R&D, innovation activity, and the use of external numerical flexibility

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ABSTRACT

We address theoretically and empirically the impact of *R&D* and innovation activity (*IA*) on the use of external numerical flexibility (*ENF*). We build a firm-sided model showing that a first-order stochastic dominance shift in the productivity distribution function decreases the probability of hiring workers with temporary contracts, while a second-order shift has ambiguous effects. Next, using a dataset based on a survey of Italian manufacturing firms, we find that *R&D* and *IA* increase the extensive and intensive margins of employing workers with temporary contracts. Moreover, we disentangle the impact of different types of *R&D* and *IA*, finding that *extra muros R&D* always has a positive effect, while the effect of *intra muros R&D* is generally null. Also the effect of *IA* changes according to the type of activity: positive with product innovation, null with process innovation.

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1. Introduction

In this paper we study the effect of undertaking *R&D* and innovation activities (*IA*, hereafter) on the use of external numerical flexibility (*IA*, hereafter). *R&D* and *IA* are considered risky activities, i.e., they are associated with higher but more volatile returns. By *ENF*, we mean labor contracts with no cost incurred by their non-renewal. Since firing costs are an adjustment cost and since *R&D* and *IA* imply higher uncertainty, one may expect a positive relation between these activities and the use of flexible employment.[1] However, other considerations may suggest a negative relation. First, *R&D* and *IA* should improve firm performance, thus reducing the conditional expectation of future dismissals and the related firing costs. Second, these activities may perform better in the presence of a commitment to a long-lasting labor relationship, since they may induce workers to enhance their firm-specific human capital. Hence, from a theoretical standpoint, the sign of the relation between *R&D* and *ENF* is not clear.

We address this issue both theoretically and empirically. We begin with a model in which a firm has to choose between a permanent and a temporary labor contract, and we study how the probability of opting

for a temporary contract changes if the firm is engaged in *R&D* and *IA*. We show that while first-order stochastic shifts of the probability distribution of the firm productivity have a positive impact on the probability of hiring workers with permanent contracts, second-order shifts have ambiguous effects on this probability. Since undertaking *R&D* and *IA* implies both higher and more volatile expected returns, the effect on the labor contract choice is not theoretically predictable.

We then proceed to address this issue empirically. Specifically, using a dataset of Italian manufacturing firms, we estimate the impact of *R&D* and *IA* on both the probability of using at least one temporary contract and on its share in the firm workforce. We start looking at the aggregate of *R&D* and *IA* and find that both increase the extensive and intensive margins of using flexible employment. When we disaggregate among different types of *R&D* and *IA*, we find some differences. *Extra muros R&D* has always a positive impact on *ENF*, while the effect of *intra muros R&D* is generally not statistically significant. An interpretation of this result is that the increase in uncertainty associated with *R&D* activity boosts the use of flexible employment in order to reduce the loss implied by a negative scenario; however, there could be some positive complementarity between *R&D* activity and long-lasting labor contracts that mitigates this incentive. When we further distinguish between product innovation and process innovation, we get clear cut results. While product innovation activity has always a positive impact on the use of *ENF*, process innovation activity has no influence. This could be due to the fact that product innovation typically implies higher uncertainty, while process innovation is generally associated with cost rationalization, whose effects are not as uncertain.

The rest of this paper is organized as follows. The next section briefly reviews the literature concerning a firm's choice between permanent and temporary contracts, and the literature concerning the effects of

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  [1] Hereafter, the term *flexibility* will be used to refer to external numerical flexibility, thus excluding for instance internal numerical flexibility (part-time contracts) and functional flexibility (changing workers' tasks).

R&D and *IA* on firm performance. The theoretical model of Section 3 investigates how shifts in stochastic dominance affect the labor contract choice. Section 4 presents the empirical strategy: it describes the dataset and discusses the results of our regressions with different sets of explanatory variables. Section 5 concludes.

2. Review of the literature

2.1. ENF

By *ENF*, we refer to the possibility of changing the numbers of employed workers by using temporary contracts with no firing costs. Of these, the most frequently used are fixed-term contracts and temporary work agency (*TWA*, hereafter) workers. Even if with some differences, these contracts were originally introduced to meet firm specific needs, e.g., the adjustment of the production capacity to peaks of production. Subsequently, the use of flexible employment has gone beyond this original scope and nowadays it is sometimes intended as a common practice in the management of the workforce: firms may systematically use flexible employment as a buffer to reduce the costs of downsizing (see Foote and Folta, 2002).

One stream of the literature assumes that temporary and permanent workers have the same productivity. Because of the difference in firing costs, this implies that firms should always prefer flexible employment. For example, Cahuc and Postel-Vinay (2002) describe an economy in which both types of employment coexist because of the presence of institutional rules that limit the creation of flexible employment. Similarly, Boeri and Garibaldi (2007) describe an economy that starts with a stock of permanent workers, and then introduce the possibility of hiring flexible employment, the newly hired being all given temporary contracts.

Others, instead, support the idea that, notwithstanding the firing costs, permanent contracts may be convenient because they have a higher level of productivity. Aguirregabiria and Alonso-Borrego (2009) and Caggese and Cuñat (2008) attribute a higher labor-augmenting factor to permanent workers, while Addessi (2012) argues that the most important difference is in the contribution to the firm's productivity growth.[2] In a similar vein, Albert et al. (2005) find a negative relation between flexible employment and firm-provided training activities, probably with negative effects on the workers' human capital accumulation. Lotti and Viviano (2011) support the idea that the hiring of temporary workers is a real option allowing firms to adjust the workforce in the case of economic fluctuations and future demand uncertainty, the price of this real option being a lower productivity.

Finally, studies that use cross-country industry-level data (Bassanini et al., 2008; Damiani and Pompei, 2010; Lisi, 2009) find that the incidence of flexible employment may dampen *TFP* growth. In the light of the above, the assumption of our model that permanent contracts are associated with higher productivity than temporary contracts seems well supported.

2.2. R&D and IA

Broadly speaking, firm *R&D* and *IA* aim at gaining market power by improving the quality of the product and/or upgrading the production process efficiency. It is difficult to disentangle these effects empirically since datasets generally report firm revenues and not prices, quantities, or product quality, separately. When these activities are studied, they are generally considered a kind of investment possessing higher mean returns and more uncertainty. A cornerstone in this strand of the literature is Griliches (1979), where the *R&D* expenditure generates 'knowledge capital' that increases firm productivity and has a depreciation rate just as does physical capital. Recently, Doraszelski and Jaumandreu (2009) relax some assumptions concerning the relation between *R&D* and productivity. They stress that the accumulation of knowledge is not deterministic, assuming that firm *TFP* follows a stochastic process influenced by firm *R&D* expenditure. Their estimation results show that *R&D* expenditure has net returns significantly higher and more volatile than those deriving from physical capital.

The choice of engaging in *R&D* and *IA* may be related to labor market institutions. Saint-Paul (2002) distinguishes between 'primary innovation' (the introduction of new products) and 'secondary innovation' (the upgrading of existing products). The former is considered a riskier activity because the demand facing a producer of new goods is more volatile; consequently, firms operating in labor markets with high employment protection (as have most European countries) should prefer the latter because it implies a lower probability of paying the firing costs associated with the reduction of the workforce. In countries such as the U.S., where employment protection is low, firms are less scared of starting a riskier activity because in case of a non-performing outcome, they can adjust the level of their workforce without bearing firing costs. In Koeniger (2005) the relation between firing costs and innovation is more ambiguous. Employment protection, on the one hand, deters the entry of new innovating firms because the presence of these costs increases the expected returns required to start a business, but, on the other hand, it pushes incumbent firms to innovate in order to avoid dismissal costs.

These contributions analyze the role of labor market institutions, such as employment protection legislation (*EPL*), on a firm's choice to undertake *R&D* and *IA*.[3] Alternatively, other contributions are more interested in how the performance of *R&D* and *IA* is affected by different labor contracts. Zhou et al. (2011) review some of the reasons that might induce a negative or a positive relation between the *R&D* and *IA* with the use of flexible employment. Permanent employees may be reluctant to adapt to new technologies, may hamper or make the reallocation of labor services very expensive, and may reduce firm returns from innovation by making higher wage claims in case of success. On the other hand, the use of *ENF* may impair the organizational learning process, may reduce employee loyalty and effort in acquiring firm-specific knowledge, and may reduce the firm's incentive to provide training. Kleinknecht et al. (2006) estimate the impact of the use of workers with temporary contracts and of *TWA* workers on both firm employment and sales, distinguishing between innovating and non-innovating firms. They find that the use of workers with temporary contracts has no significant effect on sales, but a positive effect on employment in non-innovating firms (suggesting a negative effect on productivity). Furthermore, they find that the use of *TWA* workers has a positive effect on employment growth and sales in innovating firms, while the opposite effect emerges in non-innovating firms.

Finally, Malgarini et al. (2011) address our same topic. They estimate the effect of aggregate *IA* on the probability of using flexible employment using a dataset of Italian firms over the period 2006–2010, finding a positive impact only when the Italian economy is in a downturn. They try to get rid of unobserved firm-specific characteristics using a sequential set of firm decisions while we use a large set of control variables. However, both papers share the view that the engagement in *R&D* and *IA* is a firm strategic or long-run choice, taken before the choice of labor contracts.[4] In fact, it is quite hard to see how the presence of at least one flexible employee could affect the choice concerning the engagement in *R&D* and *IA*.

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[2] Focusing on the effect of *TWA* workers on firm productivity, Hirsch and Muller (2012) find an hump-shaped relation: the effect of employing *TWA* workers is initially positive but, for intensive levels of use, it becomes negative.

[3] On the interactions between *EPL* and labor market performance, see Saltari and Tilli (2009, 2011).

[4] For example, Aw et al. (2009) investigate the effect of *R&D* and export activities on firm productivity. In their model, firms choose whether to engage in *R&D* and/or export activities assuming that labor services will be chosen optimally.