and zero otherwise.

Table 6: Response to Productivity Shocks

regression: $l_{i,t}^{flexible} / l_{i,t}^{tot} = a_i + d_t + s_{j,i} + \beta t.ft_{i,t} + \varepsilon_{i,t}$								
regressor	Self Declared*=0		Self Declared*=1		Predicted Self Decl*=0		Predicted Self Decl*=1	
$\widehat{\beta}$	0.06		0.91**		0.17		0.82**	
	(0.06)		(0.38)		(0.33)		(0.40)	
$\widehat{\beta}^{neg}$		-0.16		-0.68		0.51		-0.28
		(0.34)		(0.58)		(0.51)		(0.50)
$\widehat{\beta}^{pos}$		0.19		1.95**		-0.17		1.01
		(0.35)		(0.79)		(0.34)		(0.73)
n. observations	693	693	315	315	431	431	219	219
F - test (p. val)	0.24	0.26	0.17	0.15	0.25	0.21	0.13	0.06
Hansen test	0.74	0.63	0.49	0.65	0.31	0.48	0.78	0.90
AR(1) test	0.10	0.22	0.22	0.09	0.27	0.14	0.60	0.35
AR (2) test	0.79	0.72	0.15	0.13	0.92	0.70	0.30	0.61

The coefficients are estimated with a two step robust System GMM estimator (Blundell and Bond, 1998). The standard error is reported in parenthesis. The finite-sample correction to the two-step covariance matrix is derived by Windmeijer (2005). We use the command Xtabond2 on the software package Stata. Year and size dummy variables are entered as strictly exogenous regressors.

Instruments for the equation in levels are t-1 to t-3 first differences of the regressors and t-2 to t-3 the first differences of the dependent variable. Instruments for the equation in first differences are t-2 and t-3 levels of the regressors and of the dependent variable. The F. test reports the test of joint significance of all estimated coefficients. The Hansen test of overidentifying restrictions is reported. This test is robust to autocorrelation and heteroskedasticity of unknown form.

The results in table 6 Show how constrained firms react to a productivity shock by increasing the ratio of fixed-term to permanent workers. The results also show that this effect is mainly due to the reaction to positive productivity shocks as predicted by the model. To explore even further this issue we run the same set of regressions but using Self Declared and Predicted Self Declared as measures of financing constraints.

That is, we allow the measures of financing constraints to change over time for every firm.

Table 7: Response to Productivity Shocks

regression: $l_{i,t}^{flexible}/l_{i,t}^{tot} = a_i + d_t + s_{j,i} + \beta tft_{i,t} + \varepsilon_{i,t}$								
regressor	Self Declared=0		Self Declared=1		Predicted Self Decl=0		Predicted Self Decl=1	
$\widehat{\beta}$	-0.03		1.79**		0.10		0.96**	
	(0.05)		(0.74)		(0.28)		(0.44)	
$\widehat{\beta}^{neg}$		0.03		-0.02		0.13		-0.57
		(0.20)		(0.57)		(0.58)		(0.54)
$\widehat{\beta}^{pos}$		-0.13		2.10**		0.12		2.13***
		(0.26)		(0.88)		(0.41)		(0.80)
n. observations	821	821	128	128	506	506	144	144
F - test (p. val)	0.02	0.17	0.05	0.01	0.11	0.37	0.03	0.007
Hansen test	0.80	0.92	0.82	0.87	0.37	0.36	0.71	0.85
AR(1) test	0.08	0.05	0.60	0.73	0.26	0.26	0.46	0.09
AR (2) test	0.60	0.86	0.26	0.21	0.87	0.90	0.27	0.19

The coefficients are estimated with a two step robust System GMM estimator (Blundell and Bond, 1998). The standard error is reported in parenthesis. The finite-sample correction to the two-step covariance matrix is derived by Windmeijer (2005). We use the command Xtabond2 on the software package Stata. Year and size dummy variables are entered as strictly exogenous regressors.

Instruments for the equation in levels are t-1 to t-3 first differences of the regressors and t-2 to t-3 the first differences of the dependent variable. Instruments for the equation in first differences are t-2 and t-3 levels of the regressors and of the dependent variable. The F. test reports the test of joint significance of all estimated coefficients. The Hansen test of overidentifying restrictions is reported. This test is robust to autocorrelation and heteroskedasticity of unknown form.

The results in table 7 confirm and reinforce the previous findings: constrained firms tend to increase the ratio of fixed-term to permanent employees whenever they experience positive productivity shocks, while they do not significantly change the ratio after a negative shock. This is consistent with the predictions of the model. Constrained firms tend to hire more fixed-term workers in expansions because the expectation of future financing constraints restricts their hiring of permanent workers. However the effect of negative shocks is more ambiguous as constrained firms may be forced to fire permanent workers if they face a sufficiently large negative shock. Another interpretation of this result is that many of the financially constrained firms are distressed firms that are allowed by law to dismiss permanent workers when they

are hit by a negative productivity shock.

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 also find support for the empirical implications of the model. In particular financially constrained firms have a larger proportion of fixed-term contracts, these contracts absorb a larger share of employment fluctuations and react to productivity shocks as predicted by the model. Financing constraints are measured using both self declared measures and measures extracted from firm accounts. We also construct a predicted financing constraints measure using lagged variables as a way to avoid possible endogeneity problems between contemporaneous constraints and productivity shocks.

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 by making fixed-term contracts more volatile. Permanent contracts and total employment are also more volatile in the presence of financing constraints, however, in relative terms, fixed-term contracts become more unstable than permanent ones when firms face financing constraints.

The article is also an interesting step forward in understanding how do financing constraints work. Previous literature has concentrated on the effect of financing constraints on fixed and working capital investment; we offer a new dimension in which financing constraints may operate. Our results help to understand the effects

of financing constraints on investment in general and can be used to validate some measures of financing constraints.

The policy implications of our results are interesting. 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. Furthermore, the model shows how higher rigidities in permanent employment should lead to a larger volatility of fixed-term contracts and vice-versa.

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