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Mercato del lavoro, disoccupazione e riforme strutturali in Italia

a cura di
Saveria Capellari

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Dynamic effects of labor market reforms on productivity. A survey

ELENA PODRECCA*

Abstract

Institutional reforms have long been a central focus of the European economic policy debate, and the labor market in particular has been subject to never definitive reforms in the past 20 years, mainly aimed at fostering wage moderation and flexible labor contracts. The employment effects of labor market institutions have been widely analyzed, but the focus on this aspect has overshadowed an equally important but scantily investigated element: their possible dynamic impact on innovation and productivity growth. This paper is a critical survey of the literature which may help shed light on this issue. Growth theory as well as the results of the empirical growth literature teach us that the main drivers of long run productivity growth in advanced countries are innovation, research and development, human capital accumulation. Reforms which enhance labor market flexibility can in principle affect these growth drivers through different channels, but the sign of the effects on productivity growth is ambiguous. Existing empirical evidence shows that wage and numerical flexibility have negative effects on research and development, innovation and firm sponsored training, suggesting that the dynamic effects of labor flexibility are negative. This suggests that the tradeoff between labor market flexibility and productivity growth which has been detected both within many European countries and across European countries is not just a temporary, static, short run effect linked to the employment effect of flexibility enhancing reforms, but may also reflect a more worrying permanent, dynamic, long run phenomenon.

Keywords: *wage flexibility, numerical flexibility, temporary contracts, innovation, productivity growth*

JEL class.: O30, O31, E02, J24, J50, J31, J41

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1. Introduction

Institutional reforms have been a central focus of the Italian and European policy debate since the early nineties. The labor market in particular has been subject to never definite reforms in the past twenty years, mainly aimed at removing employment protection, at fostering wage moderation and liberalizing flexible forms of labor contracts. Making the labor market more flexible has been considered a pivotal part of a wider strategy aimed at reducing high structural European unemployment ever since the influential OECD Job Study (1994), which has been followed by a wide literature focusing on the impact of labor market institutions (and reforms) on employment and unemployment. The focus on this aspect, however, has overshadowed another important but scantily investigated issue: the possible effects of labor market institutions, and of reforms enhancing labor market flexibility, on productivity growth.

Reforms which enhance labor market flexibility may have both short run static (level) effects and long run dynamic (growth) effects on productivity.

The mainstream literature usually emphasizes the static short run effects, which are linked either to the employment effect of enhanced labor market flexibility or to its effect on the incentives to worker's effort. First of all, to the extent that labor market reforms are successful in increasing employment, they will have an indirect negative impact on productivity levels in the short run according to the predictions of the standard neoclassical models of production. Such models assume that labor productivity is an increasing and concave function of physical capital per worker¹. If the capital stock is fixed in the short run, which happens if any response of physical capital investment to changes in labor market conditions takes time to develop, then the employment increase will determine a reduction of capital per worker, and a consequent decrease of labor productivity in the short run. A similar negative indirect productivity effect of labor market flexibility may arise if the employment increase induced by reforms implies the use of new workers which are on average less skilled and less productive than the ones already employed. These negative static effects of labor market reforms on productivity have been detected at the macroeconomic level by Dew Becker and Gordon (2012) in their detailed empirical analysis of the employment-productivity

¹ Consider a standard production function of the type $Y = F(K,L)$ with positive and decreasing marginal returns on capital (K) and labor (L), and constant returns to scale. Given constant returns to scale one can write the production function in intensive form like: $F(K,L)/L = F(K/L, 1)$ or $Y/L = f(K/L)$, with $f' > 0$ and $f'' < 0$. Labor productivity is thus a function of capital per worker, with positive and decreasing marginal returns.

tradeoff in Europe (and in particular in the Mediterranean countries) since the mid nineties². But in principle labor market flexibility may also have direct static effects on productivity which are not mediated by employment changes and changes in capital intensity, and these effects can be both positive and negative. Positive short run static effects may arise if labor flexibility fosters efficient reallocation of resources, or if firms use temporary labor contracts to avoid under-utilization of capital and/or of labor during negative cycles³. Moreover, negative as well as positive static effects of flexibility on labor productivity and on Total Factor Productivity (TFP) levels may derive from the behavioral component of labor productivity, if flexibility affects incentives to workers' effort. For example, wage flexibility may negatively influence workers' effort and productivity according to the predictions of efficiency wage theory; similarly, temporary contracts may have a negative effect on workers' productivity if their short duration induces temporary workers to exert a lower effort than permanent workers. On the other hand, to the extent that firms use temporary contracts as an instrument to select employees, temporary workers may have an incentive to exert higher effort in order to maximize the probability of obtaining a permanent contract, with an overall positive effect on the firms' productivity⁴. Similarly, a rigid employment protection legislation (EPL) might lower the incentive to effort for protected workers⁵, whereas with a low degree of employment protection for stable employees, temporary work may be used as a stick to threaten permanent workers and to increase their effort and their productivity⁶. On the other hand, permanent workers with low job security tend to perceive temporary workers as a threat to their jobs, and may react with a lower work effort.⁷ Similarly, a high share of temporary workers in a firm's labor force

² The tradeoff had previously been predicted by Buchele and Christiansen (1999).

³ This happens if for example firms use temporary labor contracts to cope with demand variability, or to preserve their regular labor force and sustain internal labor markets during negative cycles.

⁴ Engellandt and Riphahan (2005), Dolado and Stucchi (2008), Dolado *et al.*(2012). Evidence that temporary workers tend to be more committed and to exert higher effort with respect to permanent workers only if they expect that their contract is going to be transformed from temporary to permanent is found by Beccarini (2009) and Ghignoni (2009). Both studies, however, cast strong doubts on the existence of any positive relation between indicators of effort and labor productivity.

⁵ Due to the lower probability of being fired in case of unsatisfactory productivity performance (Ichino and Riphahn (2005).

⁶ Bryson (2007).

⁷ (Kraimer et al. (2005)). Evidence that the presence of temporary workers reduces permanent workers commitment and effort is found by Battisti and Vallanti (2013).

might worsen relations among workers, and negatively affect the effort of permanent staff^{8,9}.

The above static effects of labor market flexibility on productivity are not the focus of this paper. We will instead focus on the dynamic effects, which are linked to the possible impact of increased labor market flexibility on the long run productivity growth drivers. Dynamic effects are potentially more important than static effects, since they influence productivity growth rates and the evolution of productivity levels over time; in other words, dynamic effects cumulate over time and eventually outweigh static short run effects, as even a small growth rate effect may have a large impact on productivity levels in the long run.

Growth theory, as well as the results of the empirical growth literature in the past twenty five years, teach us that the main long run drivers of productivity growth in advanced countries are innovation, technological change and human capital accumulation. Reforms which enhance labor market flexibility may be indirectly relevant for productivity growth to the extent that they affect these growth drivers. As we will see in detail in what follows, different strands of economic theory suggest the existence of several potential channels of transmission from labor market flexibility to the main growth drivers, with negative as well as positive potential effects. In theory the sign of dynamic effects is not unambiguous, and whether negative or positive effects tend to prevail in practice is an issue which can only be assessed by looking at the results of the different strands of relevant empirical literature, which we will critically survey.

The rest of the paper is organized as follows. After explaining the different meanings of labor flexibility (paragraph 2), we survey both the main predictions of the theoretical literature on the transmission channels from different forms of labor flexibility to productivity dynamics (paragraph 3), and the results of the empirical literature which has investigated both the direct relationship and the transmission channels from labor flexibility to productivity growth (paragraph 4). The conclusions are in paragraph 5.

⁸ George (2003), Broshak e Davis-Blake (2006).

⁹ Beccarini (2009) and Ghignoni (2009), using micro data for Italian firms, find that temporary workers tend to be more committed and to exert higher effort with respect to permanent workers only if they expect that their contract is going to be transformed from temporary to permanent. The transmission of these effects to productivity, however, is not demonstrated: on the contrary, both contribution cast strong doubts on the existence of any positive relation between indicators of effort and labor productivity. The contribution by Battisti and Vallanti (2013) finds instead that, in a sample of Italian firms, the presence of temporary workers tends to reduce permanent workers commitment and effort.

2. Labor market flexibility concepts

As making the labor market more flexible has been the one of the main goals of labor market reforms, it is useful to start our discussion by focusing on the various possible types of “labor flexibility”. Three relevant dimensions of flexibility can be identified from a microeconomic perspective: wage flexibility, numerical flexibility and functional flexibility¹⁰. Wage flexibility refers to the ease with which wages adjust downwards in response to negative market conditions, and is affected by institutions such as union density, the degree of bargaining centralization and/or coordination, unemployment benefits duration and replacement rates, minimum wages and the tax wedge. Numerical flexibility concerns the ease with which firms can change the number of employees in response to their changing requirements, and is affected by hiring and firing costs, by the use of temporary contracts, and in general by employment protection legislation. The boundary between numerical flexibility and wage flexibility is in fact somehow blurred. Numerical flexibility may reduce wage costs for the firm if it shifts the risk of temporary demand shortages from the firm to the workers and if flexible workers can be hired at lower wages for equal tasks¹¹. Moreover, a rising share of temporary workers may reduce the probability that the firms pay high “efficiency wages” to stable workers¹², and may reduce the wage bill due to a composition effect¹³. Functional flexibility concerns internal labor markets, and refers to the qualitative adaptation of workers’ competences to the firm’s changing needs. It reflects the ability of firms to re-allocate labor internally and it implies the development of multi-skilled employees. Since this is achieved essentially through training, functional flexibility does not yield any savings of wage costs, and may actually increase them.

In the mainstream interpretation, a “flexible labor market” is characterized by an high degree of wage flexibility and numerical flexibility. According to this interpretation a flexible labor market is a framework where firms can easily hire workers for as long as they need and fire them as they please, where

¹⁰ These concepts of flexibility were first introduced by Atkinson (1985a, 1985b, 1986), and used, for example, in Giannetti and Madia (2013), Zhou, Dekker and Kleinknecht (2011), Lucidi e Kleinknecht (2010). A detailed review of flexibility concepts may be found in Wilthagen and Tros (2004).

¹¹ Zhou et al. 2011

¹² Sanchez and Toharia (2000).

¹³ Bentolila and Dolado (1994). The authors underline, however, that as soon as the share of flexible workers stabilizes wages may start increasing again as flexibility at the margin (which does not influence core workers) increases insiders power to raise unit labor costs.

profits as well as entry and exit are not constrained by institutional rigidities such as employment protection legislation or union activities. Labor market deregulation is typically aimed at removing these obstacles to wage and numerical flexibility, in order to increase employment, improve efficiency and eventually to boost productivity. But is a deregulated labor market a necessarily good environment for productivity growth?

3. Dynamic effects of flexibility on productivity growth: the theory

The economic debate traditionally tends to highlight the effects of innovation and productivity growth on employment levels¹⁴ or on wages and skills of the labor force¹⁵. In such framework wage differentials and the need to remove rigidities such as hiring and firing costs are seen as the direct effects of innovation. However, different strands of economic theory suggest that causality may well run in the opposite direction, from wage and numerical flexibility to innovation and productivity growth, through various channels of transmission, all of which may imply negative as well as positive effects. One may think of at least four transmission channels from wage and numerical flexibility to long run productivity growth rates: through innovation and selection, through training and human capital accumulation, through the role of trust on productivity growth and through the impact of aggregate demand on productivity growth¹⁶. We will consider each one in detail.

3.1. FLEXIBILITY, INNOVATION AND SELECTION

Several strands of literature predict negative effects of wage and numerical flexibility on the firms' innovative ability. First of all, it is possible that higher wage and numerical rigidity and higher labor costs stimulate a process of dynamic substitution between capital and labor, i.e. stimulate the adoption of labor saving technologies (Sylos Labini (1984, 1993, 1999)). Notice that this dynamic substitution effect is different from the standard static substitution effect in response to changes of relative factor prices underlined by neoclassical theory, since it implies a technological improvement incorporated in new

¹⁴ For example Vivarelli, 1995; Vivarelli and Pianta, 2000.

¹⁵ Johnson (1997), Mortensen and Pissarides (1999), Mincer (2003).

¹⁶ This taxonomy of the transmission channels has been proposed by Lucidi and Kleinknecht (2010).

capital goods. Similarly, the theory of induced technical change predicts that higher relative wages tend to increase the labor-saving distortion of new technologies (Hicks (1932), Kennedy (1964), Ruttan (1997)). In models in which plants have different technological ages, more aggressive wage claims on the part of unions will induce the substitution of older and more labor intensive vintages of capital with new, more productive ones.

Moreover, from a Schumpeterian or an evolutionist point of view, it is easier for innovators to cope with more aggressive wage bargaining or with higher adjustment costs caused by institutional rigidities, and this may ease the process of creative disruption by which innovators crowd out less dynamic competitors. Labor market rigidities could therefore determine changes in the structure of the economy towards more dynamic firms and industries. To be more precise: when firms develop innovations they accumulate specific knowledge, which includes “tacit” knowledge accumulated by workers and entrepreneurs through practical experience¹⁷. Tacit knowledge is difficult to imitate, and its systematic accumulation works as an entry barrier against imitators, and gives to the innovating firms some degree of monopoly power¹⁸, which assures higher than average profits. Such extra profits allow innovating firms to survive despite aggressive wage policies and institutional rigidities (Kleinknecht (1998)). On the other hand high wages or wage compression would force productivity laggards to either increase their efficiency or to exit the market. Conversely, deregulation of the labor market and wage flexibility increase the chances of survival of technological laggards, of weak firms which benefit from cost cutting strategies. In the aggregate this implies a lower average entrepreneurial quality and a loss of innovative dynamism (Antonucci and Pianta, 2002).

Other strands of literature predict instead a positive link between wage and numerical flexibility and innovation. According to the standard incomplete contracts approach, for example, a firms’ incentive to invest decreases as the bargaining power of unions increases (Grout (1984), Van der Ploeg (1987), Malcomson (1997), Menezes-Filho and Van Reenen (2003)). Protected workers have a strong bargaining power, which under decentralized bargaining would erode part of the monopoly profits deriving from innovation, thereby reducing the firms’ incentive to take the risks of innovative activity. This conclusion has however been qualified by some contributions considering strategic aspects of oligopolistic competition (Ulph and Ulph, 2001; Haucap and Wei, 2004). In unionized industries a firms’ innovation incentives

¹⁷ Tacit knowledge has also been described as not codified, implicit and idiosyncratic (Dosi, 1988).

¹⁸ Which can be increased by patent protection

depend both on its own wages and on wages of its competitors, as well as on the relative adjustments following an innovation. In such framework these papers demonstrate that firms facing stronger unions may have a strategic competitive advantage with respect to competitors facing weaker unions or paying competitive wages, and that unionization may increase a firm's innovation incentives and its competitiveness. Haucap and Wei (2004) in particular analyze the effects on innovation incentives and employment of different wage bargaining frameworks (decentralization, coordination and centralization¹⁹), and show that centralization yields the highest incentive to innovation investment, while coordination yields the lowest; innovation incentives are non linear in the degree of centralization, and decentralization yields higher incentives than coordination. The intuition is that while coordination allows unions to exploit their potential to erode monopoly rents, centralization and decentralization limit the unions' power either through a uniformity rule or through competition among unions at the firm's level. The analysis shows that the uniformity rule implied by centralization is a more effective constraint for unions with respect to competition resulting from decentralization, and that decentralization yields instead the best result in terms of employment.

Other contributions have suggested that high employment protection (low numerical flexibility) may harm productivity growth by slowing down labor reallocation from declining firms and industries to emerging and more dynamic ones, characterized by higher than average productivity growth (Hopenhayn and Rogerson (1993), Nickell and Layard (1999)). The argument, however, is not fully convincing: emerging and dynamic firms and industries will probably offer higher wages and better career opportunities with respect to declining ones, which will stimulate voluntary mobility of workers²⁰, despite high firing costs.

A different argument is that firing costs represent adjustment costs which curb both labor saving innovations at the firm level (Bassanini and Ernst (2002a, 2002b), Scarpetta and Tressel (2004)) and the entry of new innovative firms (Bertola (1994)). In addition, firing costs may also influence the firms' exit decisions. If exiting firms have to pay firing costs, these work as a tax on exit which discourages exit of low productivity firms; if on the other hand exiting firms are exempt from firing costs, their continuation value is reduced relative to the exit value, which promotes exit of low productivity firms (Poschke (2009)).

¹⁹ Under the three different frameworks wages are set independently at the firm's level (decentralization), or set by one industry union either for each individual firm (coordination) or at a flat rate for all firms in the industry (centralization).

²⁰ If skills allow such mobility.

In general, however, the idea that firing costs are a brake to innovation is not fully convincing, for at least two reasons. First, high firing costs may encourage firms to invest in functional flexibility through training of the labor force, and to reallocate labor on the internal market. Second, more protected workers will be more keen to cooperate with management in the development of labor saving processes and to disclose their tacit knowledge to the firm (Lorenz (1992, 1999), Griffith and Macartney (2010)).

3.2. FLEXIBILITY AND HUMAN CAPITAL ACCUMULATION

Numerical (and wage) flexibility may have an intuitive negative impact of workers' training and human capital accumulation: temporary labor relations tend to reduce the firm's incentives to invest in training of the workforce since the short duration of the future benefits reduces the return to investment. On the other hand, and for the same reason, workers will be reluctant to invest in firm specific skills in the absence of long term commitment. This general intuition has been formally modeled by different contributions. According to the models of Acemoglu (1997a,1997b), if technology choices are endogenous and when complementarities between labor skills and technological choices are considered, labor market deregulation is not the best policy choice. When the turnover rate is high firms do not invest in workers' training and in R&D since the additional return on training and on knowledge from R&D would benefit workers that will probably soon quit the firm. Similarly, if firms do not invest in R&D and new technology their wages will not be adequately high and their workers will not invest in human capital accumulation. In sum: long term employment relationships are a fundamental contribution to technological change.

Belot, Boone and Van Ours (2007) suggest that employment protection legislation encourages workers to invest in match specific human capital. MacLeod (2005) shows that with incomplete labor contracts, for example because the firms use subjective measures of performance or because job specific investments are difficult to measure, a long term contract which increases firing costs enhances efficiency.

Another transmission mechanism from wage and numerical flexibility to human capital accumulation works through the effects of labor market rigidity or flexibility on the wage structure.

In Acemoglu e Pischke (1999), labor market rigidity determines wage compression from below, and wage compression encourages the firms to invest in general training. Human capital investment sponsored by firms may

therefore be enhanced by labor market institutions like the minimum wage, which increases the wage of low skilled workers with no effects on wages for higher skills, or by egalitarian wage bargaining on the part of unions, which forces the firms to pay higher wages to less skilled workers. The intuition is the following: if firms train workers whose productivity is lower than the minimum wage, they will not have to pay an higher wage as productivity increases, and will benefit from the entire amount of the associated increase in returns. A similar effect could derive from firing costs, as suggested by Jansen (1998). Moreover, wage compression could encourage human capital accumulation on the part of workers: since high wages for low skills reduce demand for unskilled labor, workers have an incentive to invest in training in order to increase their employability (Agell (1999)).

Reduced training and human capital accumulation induced by numerical flexibility and wage flexibility could in turn have negative effects on productivity and innovation.

3.3. FLEXIBILITY AND TRUST

Long term labor relations tend to promote trust and cooperation between firms and workers, and, as some papers suggest, human resource management practices based on trust and cooperative labor relations increase productivity and innovative activity (for example Lorenz (1999), Michie and Sheehan-Quinn (2001, 2005), Naastepad and Storm (2005)). According to these contributions stable labor relations and a strong protection against firing are an investment in trust, in loyalty and commitment, which may favor productivity growth in different ways. For example by reducing uncertainty arising from opportunistic behavior, thereby decreasing monitoring and control costs; or by favoring the accumulation of tacit knowledge, as well as by avoiding the leakage of trade secrets and tacit knowledge to competitors (Lucidi and Kleinknecht (2010), Kleinknecht et al. 2006)).

3.4. FLEXIBILITY AND AGGREGATE DEMAND

The last possible transmission mechanism from labor flexibility to productivity growth works through aggregate demand. The existence of a direct link between aggregate demand, innovative activity and productivity growth is suggested both by the Verdoon-Kaldor law and by the Schmookler's hypothesis. The Verdoon-Kaldor law (Verdoon (1949), Kaldor (1966, 1967)) maintains

that aggregate demand growth stimulates faster production growth in manufacturing, and faster production growth enhances productivity growth. The rationale behind the hypothesis is the presence of increasing returns, which arise because of technological progress induced by output growth. Schmookler's hypothesis (Schmookler (1966)) maintains that technological innovations, in particular patent activity, are a positive function of effective demand. The idea is that positive demand prospects lower the risks of innovative projects, shorten their payback period and alleviate financial constraints either by making banks more keen to lend or by increasing the chances of internal financing. Some recent contributions have presented empirical evidence for the Verdoon law (McCombie et al (2002)), and have found that changes in R&D efforts across firms are positively linked to demand growth in a firm's main sector of activity, confirming Schmookler's demand-pull hypothesis (Brouwer and Kleiknecht (1999)).

How do wage and numerical flexibility affect aggregate demand? They can in principle curb aggregate consumption and effective demand both directly, through a reduction of workers' purchasing power (not compensated by an increase in consumption credit), and indirectly through the increase of precautionary savings on the part of insecure workers facing a firing threat. The slowdown of aggregate demand in turn will negatively affect innovation and productivity growth both according to the Verdoon-Kaldor law and the Schmookler's hypothesis. Moreover one cannot exclude a further negative feedback effect on the export component of aggregate demand, given the possible negative impact of slower innovation and lower productivity on international market shares (Carlin et al. (2001), Kleinknecht and Oostendorp (2002)).

In sum, the overall dynamic effects of wage and numerical flexibility on long run productivity growth are not clear cut. While on one hand the transmission mechanism working through human capital accumulation, trust and aggregate demand consistently suggest a negative link, on the other hand the transmission mechanisms working through investment, innovation and selection may have either negative or positive effects. Economic theory cannot predict whether positive or negative effects of flexibility will prevail, and it is therefore essential to analyze the results of the different strands of empirical literature which have investigated both the direct links between flexibility and productivity growth and, more importantly, the different transmission mechanisms suggested by economic theory.

4. Empirical evidence on labor flexibility and productivity growth

Even if the empirical literature on the subject is still relatively scarce and does not define a systematic framework, several recent contributions have investigated the direct relationship between labor market flexibility and labor productivity growth or total factor productivity (TFP) growth, and some have analyzed their effects on the drivers of productivity growth such as innovation, research and development, training and human capital accumulation.

4.1. THE DIRECT LINK BETWEEN FLEXIBILITY AND PRODUCTIVITY GROWTH (AND LEVELS)

We start by reviewing the empirical studies which have analyzed the direct link between flexibility and labor productivity and between flexibility and total factor productivity (TFP). We will consider both empirical studies which consider productivity growth rates and those which focus on levels. It is true that the dynamic effects of flexibility that we want to focus on imply a growth rate effect on productivity, but they have an obvious impact on productivity levels as well. Indeed, static and dynamic effects are not distinguishable in studies which consider the direct relation between flexibility and labor productivity.

At any rate, empirical studies on the direct link between various measures of labor market flexibility and labor productivity or TFP growth (and levels) have consistently found a negative relationship, both on data at the firm level and at the industry level for single countries and on industry or aggregate data across countries. Only a few studies have found mixed effects.

4.1.1 *The Italian case*

Negative effects of numerical flexibility as well as of wage flexibility are consistently found in all contributions focusing on the Italian experience, which has been widely studied.

Four micro studies on manufacturing firms are Boeri and Garibaldi (2007), Lucidi and Kleinknecht (2010), Cappellari *et al.* (2012) and Addessi (2014). These studies use data²¹ covering the periods immediately preceding and following the introduction of a series of flexibility enhancing labor market reforms in Italy²² which in different times have liberalized the use of temporary

²¹ From different editions of the Capitalia-Unicredit survey on manufacturing firms, or from the Excelsior-Unioncamere database.

²² The most important legislation was Law n. 196/1997 (the so called “Treu Package”), Decree Law 61/2000, Decree Law 368/2001, and Law 30/2003 (the so called “Biagi Law”).

contracts, have encouraged the use of part time, have allowed hiring through private manpower agencies, have introduced other atypical contract frameworks like job on call and staff leasing, and have reformed apprenticeship.

Boeri and Garibaldi (2007) find a negative relationship between temporary contracts and subsequent labor productivity growth in a set of 1300 manufacturing firms observed over the period 1995-2000, in regressions controlling for industry, firm dimension, skill level of the labor force and regional effects²³, and designed to avoid endogeneity bias as well as bias due to unobservable factors. The authors consider the negative productivity effect as a temporary static effect due to the employment increase and to decreasing returns to labor, but an interpretation overlooking the possible dynamic effects on firms' innovative activity, cannot be taken for granted. Moreover, one must be careful before drawing strong conclusions from micro studies examining firms' behavior over periods characterized by different conditions of the business cycle.

The study by Lucidi and Kleinknecht (2010) focuses on a set of 3000 firms over 2001-2003 and investigates the effects of wage flexibility, of temporary contracts and of turnover rates on subsequent labor productivity growth, in regressions controlling for initial productivity, investment, aggregate demand variations, firms' size and age as well as industry and regional effects. As in the previous study both endogeneity and omitted variables bias is controlled for. Both wage flexibility and numerical flexibility are found to have a negative impact on productivity growth. Specifically, the firms which at the beginning of the period (2001) faced higher wage costs, and which faced higher wage growth in the previous period (1998-2001) experienced higher productivity growth in 2001-2003. Similarly, the firms which at the beginning of the period had higher shares of temporary work and higher turnover rates experienced a lower growth rate over 2001-2003. The results indirectly support the idea that lower flexibility fosters technological change and innovation, as many of the theories reviewed in paragraph 3 suggest, but the interpretation cannot be taken for granted, in particular as regards numerical flexibility, since the negative productivity effects of temporary work may be due both to dynamic effects on innovative activity and technical change²⁴, and to static effects deriving from an employment increase.

Cappellari, Dell'Aringa and Leonardi (2012) investigate the effects of the reform which in 2001 deregulated temporary contracts²⁵, using data for 13000

²³ Their findings are the empirical complement to a theoretical model on the effects of asymmetric reforms of employment protection which liberalize the use of temporary contracts without changing the employment protection regimes for workers hired with permanent contracts.

²⁴ This is the interpretation of the authors.

²⁵ Decree Law 368/2001. The paper also studies the effects of the reform of apprenticeship,

private firms over the period 2004-2007. Since the reform was implemented at different times in different industries and different regions, the authors can exploit regional and industry variability in the exposure of firms to the reform and identify the differential effects of the reform by means of a difference in difference approach. The analysis controls for region, sector and time fixed effects, therefore excluding the influence of other sector specific effects, and excludes reverse causality by showing that there are no differences in the trends of temporary work and productivity between exposed firms and control firms. The results show that the deregulation of temporary contracts did not have the expected effects, but induced substitution of temporary workers with external staff, which reduced the productivity levels of treated firms with respect to controls. Capital intensity was also reduced, which further contributed to the relative productivity decline²⁶.

Addressi (2014) estimates the simultaneous effects of the composition of labor contracts on labor productivity and TFP on micro data for 1866 manufacturing firms' over the period 2001-2003. He uses a structural approach²⁷ to estimate a production function where temporary and permanent workers are perfect substitutes, but may have different productivities, and where TFP follows a controlled Markov process which may be influenced by the share of permanent contracts on total contracts²⁸. The estimates, which control for other specific firms' and workers' characteristics²⁹, suggest that the share of permanent contracts on total contracts has a positive effect on TFP dynamics³⁰, while there is no robust evidence of a significant difference in the marginal returns of temporary and permanent labor³¹. The results are in line with the

introduced in 2003 (Law 30/2003).

²⁶ On the other hand the reform of apprenticeship contracts has induced the substitution of temporary and external staff with apprentices, with globally positive productivity effects.

²⁷ A la Olley and Pakes (1996).

²⁸ The form of the production function is:

$$y_t = e^{\omega_t} K_t^\alpha (P_t + sT_t)^\beta \quad \text{and} \quad \omega_t = g(\omega_{t-1}) + \gamma \left(\frac{P_{t-1}}{P_{t-1} + T_{t-1}} \right),$$

where P and T are permanent and temporary workers. The parameter $s > 0$ is a measure of the relative productivity of temporary workers.

²⁹ Workers' education level and participation in training courses, Pavitt's taxonomy, dummy variables for firms which declare to be financially constrained, engagement in R&D and innovation activity, whether the firm has never employed temporary contracts or temporary external staff.

³⁰ The estimate of parameter γ is positive and significant.

³¹ The estimate of parameter s or the production function is not significantly different from 1, so that, given the form of the production function, marginal products of permanent and temporary workers are the same.

predictions of the theoretical models which suggests that long term labor relations promote trust and foster technological change and innovation, possibly through the accumulation of tacit knowledge, but this interpretation, again, cannot be taken for granted, as the results tell us nothing about the channels through which permanent contracts affect TFP.

The negative relation between flexibility and productivity growth and levels found by the microeconomic studies, is confirmed by the macroeconomic analysis at the sector level conducted by Jona Lasinio and Vallanti (2013). The authors use panel data for 18 industries over the period 1980-2008 to investigate the effect on labor productivity growth (and levels) of deregulation of temporary contracts (measured by an index of employment protection for temporary contracts), as well as of the wage bargaining regime (measured by an index of centralization/decentralization and an index of the degree of coordination among employers and unions). A difference in difference technique is used, exploiting the fact that reform-induced flexibility may have a different impact according to industry characteristics; in particular, the impact of higher flexibility may differ across sectors according to the characteristics of the human capital they use (high skill or low skill), or to their “intrinsic flexibility need”. The results, which control for both industry and time fixed effects, show that deregulation of temporary contracts negatively affects labor productivity growth (and levels)³² both because it reduces productivity in each sector (intra-sector effect) and because it tends to increase the share of employment of sectors with lower productivity and productivity dynamics (inter industry effect). The negative intra sector effect is smaller in sectors with high skill human capital (which is not surprising, since one expects that firms in these sectors use temporary contracts mainly to select workers) and stronger in sectors with higher intrinsic reallocation needs (which again is expected, since in this case temporary work allows flexibility in case of negative shocks, reduces adjustment costs and implies a substitution between temporary and permanent labor, and between labor and capital). Industries with a low share of skilled workers have experienced both a stronger negative effect on productivity growth (and levels) rates and higher employment growth as a result of deregulation of temporary contracts. This has determined an increase of the weight of sectors with low productivity dynamics, and a further negative impact on aggregate productivity growth. As to the effects of the wage bargaining framework, decentralization appears to increase labor productivity in sectors with high skill human capital and in sectors with a lower intrinsic reallocation need, a finding which is at odds with the predictions of the standard incomplete contracts approach re-

³² The negative effect on the growth rate is found when the time sample is limited to the period 1992-2008 (excluding the period 1980-1992).

viewed in section 3.1 (which suggest that decentralization reduces innovation incentives by eroding the rents from innovation).

4.1.2 Evidence for other countries

A negative effect of flexible labor on productivity growth and levels in particular in the manufacturing and energy sectors is confirmed also for Spain, in the contribution of Marchante (2010), Dolado and Stucchi (2008) and Dolado et al. (2012). Ortega and Marchante (2010) investigate the impact of the increase of temporary employment on labor productivity growth over the period 1987-2000, using pooled sectoral data for 17 Spanish regions. For each of 6 private non agricultural sectors they estimate a production function model in first differences, where effective labor depends on the shares of permanent, temporary and self employed workers, and which includes variables capturing the intensity in the use of labor and capital inputs, which should control for the cyclical component of productivity growth. Instrumental variable estimation controls for possible endogeneity bias and measurement errors.³³ The results show that the use of temporary contracts for regular jobs has slowed down productivity growth in the manufacturing and energy industries, and that this has not been affected by compositional changes in activity over the period. Such effect is not found in low technology, low human capital industries like constructions and hospitality. A negative effect of higher shares of temporary jobs on TFP has been found by Dolado and Stucchi (2008) on microdata for a representative sample of Spanish manufacturing firms over the period 1991-2005. Both their non parametric tests of stochastic dominance and their parametric multivariate regressions controlling for other standard explanatory variables show that higher shares of temporary jobs tend to lower TFP for given conversion rates from temporary to permanent employment, and that higher conversion rates increase TFP for given shares of temporary jobs. Positive effects of conversion rates on TFP are confirmed by Dolado *et al.* (2012) who estimate a dynamic panel data model of TFP (using GMM system estimation method) using the same micro dataset. Their empirical analysis suggests that up to 20% of the decline of TFP in Spanish manufacturing firms between 1991 and 2005 may be explained by the reduction of conversion rates. The authors conjecture that the labor market reforms which have determined a gap in employment protection between permanent and temporary workers are the fundamental cause of such findings, but such interpretation cannot be taken for granted. Moreover, both microeconomic studies reflect firm's behavior over

³³ Fixed effects are never mentioned in the paper considered, but in the model framework first differencing would get rid of any fixed region specific effect. Time effects are not considered either.

a long sample period characterized by different conditions of the business cycle³⁴, which suggests caution in drawing strong conclusions.

Evidence on positive productivity effects of wage compression has been found for Sweden in the contribution by Hibbs and Locking (2000). The authors use industry data over the period 1964-1993 and plant data over the period 1972-1993, to estimate wage dispersion-augmented production functions, and the derived wage dispersion-augmented labor productivity functions. The first part of the sample period, from the '60s to the '80s, was characterized by centralized solidarity bargaining and low wage dispersion, while in the '80's centralization broke down and the subsequent period was characterized by a substantial de-compression of wages. The results of the estimates, which appropriately control for multiple period shift in trend, show that within sector and within industry wage dispersion have a negative effect on labor productivity growth. This corroborates the predictions of models underlying the role of wage compression as an incentive to firms' investment in general training and as an incentive to human capital accumulation on the part of workers. Between industry wage dispersion, on the other hand positively affects labor productivity growth, which is expected if one thinks that wage differentials tend to expedite the flow of labor and capital resources from less to more efficient activities.

Mixed effects of numerical flexibility have been found by two papers focusing on the US and the German experience respectively.

Autor et al. (2007) analyze the effects of dismissal protection³⁵ on US micro data at the establishment level over the period 1970-1999. They find that, as expected, dismissal protection reduces employment flows and firm entry rates. Moreover they find evidence of capital and skill deepening³⁶ and of a decline in TFP following the introduction of dismissal protection, which would suggest a reduction in productive efficiency. At the same time, however, there is evidence of a strong growth in employment following the introduction of dismissal protection, which leads the authors to consider their results tentative, albeit suggestive. The usual caveat about drawing strong conclusions from microeconomic studies which analyze firms' behavior over sample periods characterized by different conditions of the business cycle applies.

Non linear effects of the share of temporary agency work on labor productivity levels have been found for Germany by Hirsch and Mueller (2012).

³⁴ This problem might partly have been mitigated, although not eliminated, by the inclusion in both studies of a dummy variable for firms perception of whether they face an expansive or recessive market among the explanatory variables.

³⁵ As measured by wrongful-discharge protection by US state courts.

³⁶ The firms increased investment and increased non production worker employment

Using a big panel of over 25.000 observations on over 6000 plants in different sectors over the period 2003-2008, the authors find an inverse U relationship between the share of temporary agency work and the level of productivity. In plants which do not use temporary agency work and in plants which are heavy users of such contracts, productivity is significantly lower compared to moderate users. In interpreting the results the authors notice that most plants (87%) have a share of temporary work which implies positive effects. For plants which use high shares of temporary work, the productivity loss might of course be counterbalanced by a cost cut. However, the study by Nielen and Schiersch (2011) does not support such interpretation, since it finds a U-shaped relationship between total costs and the share of costs for temporary work.

The study by Arvanitis (2005) does not find any significant productivity effect of numerical flexibility on a sample of Swiss firms. In Switzerland, however, such form of flexibility has been used to a lesser extent with respect to forms of functional flexibility, which instead had a positive productivity effect.

4.1.3 Cross country evidence

Studies on cross section or panel data for different countries confirm a negative effect of wage flexibility and wage compression on productivity growth, while the results for different indicators of numerical flexibility are more varied.

As to wage flexibility, Vergeer and Kleinknecht (2010) estimate a positive relationship between wage growth and productivity growth on data for 19 OECD countries over 1960-1994. An increase of one percentage point of wage growth increases productivity growth in subsequent periods by 0,3-0,4 percentage points. The result must be considered with caution: the estimate reflects average experience of different countries and may hide marked individual differences; moreover the result may be caused either by a dynamic effect by which a slower wage growth slows down the adoption of labor saving technologies and the process of selection of more innovative and dynamic firms, or by a static effect linked to the employment of low productivity workers brought about by the reduction of minimum wages and social benefits. Kılıçaslan and Taymaz (2008) consider the effects of labor market regulation³⁷ and of inter-sector wage differentials on labor productivity levels in manufacturing using panel data for 44 countries³⁸ over the period 1965-1999. They find that countries with higher regulations on labor conditions and on wages have higher productivity levels; wage compression also determines higher productivity, through a process of

³⁷ As measured by indexes developed by the authors which reflect i) labor conditions and wages, ii) labor organization and social policy, iii) social and economic rights and iv) special measures.

³⁸ 24 advanced countries and 20 low income countries.

selection which reallocates resources towards more productive activities. This confirms both the findings at the microeconomic level underlined in the previous paragraph, and the theoretical hypothesis about the positive effects of wage compression on productivity growth.

Regarding numerical flexibility, Auer et al. (2005) analyze the link between average employment tenure and productivity growth on data for 6 major industries in 13 European countries over 1992-2002. Average employment tenure can be taken as a (negative) indicator of numerical flexibility, since it is influenced (besides by market conditions) by institutional factors such as collective bargaining or employment protection legislation, and higher labor market regulation tends to increase it. The authors find a significant positive link between average employment tenure and productivity growth. The relation seems to be slightly non linear: productivity growth increases for average job tenures up to 13,6 years and then slightly decreases for higher tenures. The estimates are repeated disaggregating employment tenure in three classes (lower than 1 year, higher than 10 years and higher than 20 years), and using the share of workers in each tenure class instead of average tenure. The result is in line with the previous one: productivity growth declines as the share of workers in the first and third class decreases, and increases as the share of the intermediate class increases.

Damiani and Pompei (2010) examine total factor productivity (TFP) growth differentials at the industry level in sixteen European countries over the period 1995-2005³⁹ to investigate, among others, the role of flexible labor contracts in explaining the big differentials across countries. The analysis shows that in labor intensive sectors, like the service sector, fixed term contracts have a negative effect on total factor productivity growth. Moreover, in sectors and countries where the share of fixed term contracts is significant, higher regulation of such contractual forms positively affects productivity growth.

Storm (2007) and Storm and Naastepad (2009) investigate the relationship between labor market institutions and productivity growth on data for 20 OECD countries over the period 1984-1997 and 1984-2004 respectively. The first result is that more “rigid”, i.e. highly regulated and coordinated, labor markets foster labor productivity growth in the long run. The data confirm the presence of significant differences in the nature of regulation across countries of the sample and, in line with other contributions in the literature, show that these characteristics tend to vary together, so that it is possible to distinguish among three different industrial relation systems: highly coordinated systems with high real wage growth (group 1), highly coordinated systems with low

³⁹ The EUKLEMS databased is used.

wage growth (group 2) and liberal system with low wage growth (group 3). Wage growth is higher in group 1 than in other groups, while countries of group 3 present marked differences in wage inequalities, average employment tenure, coordination of wage bargaining and employment protection with respect to other countries. The second finding, which confirms and reinforces the first, is that labor productivity growth is higher in countries with highly coordinated systems and high wage growth (group 1).

Two studies by Scarpetta and Tressel (2004) and Bassanini, Nunziata and Venn (2009) have focused on the productivity effects of employment protection. Scarpetta and Tressel (2004) investigate the effects of employment protection and of industrial relations regimes (measured by an index for the degree of corporatism) on TFP growth, using panel data for 17 manufacturing industries in 18 OECD countries over the period 1984-1998. Neither employment protection nor the index of corporatism have significant effects when considered on their own, but in models where only their interaction is introduced, it appears that in countries with an intermediate degree of corporatism employment protection is negatively related with TFP growth. In countries with high or low degree of corporatism, instead, employment protection does not seem to have any significant effect. The results of the study however are rather weak, and must be considered with caution: as labor market indicators do not vary between industries (and as their temporal variability is almost absent, especially for employment protection indexes), they are highly correlated with fixed effects for individual countries, which in fact are excluded from the regressions. One cannot tell, therefore, whether the effect registered for countries with intermediate coordination can be ascribed to the employment protection index or to other unobservable country fixed effects, i.e. the effects of a diversified system of country specific factors different from employment protection⁴⁰.

Bassanini, Nunziata and Venn (2009) start from the observation that whatever the effects of employment protection on TFP growth, they will tend to be different in different industries⁴¹, and assume that employment protection is more binding in industries where, in the absence of regulation, firms resort to firing in order to adapt the labor force to their changing needs with respect to industries where firms resort to internal labor market adjustments

⁴⁰ The authors neglect the fact that the employment protection index may capture the effect of the country dummies, and argue instead that the omission of the fixed effects (which reflect factors which may differ from employment protection regimes) might give rise to omitted variables bias, which is however excluded by their statistical tests of correct specification. Their argument however is not convincing: if the employment protection index is a proxy of fixed effects, obviously fixed effects are not an omitted variable!

⁴¹ The same observation motivates the contribution by Bassanini and Venn (2007).

or to voluntary turnover. They use industry level data for OECD countries over 1982-2003 to perform a difference in difference analysis of the effects of employment protection indexes (both for regular workers and for temporary contracts) on total factor productivity growth in industries in which employment protection is binding (those with high firing propensity) with respect to industries in which it is not binding (industries with low firing propensity)⁴². The results show that higher employment protection reduces average TFP growth in industries where employment protection is binding with respect to other industries. The differential effect appears to be entirely due to regulation of permanent contracts, while regulation on the use of temporary work has no significant and robust effects. On the other hand there is no evidence that different employment protection regimes influence the adoption of better technologies or catching up with respect to the industry productivity frontier⁴³.

To sum up, all studies focusing on wage flexibility and wage compression, both on macroeconomic cross country data and microeconomic data for single countries, consistently find a negative effect of wage flexibility and positive effect of wage compression on productivity and TFP growth. Similarly, coordinated bargaining systems with high wage growth experience higher productivity growth rates. These findings do not support the predictions of incomplete contract models where high wage growth and coordinated bargaining erode rents from innovative activity and reduce innovation incentives and productivity growth. Instead they are in line with the predictions of models where more aggressive bargaining and high wage growth induce dynamic substitution effects, induced technical change and selection of more innovative and dynamic firms, as well as with models underlying the role of wage compression and high wage growth as incentives to firms' investment in training and to human capital accumulation on the part of workers, or with efficiency wage models. This does not mean, however, that these models are verified: evidence of a direct negative relation between wage flexibility and productivity growth

⁴² The benchmark to classify an industry as one with high or low propensity to firing in the absence of regulation are the firing rates at the industry level in the US.

⁴³ Before Bassanini et al (2006), difference in difference analysis has been proposed by Micco and Pages (2006), who study the differential effects of employment protection regimes on industry data for industrial and developing countries. The idea in this case is that the effects of stricter employment protection, which increases firing costs, is more binding in industries that are more exposed to demand variability and to supply shocks. The results show that stricter employment protection significantly slows down turnover, with higher effects in intrinsically more volatile sectors. In sectors which are intrinsically more affected by firing costs, employment and value added decline relative to other sectors. The effects are driven by a reduction of net entry rates of new firms. Average employment of single plants, instead, is not affected in any significant way.

tells us nothing on the transmission mechanisms, and may well derive, for example, from static effects linked to employment changes.

As to numerical flexibility, the shares of temporary contracts are found to have unambiguous negative effects on labor productivity and on TFP growth (and levels) in all the micro and macro studies conducted for Italy and Spain, while only 3 studies for other countries (Germany, the US and Switzerland) find ambiguous effects or no significant effects. The result of a negative link is confirmed by cross country studies, which show that temporary contracts have a negative effect on TFP growth in labor intensive sectors, like the service sector. Various cross country studies and microeconomic studies for single countries also suggest that higher protection of temporary contracts may positively affect both productivity growth rates and productivity levels, while only one cross country study suggests that employment protection for permanent workers may reduce productivity growth in industries where employment protection is binding relative to other industries. The findings of a negative effect of temporary contracts and of their deregulation on productivity and TFP growth (and levels) are in line with the predictions of models emphasizing the effects of numerical flexibility on human capital accumulation by workers and investment in training by firms, or of models where labor stability promotes trust, cooperative labor behavior and accumulation of tacit knowledge and where stricter labor regulation selects the most efficient and dynamic firms, as well as of models emphasizing the effect of fixed term contracts on the incentives to worker's effort. As before, the fact that evidence is in line with the predictions of these models does not mean that the models are verified, because this kind of evidence gives us no clue on the transmission mechanisms from flexibility to productivity.

Overall, the evidence so far presented suggests the prevalence of negative effects of wage flexibility and numerical flexibility on productivity growth and levels, but is not conclusive as to the importance of dynamic effects. The links between labor market flexibility and productivity growth are complex, and empirical work on the direct relationship between flexibility and productivity growth (or levels) does not allow to distinguish static from dynamic effects. To this end it is essential to analyze the results of empirical studies which have investigated the transmission mechanisms from flexibility to productivity growth, i.e. the effects of flexibility on the long run growth drivers: research and development and innovation, training and human capital accumulation.

4.2. THE TRANSMISSION MECHANISMS

4.2.1 *Effects on innovation*

The studies which investigate the effects of labor flexibility on innovation tend to find negative effects of wage and numerical flexibility (as well as positive effects of functional flexibility).

Michie and Sheehan-Quinn (2001, 2005) survey several hundred UK firms and use the resulting stratified sample of data⁴⁴ to estimate Probit models in which the probability of product and process innovation depends on a set of control variables including the use of flexible work, the type of industrial relations and the use of innovative human resource management practices. The results show that the use of progressive practices of human resource management, a low turnover rate and trade union density positively affect the overall probability of innovation as well as the probability of product and process innovation⁴⁵. As to the effects of numerical flexibility, the use of temporary and fixed term contracts is negatively related with process innovation as well as with the overall probability of innovation, but not with product innovation; part time work is negatively related with process innovation only⁴⁶. The relation between flexibility and innovation is obviously complex, but what emerges clearly from the study is the absence of any evidence that the kind of flexibility resulting from labor market deregulation has a positive effect on innovation: there are instead many indications that the opposite holds.

Negative effects of numerical flexibility and wage flexibility on innovation also emerge for the Italian case in the contributions by Pieroni and Pompei (2008) and Giannetti and Madia (2013).

Pieroni and Pompei (2008) estimate the effect of gross job turnover⁴⁷ (as a proxy of numerical flexibility) and of blue collar and white collar wages on patents per capita in Italian manufacturing industries, using data for 10 sectors at the regional level over the period 1990-1996. Dynamic panel models are estimated in a GMM framework, properly controlling for the effects of the business cycle as well as for the technological and geographical context. Wage levels turn out to be unambiguously positively associated to the number of patents per capita. Gross turnover is not significant for the whole geo-

⁴⁴ Only firms with over 50 employees were selected. Stratification included two dimensions: organization size and the primary sector of business activity. The final sample size is 200 firms.

⁴⁵ Functional flexibility is also positively related to short term financial performance of the firms.

⁴⁶ Numerical flexibility is always positively linked to short term financial performances of the firm.

⁴⁷ Defined as the sum of job creation and job destruction at the firm level.

graphical sample, but has a negative effect on patent activity both in the sample of Northwestern and Northeastern regions, where innovation activity is widespread and patent activity more significant.

Giannetti and Madia (2013) analyze the effects of numerical flexibility (as well as functional flexibility) on innovation activity in a microeconomic study at the firm's level. Their data comprises a representative sample of over 2000 manufacturing firms observed over 1998-2000 and 2001-2003⁴⁸. Numerical flexibility is measured by the shares of full time temporary workers, of workers hired on a temporary basis to collaborate to a project, of temporary agency work, of young low wage workers hired with apprenticeship contracts and by the turnover rate. Functional flexibility is measured by the share of part time workers and by the share of employees that received training. The authors estimate the effects of flexibility on the overall probability to innovate and on innovation intensity (as measured by the share of innovative sales on total sales), controlling for a set of other variables which may affect innovation⁴⁹, as well as for possible endogeneity. All forms of functional flexibility have a positive effect both on the probability of innovation and on innovation intensity, whereas the results for numerical flexibility are more varied. Turnover negatively affects innovation intensity only in high tech firms, and no significant effect is found for temporary work and external agency work⁵⁰; apprenticeship contracts, on the other hand have a positive effect both on innovation intensity and the probability of innovation for all firms⁵¹.

A study for the Netherlands by Zhou *et al.* (2011), investigates the effects of different forms of functional and numerical flexibility on product innovation using a panel of over 1000 firms observed during the period 1993-2001. The authors use different econometric models, and their estimates control for human capital quality, R&D intensity, firm's age and size, export intensity and sector average of innovative product sales. The results suggest that firms with an higher share of temporary contracts tend to have higher sales of imitative products, new to the firm, but lower sales of innovative products, new to the market. Functional flexibility and investment in training increase the sales of innovative products.

⁴⁸ Data are from the 8th and 9th wave of the Unicredit-Capitalia survey on manufacturing firms.

⁴⁹ Such as R&D expenditure, fixed capital per worker, the sectoral and geographical dimension, age and size of the firm, the presence of international agreements, the degree of international competition, the purchase and sale of patents. These variables are considered exogenous, and their relations with flexibility are not investigated.

⁵⁰ But the sign of the estimated coefficient is negative.

⁵¹ Which confirms the results of Cappellari *et al.* (2012).

In a study on 13 OECD countries over the '90s, Gust and Marquez (2004) investigate the effects of the OECD index of employment protection and of two other indexes of overall regulatory burdens on the adoption of information technology (IT) in the manufacturing sector. In estimates where employment protection is the only regulation index, a negative effect on IT spending is detected, but the result disappears when controlling for endogeneity. Similarly, the employment protection index is not significant in specifications which include one or both the indexes of regulatory burdens, whatever the estimation method. Also the indexes of regulatory burdens are never significant, and the only weak indication of a possible relation between labor market regulation, administrative regulation and IT spending comes from a statistical test of joint significance which suggests that, despite none of the regulation indexes is individually significant, one cannot exclude the significance of all regulation indexes taken together. Although the authors claim that their findings "support the view that burdensome regulatory environments, and in particular regulations affecting labor market practices have impeded the adoption of information technology..."⁵², such a clear-cut conclusion does not appear to be justified by the results.

Overall, apart for the positive effect of apprenticeship contracts, by which young workers are hired on a lower-wage basis in exchange for training on the job, there is no evidence of any other positive effect of flexible labor on innovation. Higher rigidities and firing costs or higher wages do not seem to curb innovation at the firm level: on the contrary, the empirical findings suggest the existence of at least some negative effect of all other forms of flexible labor on innovation. More specifically: turnover is negatively linked to the probability of innovation⁵³, at least in high tech firms; similarly, in all but one study temporary work tends to have a negative effect on the overall probability of innovation and on the probability of process innovation, while the effects on product innovation are mixed⁵⁴; wage levels positively affect patents per capita, and union density has a positive effect on the probability of (overall, product and process) innovation.

⁵² Gust e Marquez, 2004, page 33.

⁵³ Both overall and process innovation. Mixed results emerge for product innovation.

⁵⁴ Temporary work does not affect product innovation in one study, but in a different study it negatively affects the sales of innovative products (new to the market) and positively affects the sales of imitative products (new to the firm).

4.2.2. *Effects on R&D activity*

Some contributions have investigated the effects of labor flexibility on Research and Development (R&D) activity.

Two cross country studies are Bassanini and Ernst (2001a) and Koeninger (2005). Bassanini and Ernst (2002a) analyze the effect of the interactions between labor market institutions and technological regimes on R&D intensity⁵⁵ using cross section data for 18 manufacturing industries in 18 countries. Labor market institutions are represented by coordination indexes and by employment protection indexes. Technological regimes are represented by a dummy distinguishing sectors in *Schumpeter mark I* sectors (“low tech” sectors, for simplicity), characterized by low specificity, low cumulativeness, large scope and accessibility of the knowledge base, and *Schumpeter mark II* sectors (“high tech” sectors, for simplicity), characterized by high specificity, high cumulativeness and low accessibility of the knowledge base⁵⁶. In the econometric model, R&D intensity depends on the interactions between the labor market institutions indicators and the technological regime dummy, as well as on a set of other potentially relevant variables (among which some indicators of product market regulation). The results show that, in countries with a high degree of coordination, R&D intensity increases in high tech sector relative to low tech sectors where employment protection is higher. This suggests that, as indicated by the theoretical literature, in Schumpeter Mark II industries high employment protection and coordinated industrial relation systems, by aligning firms and worker objectives, may stimulate firms’ investment in training of their labor force and accumulation of firm specific knowledge, with positive effects on innovation activity. The authors do not recognize that their results reflect a positive effect of stringent employment protection regimes for high tech industries in countries with high coordination. They argue instead that, as in high tech industries the chances of resorting to internal market adjustments are higher, and are encouraged by coordinated systems of industrial relations, firms in these sectors and systems are less sensitive to employment protection laws which hinder numerical adjustment on the external market. The argument is however unconvincing, since this would imply a non significant coefficient for the differential effects of employment protection regimes in high tech industries of coordinated countries, whereas the estimates are positive and highly significant.

⁵⁵ R&D intensity is defined as the ratio between R&D expenditures and sales.

⁵⁶ The scope of the knowledge base identifies the degree to which new knowledge is specific to a particular application or can be applied to various activities; the accessibility of the knowledge base refers to the opportunity to gain knowledge external to the firm.

Koeniger (2005) finds that, in a panel of OECD countries over the period 1973-1988, the relation between employment protection indexes and R&D intensity is positive when correctly considering both fixed effects and common time effects. When both time and fixed effects are omitted the relation is negative, and it is not significant when omitting time effects only.

The results of the cross country studies are broadly confirmed by studies focusing on firm level data for single countries.

Kleinknecht *et al.* (2014) use firm level data for 1987-1988 for the Netherlands to analyze the effects of the share of temporary contracts and the percentage of hours worked by external staff on R&D activity⁵⁷ in different technological regimes. The indicator of the technological regime is a measure of the degree of concentration of R&D budgets in an industry⁵⁸, used as a proxy for the extent to which an industry is Schumpeter I or Schumpeter II. The estimations of their Logit models⁵⁹ show that external agency work has no significant effects on R&D, while the temporary work has significantly negative effects; in models introducing also the interaction between the share of temporary work and the index measuring the degree of concentration of R&D budgets in an industry, the coefficient on temporary work loses significance, while that of the interaction is significantly negative, indicating that it is the mix of high concentration of R&D in a sector (proxy for a Schumpeter II technological regime) and high shares of temporary contracts that determines a strongly negative impact on the probability that a firm would engage in R&D. When splitting the sample in two technological regimes (Schumpeter I and II) the results are confirmed: the coefficient of temporary work is negative and significant only for firms in Schumpeter II industries).⁶⁰

Serrano and Altuzarra (2010) test for the existence of non linearity in the relation between the share of temporary contracts on total employment and on dichotomous indicators of R&D activity and innovation, using micro data for Spanish manufacturing firms over 2000-2002. The estimates of their random effects Logit models, which also control for size, industry, foreign capital and geographical markets, detect no significant effects of the share of temporary contracts (and its square) on the probability that the firms engage in R&D or innovation, even if the sign of the estimated coefficients are compatible with

⁵⁷ Measured by dummies specifying whether or not the firm engages in R&D, and whether the firm describes R&D activity as permanent or occasional.

⁵⁸ The Herfindahl-Hirschman index.

⁵⁹ Which also control for firm size and ages, dummies for firm reorganization or mergers and acquisitions

⁶⁰ The coefficient is not significant for the Schumpeter 1 group.

an inverted-U shape relationship. In light of the results in Kleinknecht *et al.* (2014), the inconclusive results in Serrano and Altuzarra (2010) might depend on the fact that the authors did not allow for differential effects of temporary work in different technological regimes.

Di Cintio and Grassi (2012) study the effects of uncertainty and of flexible labor relations on R&D expenditure on micro data on Italian manufacturing firms over the period 2001-2003. Their Tobit models control for uncertainty⁶¹, the share of temporary labor contracts and its square, the interaction between uncertainty and temporary contracts, and a set of other relevant variables potentially influencing R&D expenditure⁶². The results show that uncertainty negatively affects R&D expenditure, and that such negative effect is weakened by the share of fixed term contracts. On the other hand, the linear term of the share of fixed term contracts is never significantly different from zero, while its square is consistently negative and significant in all specifications. The authors interpret this result as evidence of a non monotonic impact of flexible labor contracts on R&D spending, but their interpretation is unwarranted. Since the estimated coefficient of the linear term of temporary contracts is always zero and that of the square term is always negative, there is no evidence of non a non monotonic impact: R&D expenditure seems instead to be a monotone decreasing function of temporary contracts.

Addessi *et al.* (2014) focus on the possible reverse causality link between innovation and flexibility, and investigate the effects of R&D and of innovation activity on the choice to resort to numerical flexibility (temporary labor contracts), and on the choice of the share of temporary work on total employment. The empirical analysis (conducted on micro data on Italian manufacturing firms over the period 2001-2003) finds no significant link between internal R&D activity and the use of flexible contracts, while a positive link emerges between external R&D activity and flexible work. The rationale for the result may be the presence of positive complementarity between R&D and long term contracts; if from one hand R&D activity is risky and may induce firms to use flexible labor in order to reduce firing costs, on the other hand when R&D is internal to the firm stable labor relations are preferred. As to innovation activity, product innovations seem to have a positive effect on the use of flexible contracts, while the effect is not significant for process innovation.

⁶¹ Measured by the standard deviation of past sales per employee normalized by the average sales per employee in firm's operating industry.

⁶² Including the variations in workers inflows and outflows rates, firm size, a dummy of whether the firm engaged in R&D in the previous period, past revenues and their square, a dummy for corporation, a geographical dummy, sectoral dummies, the share of executives, the share of high and low level white collars, the share of blue collars and investment in physical capital.

In sum: cross country studies detect a positive effect of EPL on R&D intensity, especially in “high tech” sectors of coordinated countries; microeconomic studies for single countries suggest that temporary contracts may weaken the negative effect of uncertainty on R&D expenditure, but they tend to have a direct negative effect on both the probability of engaging in R&D and on the level R&D expenditure, particularly in “high tech” sectors. There seems to be no reverse causality from internal R&D to the use of flexible contracts⁶³.

4.2.3. *Effects on firm sponsored training*

The effects of numerical flexibility on firm sponsored training is investigated by Arulampalam and Both (1998) for the UK and by Picchio and Van Ours (2011) for the Netherlands.

Arulampalam and Both (1998) use individual data from the British Household survey to explore the effects of the contract type (permanent or temporary), of part time employment and of union coverage on work related training of employees. The estimation sample includes 2982 men and 3117 women aged 18-55 and 3 time periods (1991-1993). The estimates of both a pooled Probit model controlling for a set of relevant individual characteristics and a random effect Probit model which also controls for unobserved individual effects, show that the probability of receiving work related training is significantly lower for workers with fixed term contracts, for part time workers as well as for workers which are not covered by a collective union agreement. A trade off therefore emerges between the expansion of flexible forms of employment and the expansion of the proportion of workers getting work-related training. Such tradeoff may reflect a negative effect of temporary work on training, but may derive from reverse causality as well⁶⁴. On the other hand, the fact that union presence is associated with higher work related training is certainly indicative of a causal effect in one direction only, and suggests that unions and firms tend to cooperate to exploit mutual gains in training provision, which reinforces the findings of Michie and Sheehan-Quinn (2001, 2005) on the positive effect of union density on firm’s probability of innovation.

Evidence of negative causal effects of temporary work on firm sponsored training are found by Picchio and van Ours (2011) for the Netherlands. Using employees’ longitudinal data the authors study the causal effect of holding a temporary job (rather than an open ended contract) on the probability of

⁶³ While a positive link exists between external R&D and the use of flexible work.

⁶⁴ For example Albert et al. (2005), focusing on Spanish data, find that temporary work contracts are less likely to be chosen by firms which invest in training of their employees, and are less likely to be chosen by workers to participate in firm sponsored training activities offered by firms.

receiving firm sponsored training, by means of dynamic panel data models which control for observed and unobserved heterogeneity as well as for feedbacks from shocks in the training status to the future chance of having a temporary or open ended job contract. The results unambiguously show that temporary workers are significantly less likely to receive firm sponsored training.

Overall, the existing evidence consistently shows that temporary work has a negative causal effect on firm sponsored training.

Given that firm sponsored training has been found to have a positive effect on labor productivity and on innovation at the firm level⁶⁵, the above evidence corroborates the existence of a negative transmission channel from temporary work to innovation and productivity growth working through firm sponsored training.

5. Conclusions

From a theoretical point of view, dynamic effects of labor market flexibility on productivity growth can be either positive or negative. Existing empirical evidence, however, has consistently underlined negative effects of different measures of numerical and wage flexibility on three fundamental drivers of long run growth: innovation, research and development and human capital accumulation through firm sponsored training.

Regarding innovation, apart for the positive effect of apprenticeship contracts, by which young workers are hired on a lower-wage basis in exchange for training on the job, no evidence of any other positive effect of flexible labor has been detected. On the contrary, all other measures of numerical and wage flexibility are found to have some negative effects: all studies find that turnover is negatively linked to the overall probability of innovation and the probability of process innovation⁶⁶, particularly in “high tech” firms; similarly, in all studies but one, the share of temporary contracts negatively affects the overall probability of innovation as well as the probability of process innovation⁶⁷; wage levels are found to exert a positive effect on patents per capita,

⁶⁵ Positive effects of firm sponsored training on innovation have been found on firm level data for Germany (Bauernschuster et al. (2009)) and Canada (Dostie (2010)). Positive effects of firm sponsored training on productivity has been found on firm level data for Belgium (Konings and Vanormelingen (2015)), the UK (Dearden *et al.*(2006)), Germany (Konings and Vanormelingen (2015) and Spain (Alba-Ramirez (1994))).

⁶⁶ Mixed results emerge for product innovation

⁶⁷ The effects on product innovation are instead mixed. Temporary work does not affect product innovation in one study, but in a different study it negatively affects the sales of innovative products (new to the market) and positively affects the sales of imitative products (new to the firm).

and union density is shown to have a positive effect on the overall probability of innovation as well as on the probability of product and process innovation.

As to Research and Development, microeconomic studies for single countries suggest that temporary contracts may weaken the negative effect of uncertainty on R&D expenditure, but they have a direct negative effect on both the probability of engaging in R&D and on the level of R&D expenditure, particularly in “high tech” sectors. Cross country studies on the other hand detect a positive effect of EPL on R&D intensity, especially in “high tech” sectors of coordinated countries.

Finally, regarding firm sponsored training, the existing empirical evidence consistently shows that the share of temporary work has a negative effect on firm sponsored – work related training, and on the other hand firm sponsored training has been found to have positive effects on the probability that the firms innovate, and on the productivity of their labor force.

Although further empirical research is certainly needed on the effects of wage and numerical flexibility not only on the above long run growth drivers, but especially on physical capital investment, the above evidence suggests that the tradeoff between wage and numerical flexibility measures and productivity growth (and TFP growth) which has been detected both within many European countries and across European countries is not just a temporary, static, short run effect linked to the employment change determined by flexibility enhancing reforms, but may also reflect a more worrying permanent, dynamic, long run phenomenon. The agenda is open for further research.

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