Why Hiring Temporary Workers?*

Francesca Lotti and Eliana Viviano
Bank of Italy

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Abstract

Hiring temporary workers can be viewed as a real option which allows firms to adjust labor input as economic conditions fluctuate and uncertainty about future demand increases. However, the "purchase price" of this real option may be, among other things, lower productivity. We develop a dynamic model of labor demand with uncertainty that allows us to draw some testable predictions on the level and on the composition of the labor force, according to the level of uncertainty. We conclude that, like financial options, temporary employment arrangements can be viewed as a costly instrument in terms of productivity, which however contributes to complete the market for risk.

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1 Introduction

In the last decades, aimed at reducing unemployment rates, many European countries have undertaken a series of reforms in the labor market in order to increase flexibility "at the margin". One strand of the literature focuses on the employment effect of such reforms trying to assess empirically if labor markets are segmented and/or whether temporary employment arrangements are stepping stones to find a suitable and permanent job in the future. Recently, increasing attention has been paid to the implications for the firms. Boeri and Garibaldi (2007) find a negative relationship between the share of closed-end contracts and firms' productivity growth; they interpret this result in terms of a transitory increase in labor demand induced by the higher flexibility of temporary jobs (the so-called "honeymoon effect"). They derive a model of labor demand with uncertainty, which encompasses a transition from a rigid to a two tier system. The introduction of the new regime, features a honeymoon effect that involves an increase in the share of firms able to adjust their employment levels, a temporary positive effect on average employment, and a temporary negative effect on average productivity because, under the decreasing marginal returns to labor hypothesis, firms hire increasingly less productive workers with closed-end contracts. They test their model's predictions using on Italian data from the Work Histories Italian Panel (WHIP), the Labor Force Survey (LFS) and two consecutive waves of the Mediocredito-Capitalia surveys from 1995 to 2000 (the same used by Lucidi, 2006). The authors find a robust, negative relationship between the stock of temporary workers and the change in firm's productivity. Dolado and Stucchi (2008) based on Spanish data, find that higher shares of temporary workers decrease firms' total factor productivity. On a similar perspective, Bird and Knopf (2009) analyze the effects of wrongful-discharge protections on earnings, profitability and efficiency of the US banking sector, finding that a higher employment protection legislation raises wages, reduces profits and lowers productivity. Using time and geographical variation in employment protection legislation, Autor, Kerr and Kugler (2007) find that for the US, the introduction of employment protection legislation reduces productivity by distorting production choices. A higher employment protection legislation would trigger an excessively intensive capital deepening (with respect to optimal in-

put choice of an hypothetical production function). However, they also find that that labor productivity rose substantially following adoption of new employment protection legislation. Similarly, Acharya, Baghai and Subramanian (2009) find that in the US strong dismissal laws appear to have a positive effect on the innovative pursuits of firms and their employees. Based on UK data, Michie and Sheenan (2003) find that the use of temporary workers along with little training (the so-called "low-road" practices to human resource management) is negatively correlated with productivity growth. A similar result is found by Kleinknecht et al (2006) for the Netherlands: the employment growth in the Eighties and in the Nineties, occurred by means of temporary workers, is followed by a remarkable productivity slowdown.

The results of the literature, which all confirm the negative relationship between temporary work arrangements and labor productivity impose, however, two simple related questions. Why do firms hire temporary workers? Why do policy makers allow for closed-end contracts if they negatively affect productivity and reduce employment protection? The contribution of this paper is to show that temporary workers are a sort of real option for firms. Since hiring permanent workers implies irreversible costs due to employment protection legislation, when demand uncertainty increases firm may find convenient to postpone the decision to hire workers permanently. This idea is not new: Dixit and Pindyck proposed it in their textbook "Investment under Uncertainty" edited in 1994. They argue that after the recession of early 1990s permanent full-time hiring increased slowly because a high level of uncertainty about future demand, which forced US firms to wait before make the commitment involved in hiring permanent workers. In the meantime they prefer to exploit the current profit opportunities using less irreversible and sometimes more costly methods of production, like temporary work (mainly in the form of employment-agency placement). Foote and Folta (2002) explicitly claim that the low productivity associated to hiring temporary workers is the cost of the real option of a lower degree of irreversibility.

The contribution of our paper is to derive a dynamic model of labor demand with uncertainty, where labor is treated as a quasi-irreversible input. Aimed at understanding the role of uncertainty on the level and on the composition (in terms of

permanent and temporary workers) of the workforce, we calibrate the model in order to identify a regime with low and one with high uncertainty. Higher uncertainty enlarges the "inaction area", i.e. when firm postpones any decision on labor force adjustment; higher uncertainty reduces hirings, both of temporary and permanent workers, but less so for temporary; workers with a closed-end contract - an input completely reversible - are employed as a buffer. We then test these model predictions with an empirical analysis based on a panel of Italian firms for which we have a measure of perceived demand uncertainty, along with a measure of productivity for the period that goes from 1999 to 2009. To our knowledge, this is the first time that the relationship between uncertainty, firms' workforce composition and productivity is empirically investigated on microdata on firms.

First, we examine the relationship between a firm's decision about the size and the composition of the workforce - permanent and temporary - and a measure of the firm's perceived demand volatility. This information is collected by the Bank of Italy's Survey on industrial firms with at least 50 employees (INVIND) and has been used, for instance, to show how capital investments respond to firm-specific uncertainty (e.g. Guiso and Parigi, 1999). Second, we show that firms whose share of temporary workers in total workforce is higher are characterized by lower productivity, measured by the ratio between value added and total employment. We also show that our empirical specification is particularly robust to endogeneity issues. According to our estimates, because of the increase in uncertainty at the end of 2008, the share of temporary workers in total firm employees raised by 0.6 percentage points with respect to the average of the period 1999-2007. This increase implied a reduction of labor productivity by 0.3 percentage points, which amounts to roughly 30 per cent of the total decline in labor productivity recorded in the sample in 2008 with respect to the average 1999-2007.

The paper is organized as follows. Section 2 describes the dynamic model of labor demand with uncertainty, while Section 3 is devoted to a description of the data for the empirical testing and especially of our measure of uncertainty. Section 4 deals with the effects of uncertainty on labor demand and workforce composition; Section 5 with the relationship between the share of temporary workers and productivity.

Finally, Section 6 briefly concludes.

2 A Model of Labor Demand with Uncertainty

The model requires a simple Cobb-Douglas production function with two kinds of labor input, permanent and temporary workers, and is similar to Chen and Funke (2009). Permanent workers are explicitly treated as a quasi-irreversible input because of high firing costs. Capital is not explicitly considered, since it is going to be constant at any point in time; there is no entry/exit in the market.

The production function of the representative firm is:

$$Y = A \times K^{\alpha_K} \times L_P^{\alpha_P} L_T^{\alpha_T} \tag{1}$$

where K is physical capital, L_T and L_P are temporary and permanent workers, respectively (the subscript t is omitted to avoid cumbersome notation). The firm faces an isoelastic demand curve of the following kind:

$$p_t = Y_t^{\frac{1-\rho}{\rho}} \times Z_t \tag{2}$$

where p is the price of the good, $\rho \geq 1$ and Z_t is the demand shock that follows a geometric Brownian motion of the following kind:

$$dZ_t = \eta Z_t dt + \sigma Z_t dW_t \tag{3}$$

where W_t is a Wiener process with independent, normally distributed increments, η is a deterministic drift parameter, and σ is the variance parameter. so that he demand for the good produced is subject to uncertainty.

When an input is irreversible, a firm's optimal investment rule takes on a threshold form. Adjustment of the labor force (hirings or firings) will only occur when demand hits some thresholds. It has been well documented that because uncertainty raises the

upper threshold for investment (the hiring threshold in this specific case), it reduces the long run rate of investment, with evident loss of efficiency.[1]

Firm's profits at time t are defined as:

$$\pi_t = A^{\frac{1}{\rho}} K^{\frac{\alpha_K}{\rho}} L_P^{\frac{\alpha_P}{\rho}} L_T^{\frac{\alpha_T}{\rho}} Z_t - w_P L_P - w_T L_T - C_P(\Delta L_P) - C_T(\Delta L_T) \tag{4}$$

where w_P and w_T are wages for permanent and temporary workers respectively and $C_P(\cdot)$ and $C_T(\cdot)$ are the labor adjustment cost functions. Without loss of generality, we assume that, in case of temporary workers, there are no adjustment costs, so that we will set $C_T(\cdot) = 0$. For the sake of tractability, adjustment costs for permanent workers are symmetric and convex functions:

$$C_P(\Delta L_P) = \begin{cases} c_f + b_f \Delta L_P + \frac{1}{2}\lambda_f (\Delta L_P)^2 & \text{if} \quad \Delta L_P < 0 \\ c_h + b_h \Delta L_P + \frac{1}{2}\lambda_h (\Delta L_P)^2 & \text{if} \quad \Delta L_P > 0 \\ 0 & \text{if} \quad \Delta L_P = 0 \end{cases} \tag{5}$$

where $c_{f/h}$ are fixed costs components for firing and hiring, respectively, $b_{f/h}$ are the unit prices and $\lambda_{f/h}$ are the adjustment speed parameters.

Given that r is the rate of return, firms maximizes the present discounted value of its current and future stream of profits according to:

$$V = \max_{L_P} \int_0^\infty \left[A^{\frac{1}{\rho}} K^{\frac{\alpha_K}{\rho}} L_P^{\frac{\alpha_P}{\rho}} L_T^{\frac{\alpha_T}{\rho}} Z_t - w_P L_P - w_T L_T - C_P(\Delta L_P) \right] \exp^{-rs} ds \tag{6}$$

[1]The effect of uncertainty in raising the investment threshold is demonstrated, for example, by Pindyck (1988), Dixit (1989), Bentolila and Bertola (1990), Bertola and Caballero (1994), Dixit and Pindyck (1994) and Abel and Eberly (1996).

Applying Ito's Lemma, equation (6) becomes:

$$rV = A^{\frac{1}{\rho}} K^{\frac{\alpha_K}{\rho}} L_P^{\frac{\alpha_P}{\rho}} L_T^{\frac{\alpha_T}{\rho}} Z_t - w_P L_P - w_T L_T - C_P(\Delta L_P) + \eta Z V^Z + \frac{1}{2}\sigma^2 V^{ZZ} Z^2 \quad (7)$$

where V^Z is the derivative of V with respect to Z. The firm's optimal permanent and temporary levels of employment are obtained maximizing the expected discounted value of the future cash flow. Since temporary workers can be terminated at the end of their term at no cost, there is neither a real option term associated to hiring or firing them, nor a dynamic effect in firm's choice. Clearly he model has no closed form; nevertheless it is possible to derive threshold levels for hiring/firing and by means of calibration it is possible to see how the firm's choice on the mix of temporary and permanent employment changes with demand uncertainty.

The first order condition for employment changes yields

$$\pm b_{h/f} + \lambda_{h/f} \Delta L_P = \nu \quad (8)$$

where ν is the derivative of the value function (6) with respect to L_P. Substituting the cost function depicted in equation (5) into equation (7) and rearranging, we derive firing and hiring decisions for permanent workers (see Appendix A for the computational details). The hiring (firing) thresholds are derived finding the value of ν for which an additional worker (one worker less) would generate negative profits.

Given the structure of our model, the "inaction zone", i.e. the region where no hirings and firings occur because the demand shock is not large enough to compensate the costs of adjustment, is

$$-\sqrt{\left(\frac{2c_f}{\lambda_f}\right)} \leq \Delta L_P \leq \sqrt{\left(\frac{2c_h}{\lambda_h}\right)} \quad (9)$$

Accordingly, the first order condition for temporary employment L_T is the derivative of equation (4) with respect to L_T: it reduces to a simple function of the demand shock Z and the level of permanent employment L_P.

$$\frac{\alpha_T}{\rho} A^{\frac{1}{\rho}} K^{\frac{\alpha_K}{\rho}} L_P^{\frac{\alpha_P}{\rho}} L_T^{\frac{\alpha_T}{\rho}-1} Z - w_T = 0$$

$$L_T = \left(\frac{w_T}{\frac{\alpha_T}{\rho} A^{\frac{1}{\rho}} K^{\frac{\alpha_K}{\rho}} L_P^{\frac{\alpha_P}{\rho}} Z} \right)^{\frac{\rho}{\alpha_T+\rho}} \tag{10}$$

Figure (3) shows that when the demand shock is positive and large enough to approach the hiring threshold, the firm will hire temporary workers first, and permanent employees after.[2]

Symmetrically, as the demand shocks is as negative as to hit firing thresholds, the firm will adjust workers with a closed-end contract first and permanent employees subsequently. In summary, the availability of temporary workers widens the inaction area and serves as a buffer to adjust labor force - quickly and cheaply - to unexpected demand fluctuations.

As mentioned above, we are mainly interested to understand how uncertainty, proxied by the parameter σ in equation (3), affects the number of hirings and their composition, in terms of open and closed-end contracts.

To do so, we calibrate the model as indicated on Table (2), with σ that takes two possible values, one for a low uncertainty regime ($\sigma = 0.15$) and one for a high uncertainty regime ($\sigma = 0.25$). Interestingly, firing thresholds turn out to be a little flatter with high uncertainty, but the change is barely visible. This is consistent with the rigidity of the Italian labor market. Conversely, hiring thresholds become steeper with higher uncertainty (see Figure (2) and (3) for a focus on hiring thresholds).

This stylized model allows us to draw some testable implications:

Hypothesis 1: when uncertainty increases, the number of permanent hirings decreases.

[2]The values of the parameters used in the calibration are reported on Table (1).

Hypothesis 2: when uncertainty increases, the number of temporary hirings decreases, but seemingly less so with respect to permanent hirings.

Hypothesis 3: when uncertainty increases, the number of total hirings decreases.

Hypothesis 4: when uncertainty increases and the "inaction area" becomes larger, preventing firms to adjust labor force to demand conditions, therefore undermining their efficiency (hence productivity).

Using data from the INVIND survey of the Bank of Italy, in the next sections we try to test empirically these hypotheses.

3 The Data

The data used in the empirical analysis come from the yearly Survey on Firms (INVIND) conducted since 1986 by the Bank of Italy on a representative sample of Italian firms of the industrial and service sectors with 50 employees or more (50 employees before 2000). The survey collects information on investments, sales, ICT expenditure, price changes, firm's strategies, and reports also detailed information on employment, such as yearly average employment and the total number of employees at the end of the previous year, employment composition (permanent vs. temporary workers, available from 1999 onwards) at the end of the previous year and the total number of hires and job separations during the previous year. The survey does not provide measures of value added, but it can be easily recovered with a matching with balance sheet information included in CERVED, a database fully covering the population of all the Italian companies.

INVIND is conducted each year between January and March. Together with information on the reference year, which is the year preceding to the time of the interview, firms are also required to report their expectations for the current year, like the expected percentage increase of total turnover for the current year and the average expected percentage price change. They are also required to confirm that the difference between the percentage change of nominal sales and the expected price

change is a measure of their expected real demand change. Finally they are asked to report an upper and a lower bound for their expected real demand change. These bounds can be used to proxy the variability of the expected demand, which is bounded from above by the squared of the difference between the upper and the lower bounds. This is our proxies for uncertainty. We select only firms of the manufacturing industry and, combining subsequent waves of the surveys we build a panel for the 1999-2009 period. The panel is unbalanced.

Figures 4 and 5 report the distributions of expected demand and our measure of uncertainty by the reference year of the interview, corresponds to expectations for the next year. They show that firms uncertainty remained slightly constant from 1999 to 2007 and then increased a lot in 2008 to decline again slightly in 2009.

Table 3 reports the characteristics of the sample used in the empirical analysis and some statistics on the variables we use: total hirings (normalized by total workforce), hirings of temporary workers, total workforce and labor productivity (the log of the ratio of value added to total employment) The sample size ranges from about 900 firms in 1999 to roughly 2,000 in 2009 (Table 3). Data on uncertainty and expected demand have several missing values, but they are likely to be at random, according to a standard Kruskas-Wallis test of equality of the populations of respondent and non-respondent firms.[3]

Figure 6 plots the sample average of the total number of hires in a given year (on total workforce), the hirings of permanent workers on total workforce and uncertainty over the next year demand growth. The x-axis reports the reference year for hirings, while uncertainty refers to expectations on the next year. Figure 7 reports the share of temporary workers on total workforce (average) and uncertainty; similarly, Figure 8 reports the log of productivity (average) and uncertainty. First, average uncertainty remained roughly constant between 1999 and 2006, but doubled at the beginning of 2009 and decreased in 2010, to a level which was 90 per cent higher than the average of the period 1999-2006. Second, while Figure 6 and 8 do not show any striking correlation between uncertainty and hirings, Figure 7 reveals a very high correlation between uncertainty and the share of temporary workers. This piece of evidence, even

[3] Test conducted on firms' total employment, sales, share of temporary workers.

if must be interpreted with caution as it might be spurious, is supportive of the real option theory.[4]

4 The impact of uncertainty on firms' workforce

4.1 Empirical strategy

In this section we present evidence to support the hypothesis that uncertainty about future demand conditions affects labor demand and discourages firms to hire permanent workers (for given expected demand growth). In the presence of stringent employment protection legislation, hiring permanent workers can be compared to an irreversible investment, as permanent workers cannot be fired as demand conditions get worse. If this hypothesis holds true, we should find that firms' uncertainty is negatively correlated to hirings of permanent workers. Evidence on this finding is presented in section 4.2. Instead, if temporary workers are hired to allow firms to exploit current demand opportunities in a context of high uncertainty on future demand, the correlation between uncertainty and the share of temporary workers in total workforce should be positive. This hypothesis is tested in section 4.3. The effects of uncertainty on total hirings, which is a priori undetermined, are discussed in section 4.4.

All the models presented in the next sections share roughly the same structure. In the extended version they can be written as:

$$l_{i,t} = \alpha l_{i,t-1} + \beta_1 d_{i,t}^{t+1} + \beta_2 \sigma_{i,t}^{t+1} + \beta_3 d_{i,t}^{t+1} * \sigma_{i,t}^{t+1} + u_{i,t} \tag{11}$$

where $l_{i,t}$ is the outcome, $d_{i,t}^{t+1}$ is the expected demand growth for time $t+1$ with expectations taken at time t, and $\sigma_{i,t}^{t+1}$ is demand uncertainty. Finally, $d_{i,t}^{t+1} * \sigma_{i,t}^{t+1}$ is the interaction term between the expected demand growth and uncertainty. For generality we assume that the error term $u_{i,t}$ has a firm-specific time invariant component, as well as a time variant one. Since we specify a dynamic model, we use a

[4] In our sample the share of temporary workers in total workforce increases by slightly more than 1 percentage points between 2007 and 2009, and then decline by 2 percentage points in 2009. These changes are larger than the ones depicted by official statistics.

standard Arellano-Bond GMM estimator, where, for caution, all variables are treated as endogenous. All exercises, together with lagged values of the dependent and the independent variables, include additional IVs aimed at including in our models exogenous sources of variability.

For all the estimates presented in the next sections we have also carried out several robustness checks. First, we have carried out regressions also for the sub-period 1999-2007, to check whether our results are driven by the unprecedented increase in uncertainty following the Lehman bankruptcy of September 2008. We find that our results are robust to this cut-off. Second, as discussed in section 3 our dataset is an unbalanced panel with on average 3 observations per firm. This implies that, when using lagged variables as instruments for the Arellano-Bond GMM estimator, the number of instruments is larger than the number of observations. This prevents to carry out robust Sargan tests for the validity of the overidentifying restrictions. Thus, we have selected only the firms which participated to all the eleven waves of our survey and tested the validity of the overidentifying restrictions only on this subsample (which amount to roughly 100 firms per year). The p-values associated to the Sargan test always support the validity of our model specifications.

4.2 Hirings of permanent workers

Using the model specification (11), we first estimate a model where the dependent variable is the ratio of hirings of permanent workers in year t and the total number of employees at the end of that year. The first column of Table 4 confirms the existence of a negative relationship between uncertainty and hirings of permanent workers. However, as the Arellano-Bond test for autocorrelation of residuals suggests that residuals can have also a second-order autocorrelation, the other columns of the Table include also the lag 2 of the dependent variable, without affecting the sign of the coefficient of uncertainty.

If product markets are fully competitive, output demand is exogenous and our estimates have a causal interpretation. However, under different assumptions, for instance monopolistic competition, firms influence product demand and total hirings and uncertainty are simultaneously determined. In columns (3)-(7) we present GMM

estimates which include instrumental variables, additional to the lags of the dependent and independent variables. The first instrument we use is the standard deviation of the percentage change in the value added between time t and $t+1$, calculated as follows. For each firm included in CERVED we have calculated the percentage change in the value added between time t and $t+1$ and then, for each sector we have calculated the average and the standard deviation. Because very large firms included in INVIND might still influence sectoral demand changes, sectors are broadly defined (ISIC 2-digit code). Our hypothesis is that aggregate expected demand and the associated risk affect firms' uncertainty but not hirings of firms. We do not observe, however, aggregate sectoral demand and risk and we in fact proxy them with their realized values.[5] The use of these instruments confirms the main findings. In column (3) the total number of hirings is still negatively associated to uncertainty. In columns (4)-(5) we include also the expected demand percentage change and the average percentage change of value added at the sector level as IV. As suggested by the theory, expected demand growth has a positive impact on permanent hirings in all specifications. Column (6) reports the more general model including the interaction term, which is negative and significant at 10 per cent. In this specification however, the coefficient of uncertainty is not significantly different from zero.

Summing up, our estimates suggest that moving from the 25th to the 75th percentile of the distribution of uncertainty is associated to a decrease of hirings (normalized by total workforce) equal to about -.2 percentage points. The effect is sizable if one considers that in our sample on average the share of hirings in total workforce is around 6 per cent.

4.3 Total workforce composition

Table 5 reports the same model specification (11) for the share of temporary workers over total workforce at time t. This empirical test is aimed at verifying whether uncertainty affects workforce composition as firms prefer to hire temporary workers when expected demand variability increases.

[5] Since realized variance might have an autoregressive component, we have also carried out an additional exercise, in non-reported estimates we have also used the residual of expected variance in a regression including time and sectoral dummies. Results are unchanged.

The estimates confirm the existence of a positive association between uncertainty and the use of a flexible workforce in all the specifications presented, including the ones with additional instrumental variables (the same discussed in the previous section). The coefficient corresponding to the expected demand is positive, even if not significant. The same holds for the interaction term. Moving from the 25th to the 75th percentile of the distribution of uncertainty is associated with an increase by around .3-.7 percentage points in the share of temporary workers over total workforce (the sample average being equal 7.8 per cent).

4.4 Total hirings

From the one hand uncertainty reduces the response of permanent labor demand to expected product demand growth. From the other, firms hire temporary workers, which are viewed as a flexible arrangement to exploit demand opportunities. Therefore, the overall effect of uncertainty on total labor demand is undetermined *ex ante*.

Table 6 reports the estimates of the total number of hirings over total workers as a function of perceived uncertainty, expected demand and the interaction term between the two.

Total hirings are positively correlated to expectations about demand growth and negatively with uncertainty (all the coefficients are significant). The interaction term (column 5) has a negative sign even if it is not significant at standard levels (p-value equal to 0.13). Our estimates signal the presence of a relatively strong attenuation effect of uncertainty on overall labor demand. Moving from the 25th to the 75th percentile of the distribution of uncertainty, total hirings over total workforce decrease by around -.1/-.3 percentage points over an average of around -.125 per cent.

5 Productivity

Are temporary workers an expensive option? Recent literature has extensively coped with the relationship between temporary workers and productivity and their answer is positive. However, on the empirical side, results are mainly based on aggregate estimates on sectors or countries which undergone legislative changes in employment

protection legislation (Autor, Kerr and Kugler, 2007). One of the main problem when carrying out estimates on microdata on firms is the endogeneity problem that arises because firm's decision on its workforce composition unquestionably affects productivity, but at the same time, this allocation is not independent of firm's characteristics. Moreover, from the firm's point of view, this decision implies an evident trade-off. On the one hand, this "external flexibility" may help firms to adjust labor rapidly and less costly to demand shifts, especially during economic downturns, so that the expected impact on productivity would be positive. On the other, firms may not find convenient to invest in on-the-job training of temporary workers preventing them to acquire those skills that are firm-specific (Acemoglu and Pischke, 1999), with negative effects on productivity.

To estimate the relationship between productivity and closed-end contracts, we instrument the share of temporary workers with a fiscal incentive paid by government to firms hiring permanent workers from 2001 to 2006. In Italy at the beginning of the last decade, the national government worried by the rapid increase of fixed term contracts following the reforms of 1997, drastically reduced social contributions paid by firms for newly hired permanent workers aged no less than 25 and not working with an open-end contract in the 24 months prior her/his hiring. This new tax credit applied to all new hires taking place from October 2000 on. A firm was eligible if the newly hired worker increased the overall number of permanent employees over the average recorded the previous year. Because of severe budget constraints, in 2003 the Italian government reduced the benefit and its automatism. In 2007 this benefit was completely turned off.

It is widely believed that this tax rebate was very generous, especially for firms located in Southern Italy, where the benefit was 50% higher than in other regions.[6] We define a variable equal to 0 in the years when the fiscal incentive was not in place

[6]Cipollone and Guelfi (2003) show that firms used this subsidy to hire under open-end contracts primarily those workers who would have been hired under such a contract regardless the subsidy, even though after a short transition into temporary employment. Also their findings are consistent with real option theory. Under uncertainty on workers' skills, temporary work arrangements can be viewed as a call option which give to firms the right to hire a worker with an open-ended contract only after having observed their productivity. If the cost of irreversibility decreases substantially because of the fiscal incentives, firms might prefer to do not buy this option and hire workers with an open-end contract.

and that it is equal to the tax rebate (by geographical area and normalized by the maximum value paid) from 2001 to 2006. Other things equal, fiscal incentives should positively affect hirings of permanent workers and reduce the share of temporary workers. This is what we find in Table 7, which includes also time and geographical dummies to isolate the effect of the fiscal incentives from area and time trends. Column 1 refers to hiring permanent workers, column 2 to the share of temporary workers. Fiscal incentives have the expected sign and are significant. We then use our measure of fiscal incentives as an IV for the productivity regression reported in Table 8.

The first column of Table 8 shows our baseline specification. Firm's labor productivity is a quite persistent phenomenon, as the coefficient is positive and highly significant. When we take into account the share of temporary workers (columns (2)-(4)), the negative relation between the use of closed-end contracts and productivity starts to emerge, and the coefficients are statistically significant. Columns (2)-(4) include the lagged value of the share of temporary workers to control for possible autocorrelation in the dependent variable. The coefficient is positive but not significant (p-value around 20 per cent). Finally, the use of the instrument, as in columns (3), confirms these results. To evaluate the size of the estimated effect, we look at year 2008 compared to the average 1999-2007. The estimates presented in section 4.3 suggest that the share of temporary workers in 2008 increased by .6 percentage points because of the dramatic increase in uncertainty recorded at the end of that year (with respect to the average 1999-2007). Because of this increase, productivity declined by around .3 percentage points. In our sample, the total decline in productivity at the end of 2008 was equal to around 1 per cent with respect to the period 1999-2007. Thus, our estimates suggest that 1/3 of the productivity decline registered in 2008 is due to the increase in the weight of temporary workers in total workforce.

6 Conclusions

In this paper we tried to answer to a simple question; Why do firms hire temporary workers? What are the effects that those hirings on firm's performance? When

employment protection legislation is stringent, hiring a permanent worker is like an irreversible investment. For the firm, opting for some degree of flexibility - hiring temporary workers - has with no doubt a cost: the other side of the coin is lower productivity.

At the time when closed-end contracts were first adopted, Europe witnessed high unemployment rates. These flexible job arrangements were successful in increasing employment. Nevertheless, firms may not find convenient to invest in on-the-job training of temporary workers, preventing them to acquire those firm-specific skills and employees subject to fixed term contracts are likely to exert a lower effort with respect to permanent workers performing the same task, unless they foresee a conversion of their contract into an open-end one. Now the economic landscape is different, but still characterized by a high degree of uncertainty, due to the increased level of competition, in particular from emerging countries. Firms need to preserve some margins of flexibility, but the presence of fiscal incentives to turn the closed-end contracts into permanent ones seem to be a viable way to address the "low-road" human resource management that bring about lower productivity (Michie and Sheenan, 2003) and the negative consequences for the worker of an unstable job arrangement.

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A Appendix A

... to be written.

Table 1: Model's parameters and their values for calibration for Figure (3).

Parameter	**Value**
σ	0.20
η	0.00
ρ	1.50
w_P	1.00
w_T	1.00
c_h	0.05
c_f	0.05
b_h	0.50
b_f	0.02
λ_h	0.01
λ_f	0.50
A	1.00
K	6.00

Table 2: Model's parameters and their values for calibration for Figure (2).

Parameter	**Value**
σ_{low}	0.15
σ_{high}	0.25
η	0.00
ρ	1.50
w_P	1.00
w_T	1.00
c_h	0.05
c_f	0.05
b_h	0.50
b_f	0.02
λ_h	0.01
λ_f	0.50
A	1.00
K	6.00

Table 3: Sample characteristics in 1999, 2004 and 2009.

	1999	2004	2009
(1) Total hires over workforce			
Mean	0.126	0.120	0.078
St. dev.	0.134	0.144	0.129
Freq.	935	2842	2509
(2) Hires of permanent w. over total workforce			
Mean	0.061	0.061	0.038
St. dev.	0.288	0.107	0.135
Freq.	949	2922	2570
(3) Hires of temporary w. over total hires			
Mean	0.495	0.463	0.476
St. dev.	0.353	0.385	0.404
Freq.	902	2478	1877
(4) Share of temporary workers			
Mean	0.060	0.085	0.069
St. dev.	0.109	0.175	0.137
Freq.	949	2922	2570
(5) Uncertainty			
Mean	0.013	0.017	0.019
St. dev.	0.040	0.058	0.059
Freq.	672	1077	1437
(6) Expected demand (perc. increase)			
Mean	0.063	0.036	0.048
St. dev.	0.154	0.139	0.215
Freq.	870	1436	2032
(7) Productivity			
Mean	3.982	3.965	3.883
St. dev.	0.590	0.605	0.615
Freq.	722	2359	1962

Source: Authors' calculation on INVIND data. (1) Ratio between the number of hires during the reference year over total employment. (2) Ratio between the number of hires of permanent workers in the reference year over total employment in the same year. (3) Hires of temporary workers on total hires. (4) Ratio between the number of temporary workers in total workforce; (5) Squared of the difference between the upper and the lower bound for the real expected demand change in percentage terms. Sample averages. (6) Expected real demand change, in percentage terms sample average. (7) Log of the ratio between value added (derived form CERVED) and total employment.

Table 4: Hirings of permanent workers and uncertainty. GMM estimates. Standard errors in brackets.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent var lag 1	0.220	0.292	0.292	0.332	0.247	0.167
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.08)
Dependent var lag 2		0.073	0.073	0.010	0.043	0.000
		(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Expected Demand growth				0.051	0.040	0.058
				(0.03)	(0.03)	(0.04)
Demand Uncertainty	-0.286	-0.177	-0.185		-0.247	-0.081
	(0.10)	(0.10)	(0.10)		(0.08)	(0.15)
Exp. Demand * Uncertainty						-0.173
						(0.10)
Additional instruments						
Aggregate sectoral demand	NO	NO	NO	YES	YES	YES
Aggregate sectoral uncertainty	NO	NO	YES	NO	YES	YES
Number of instruments	91	89	90	90	135	179
Sample size	8179	5873	5873	5810	5810	5810
Number of groups	2859	2188	2188	2165	2165	2165
Average obs. per group	2.9	2.7	2.7	2.7	2.7	2.7
Arellano Bond test for autocorrelation of residuals						
(H0: no autocorrelation)						
First order autocorr. (p-value)	0.000	0.000	0.000	0.000	0.000	0.000
Second order autocorr. (p-value)	0.015	0.528	0.533	0.786	0.436	0.339
Moving from the 25th to the 75th						
percentile of the distribution of uncertainty						
(percentage points)	-0.31	-0.23	-0.24	(-)	-0.29	-0.01
Hirings over total workforce at the average	6.0	6.0	6.0	6.0	6.0	6.0

Source: Authors' calculation on INVIND data. GMM estimates. In all models two lags of the dependent variable used as instruments, together with one lag of the independent variables. Uncertainty is equal to the squared of the difference between the upper and the lower bound for the real expected demand change in percentage terms. Expected demand is the firm's expectation of real demand change, in percentage terms. Sector dummies at ISIC 2-digits. Aggregate sectoral uncertainty equal to the standard deviation of the percentage change in value added of firms included in CERVED, by ISIC-2digits sector and at time $t+1$. Aggregate sectoral demand equal to the average of the percentage change in value added of firms included in CERVED, by ISIC-2digits sector and at time $t+1$.

Table 5: Workforce composition and uncertainty. Standard errors in brackets.

	(1)	(2)	(3)	(4)	(5)
Dependent var lag 1	0.326	0.352	0.290	0.309	0.291
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Expected Demand Growth			0.007	0.027	0.005
			(0.03)	(0.03)	(0.04)
Demand Uncertainty	0.413	0.567		0.320	0.233
	(0.17)	(0.18)		(0.13)	(0.12)
Exp. Demand * Uncertainty					0.018
					(0.26)
Sample size	8146	8146	8053	8053	8053
Number of groups	2855	2855	2828	2828	2828
Average obs. per group	2.9	2.9	2.8	2.8	2.8
Additional instruments					
Aggregate sectoral demand	NO	NO	YES	YES	YES
Aggregate sectoral uncertainty	NO	YES	NO	YES	YES
Number of instruments	93	94	94	140	185
Arellano Bond test for autocorrelation					
(H0: no autocorrelation)					
First order autocorrelarion (p-value)	0.000	0.000	0.000	0.000	0.000
Second order autocorrelation (p-value)	0.664	0.608	0.377	0.838	0.886
Effect on the share of temporary workers					
moving from the 25th to the 75th					
percentile of the distribution of uncertainty					
(percentage points)	0.5	0.7		0.4	0.3
Average share of temporary workers	7.8	7.8	7.8	7.8	7.8

Source: Authors' calculation on INVIND data. GMM estimates. In all models two lags of the dependent variable used as instruments, together with one lag of the independent variables. Uncertainty is equal to the squared of the difference between the upper and the lower bound for the real expected demand change in percentage terms. Expected demand is the firm's expectation of real demand change, in percentage terms. Sector dummies at ISIC 2-digits. Aggregate sectoral uncertainty equal to the standard deviation of the percentage change in value added of firms included in CERVED, by ISIC-2digits sector and at time $t+1$. Aggregate sectoral demand equal to the average of the percentage change in value added of firms included in CERVED, by ISIC-2digits sector and at time $t+1$. Fiscal incentives is a variable equal to 0 for the years of no fiscal incentive and equal to the fiscal incentive paid in the geographical area of the main branch of firm, normalized by the maximum incentiuve paid for the period 2001-2006.

Table 6: Total hirings and uncertainty. GMM estimates. Standard errors in brackets.

	(1)	(2)	(3)	(4)	(5)
Dependent var lag 1	0.436	0.436	0.507	0.513	0.494
	(0.03)	(0.03)	(0.04)	(0.03)	(0.04)
Expected Demand growth			0.160	0.145	0.137
			(0.04)	(0.03)	(0.03)
Demand Uncertainty	-0.063	-0.177		-0.076	-0.027
	(0.08)	(0.08)		(0.08)	(0.09)
Exp. Demand * Uncertainty					-0.092
					(0.06)
Additional instruments					
Aggregate sectoral demand	NO	NO	YES	YES	YES
Aggregate sectoral uncertainty	NO	YES	NO	YES	YES
Number of instruments	92	92	92	138	183
Sample size	7944	7944	7865	7865	7865
Number of groups	2790	2790	2766	2766	2766
Average obs. per group	2.8	2.8	2.8	2.8	2.8
Arellano Bond test for autocorrelation of residuals					
(H0: no autocorrelation)					
First order autocorr. (p-value)	0.000	0.000	0.000	0.000	0.000
Second order autocorr. (p-value)	0.996	0.896	0.923	0.938	0.991
Effect on the share of total hirings moving from the 25th to the 75th percentile of the distribution of uncertainty (percentage points)	-0.1	-0.3	(-)	-0.1	0.0
Total hirings over total workforce at the average	12.5	12.5	12.5	12.5	12.5

Source: Authors' calculation on INVIND data. GMM estimates. Uncertainty is equal to the squared of the difference between the upper and the lower bound for the real expected demand change in percentage terms. Expected demand is the firm's expectation of real demand change, in percentage terms. Sector dummies at ISIC 2-digits. Aggregate sectoral uncertainty equal to the standard deviation of the percentage change in value added of firms included in CERVED, by ISIC-2digits sector and at time $t+1$. Aggregate sectoral demand equal to the average of the percentage change in value added of firms included in CERVED, by ISIC-2digits sector and at time $t+1$.

Table 7: Hiring permanent workers, workforce composition and Fiscal incentives. GMM estimates. Standard errors within brackets.

	Hirings of permanent workers	Share of temporary workers
Fiscal incentives	0.040	-0.046
	(0.01)	(0.00)
Year dummies	Yes	Yes
Geographical dummies	Yes	Yes
Sample size	13,068	18,591

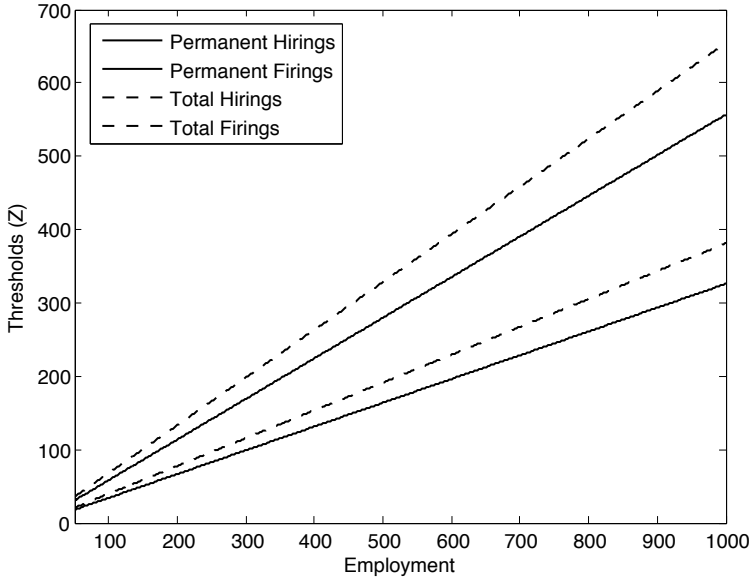
Source: Authors' calculation on INVIND data. GMM estimates. Fiscal incentives is a variable equal to 0 for the years of no fiscal incentive and equal to the fiscal incentive paid in the geographical area of the main branch of firm, normalized by the maximum incentive paid for the period 2001-2006.

Table 8: Firm's productivity and temporary workers (1999-2009). GMM estimates. Standard errors within brackets.

	(1)	(2)	(3)
Dependent var lag 1	0.721	0.775	0.554
	(0.08)	(0.11)	(0.04)
Share of temporary workers	-0.253	-0.332	-0.217
	(0.09)	(0.13)	(0.08)
Share of temporary workers lag 1		0.070	
		(0.06)	
Additional instruments			
Fiscal incentives	NO	NO	YES
Number of instruments	92	92	91
Sample size	14118	14118	14118
Number of groups	3725	3725	3725
Average obs. per group	3.790	3.790	3.790
Arellano Bond test for autocorrelation			
(H0: no autocorrelation)			
First order autocorrelarion (p-value)	0.000	0.000	0.000
Second order autocorrelation (p-value)	0.346	0.300	0.596
Effect on productivity			
moving from the 25th to the 75th			
percentile of the distribution of the share	-7.5%	-9.6%	-4.0%

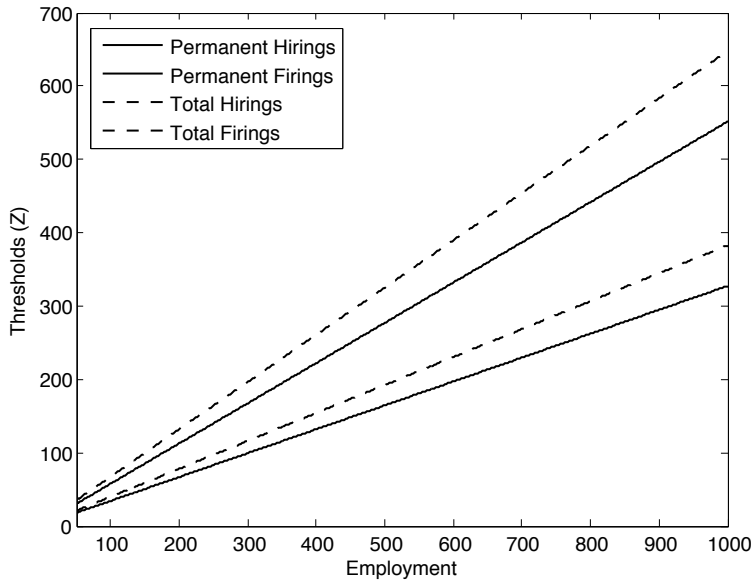
Source: Authors' calculation on INVIND data. GMM estimates. In all models two lags of the dependent variable used as instruments, together with one lag of the independent variables. Uncertainty is equal to the squared of the difference between the upper and the lower bound for the real expected demand change in percentage terms. Expected demand is the firm's expectation of real demand change, in percentage terms. Sector dummies at ISIC 2-digits. Aggregate sectoral uncertainty equal to the standard deviation of the percentage change in value added of firms included in CERVED, by ISIC-2digits sector and at time $t+1$. Aggregate sectoral demand equal to the average of the percentage change in value added of firms included in CERVED, by ISIC-2digits sector and at time $t+1$. Fiscal incentives is a variable equal to 0 for the years of no fiscal incentive and equal to the fiscal incentive paid in the geographical area of the main branch of firm, normalized by the maximum incentive paid for the period 2001-2006.

Figure 1: Hiring and firing thresholds for permanent (solid line) and total employment (dotted line), including temporary workers.

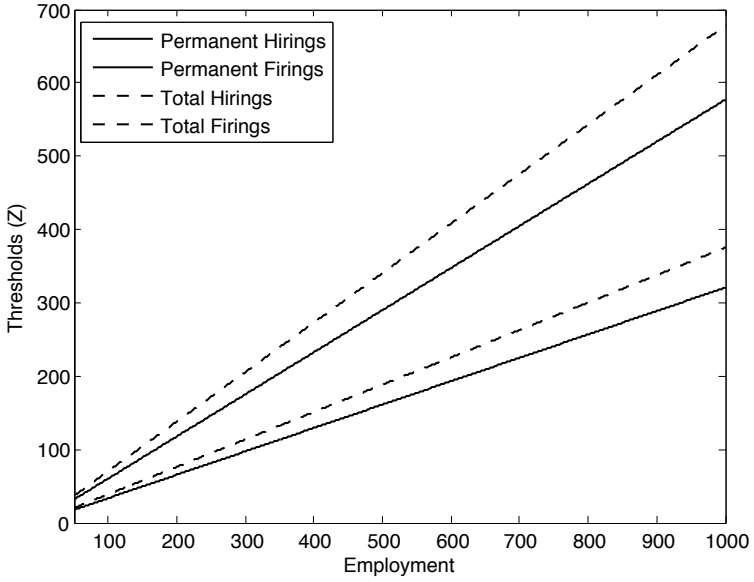


See Table (1) for the parameters used in the calibration.

Figure 2: Hiring and firing thresholds for permanent (solid line) and total employment (dotted line), including temporary workers. Low and high levels of uncertainty.



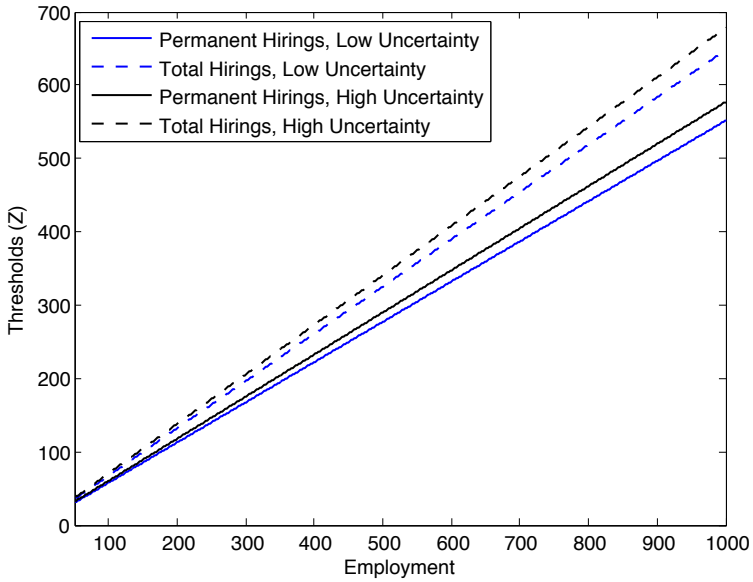
(a) Low Uncertainty ($\sigma = 0.15$)



(b) High Uncertainty ($\sigma = 0.25$)

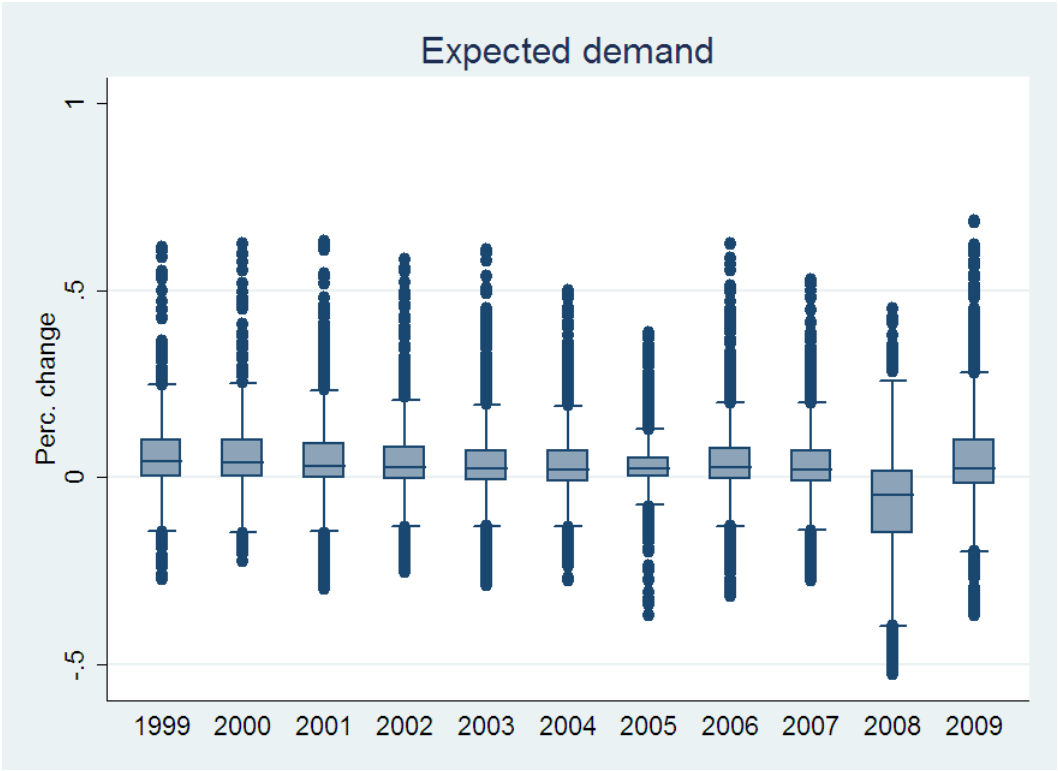
See Table (2) for the parameters used in the calibration.

Figure 3: Hiring thresholds for permanent (solid line) and total employment (dotted line), including temporary workers. Low (blue line) and high (black line) levels of uncertainty.



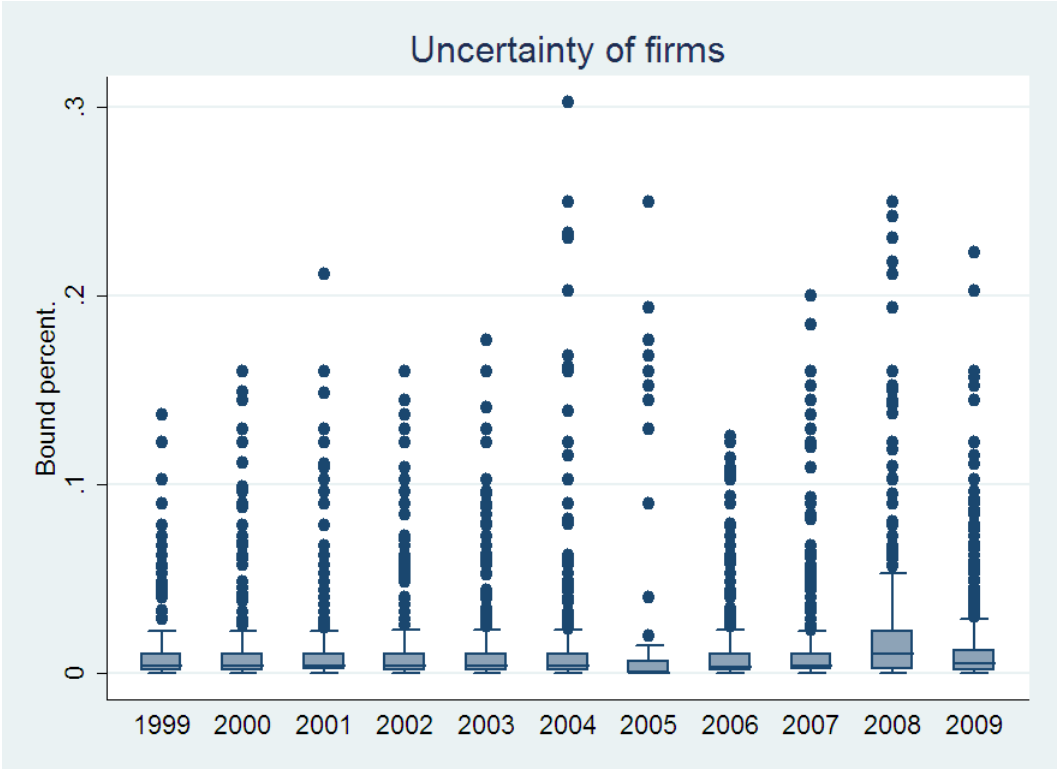
See Table (2) for the parameters used in the calibration.

Figure 4: Next year expected demand. Percentage change (1999-2009).



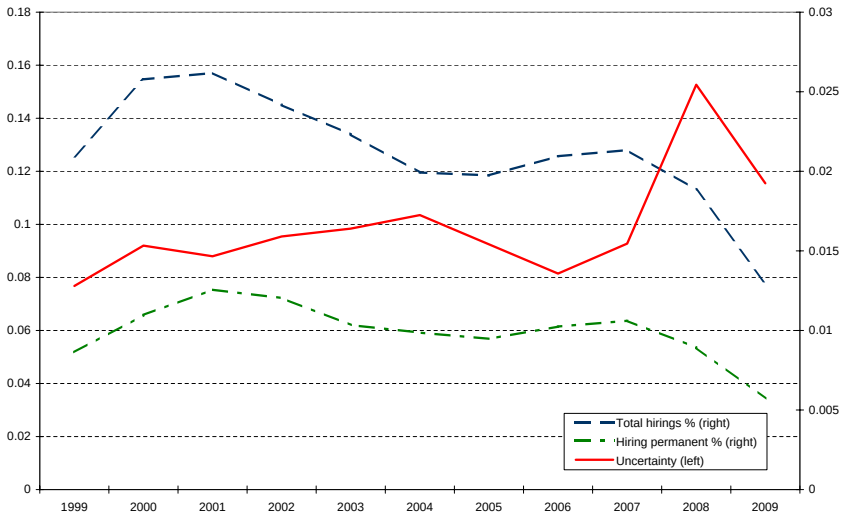
Source: Authors' calculations on INVIND data. The x-axis reports the reference year of the interview. Data on expected demand refer to the next year expectations. Expected real demand change, in percentage terms.

Figure 5: Next year expected uncertainty. Percentage change (1999-2009).



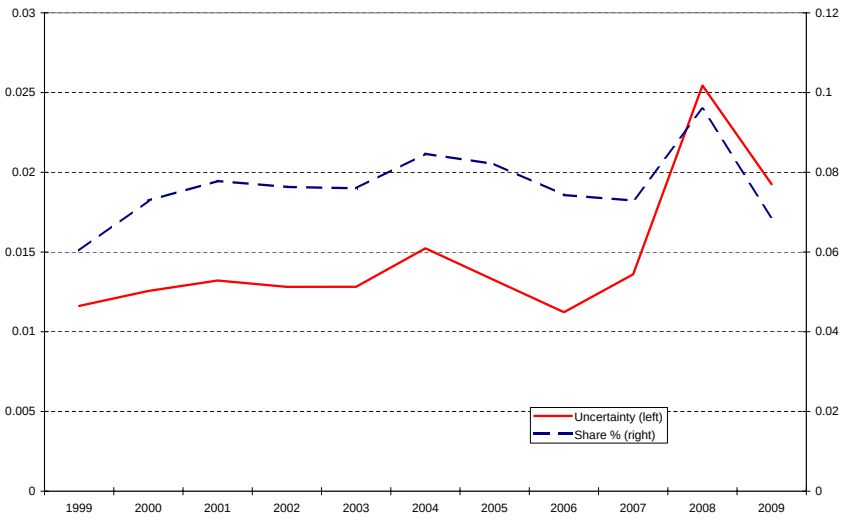
Source: Authors' calculations on INVIND data. The x-axis reports the reference year of the interview. Data on uncertainty refer to the next year expectations. Uncertainty is proxied by the squared of the difference between the upper and the lower bound for the real expected demand change, in percentage terms.

Figure 6: Total hirings on total workforce, Hirings of permanent workers on total workforce and uncertainty (1999-2009).



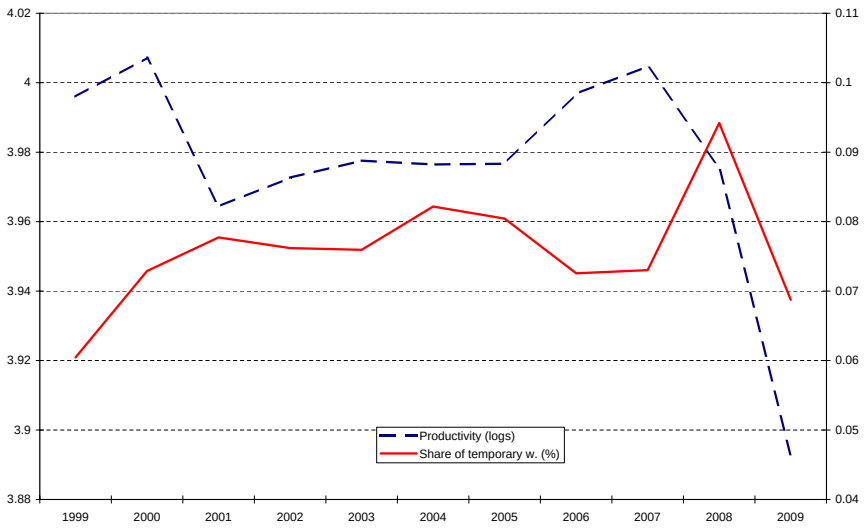
Source: Authors' calculations on INVIND data. The x-axis reports the reference year of hirings. Data on uncertainty refer to the next year.

Figure 7: Share of temporary workers on total workforce and uncertainty (1999-2009).



Source: Authors' calculations on INVIND data. The x-axis reports the reference year for data on employment composition. Data on uncertainty refer to the next year.

Figure 8: Productivity and share of temporary workers on total workforce (1999-2009).



Source: Authors' calculations on INVIND data. Productivity is measured as the log of the ratio between value added and total employment in the reference year. Uncertainty refer to the next year.