Preliminary draft

Is there a trade-off between labour flexibility and productivity growth? Preliminary evidence from Italian firms

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Abstract: Various theories suggest the existence of a negative relationship between external labour flexibility practices and productivity growth. In particular, the adoption of flexible arrangements may reduce the incentives to innovation and internal training (favouring firms which follow a 'low-road' to competitiveness), and lower workplace cooperation. This paper aims at investigating the occurrence of these effects in Italy, where the changes in labour legislation in the last ten years (alongside with an 'institutional' wage moderation period) have been accompanied by a considerable job creation process, but also by a significant labour productivity slowdown. Estimates of labour productivity equations at firm-level, using data from the 9th "Indagine sulle imprese manifatturiere" by Capitalia Bank (covering the period 2001-2003), provide a preliminary support to this hypothesis.

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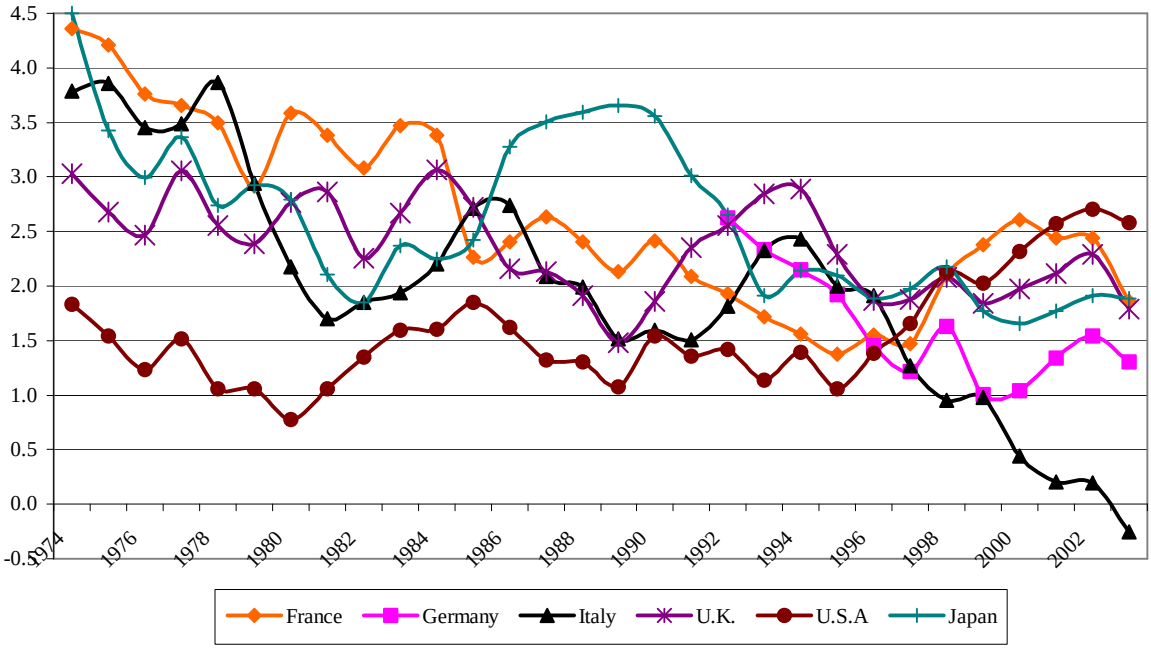
Introduction

Since the end of the 1990s, the Italian economy has been experiencing a serious slowdown of labour productivity growth, which started diverging from the trend of other industrialized countries (Figure 1) and has become even negative in the most recent years. Worryingly, this fact does not appear to be short-term or due to the negative economic cycle, but to ground on structural roots. In fact, various indicators (for example, the declining share in the world trade, the poor performances in terms of R&D spending and patenting activity) point at a general deterioration of Italy's competitive position, as recognized by some authors that started talking about "decline" (Faini and Sapir, 2005; Barca, 2005).

Figure 1. Growth of labour productivity per worked hour (in 2005 US dollars)



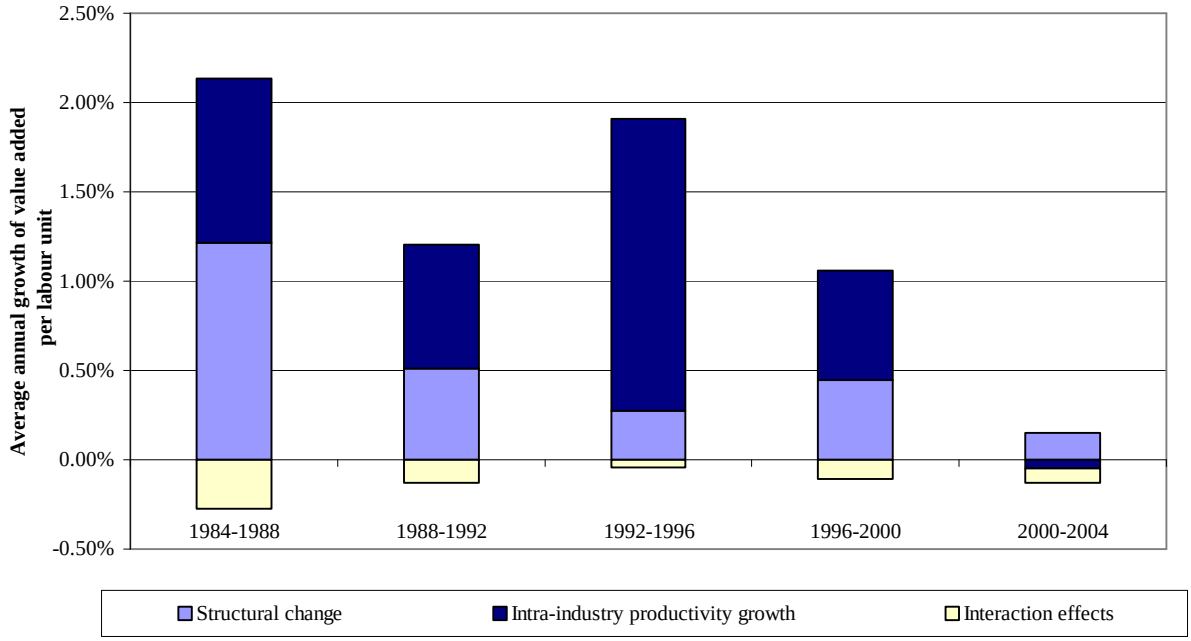
Source: Groningen Growth and Development Center. 5-years moving averages.

The anatomy of the productivity slowdown appears evident looking at Figure 2, where the average growth of value added per equivalent labour unit has been decomposed, following a shift-share procedure[2], into three components (labour productivity growth inside sectors, reallocation of labour force toward higher productivity industries, and a residual or "interaction" effect). It emerges that the average annual increase of labour productivity (the sum of the three components) slowed down from 1.9% in the period 1992-1996 to 0.9% in the

[2] For details, see Appendix A.

years 1996-2000, to virtually zero (0.02%) in the last interval, 2000-2004. Moreover, it seems important to notice that while the reallocation effect remained positive and did not change too much during the last three periods (due to a constant decrease of the manufacturing share, opposed to an increase of employment in services, which actually show a higher productivity *level*), the intra-industry component, which should reflect technological advance inside sectors, seems the most concerned by the slowdown and even exhibits a negative value in 2000-2004.

Figure 2. Decomposition of labour productivity growth (2-digit sectors, 1984-2004)



Source: own computation on Istat data. See Appendix A for details.

Surprisingly, this trend followed a decade of intense reforms in various fields, which suddenly shifted the Italian model from a "managed economy", where public intervention was pervasive, towards a "common sense" market model, aiming at increasing competition and efficiency by reducing rigidities both in labour and in goods markets. In particular, the labour market underwent radical transformations during this period. First of all, wage bargaining institutions went through a major change with the tripartite agreements occurred in 1992 and 1993, closing the period of wage indexation (*scala mobile*) which dated back to the mid 1970s. The new bargaining arrangements assigned to national labour contracts the only purpose to maintain the purchasing power of real wages, while the distribution of company-level productivity increases to workers was left to decentralized firm-level contracts (not

compulsory for firms, however). At the same time, an increase of labour flexibility was pursued through the laws 196/1997, 368/2001 and 30/2003, which, in different phases, deregulated the adoption of fixed-term contracts, allowed the activity of agency workers and introduced new "atypical" contractual arrangements.

In the mainstream view, decentralization of wage setting institutions and higher flexibility, both in the wage and the numeric dimension, were needed to face the unemployment crisis of the early 1990s, whose causes (according to the dominant paradigm of "supply-side" policies) were considered to be mainly structural. Undoubtedly, in the last ten years the conditions of the Italian labour market experienced a stiff improvement, with the unemployment rate decreasing from 11.2% in 1995 to 7.7% in 2005 and the employment rate increasing in the same period from 51.8% to 57.5% (however, still largely below the Lisbon target). Nonetheless, this improvement occurred at the expense of real wage growth: a phase of relevant wage moderation took place, in fact, since the change of the contractual arrangements, causing real wages to increase on average less than labour productivity and leading to a decline of the labour share on national income (Tronti, 2005). The magnitude of the wage restraint period appears significant also in an international comparison, where Italy ranks the last among industrialized countries for real wage growth during the decade 1992-2002 (Zenezini, 2004). On the other hand, it is important to observe that employment growth has been accompanied by an increased use of fixed-term and atypical jobs; in particular, the share of fixed-term employees over total employees (excluding free-lance workers and other 'atypical' typologies, which in the labour force survey are assimilated to self-employment) increased by five percentage points from 7.3% in 1995 to 12.3% in 2005[3].

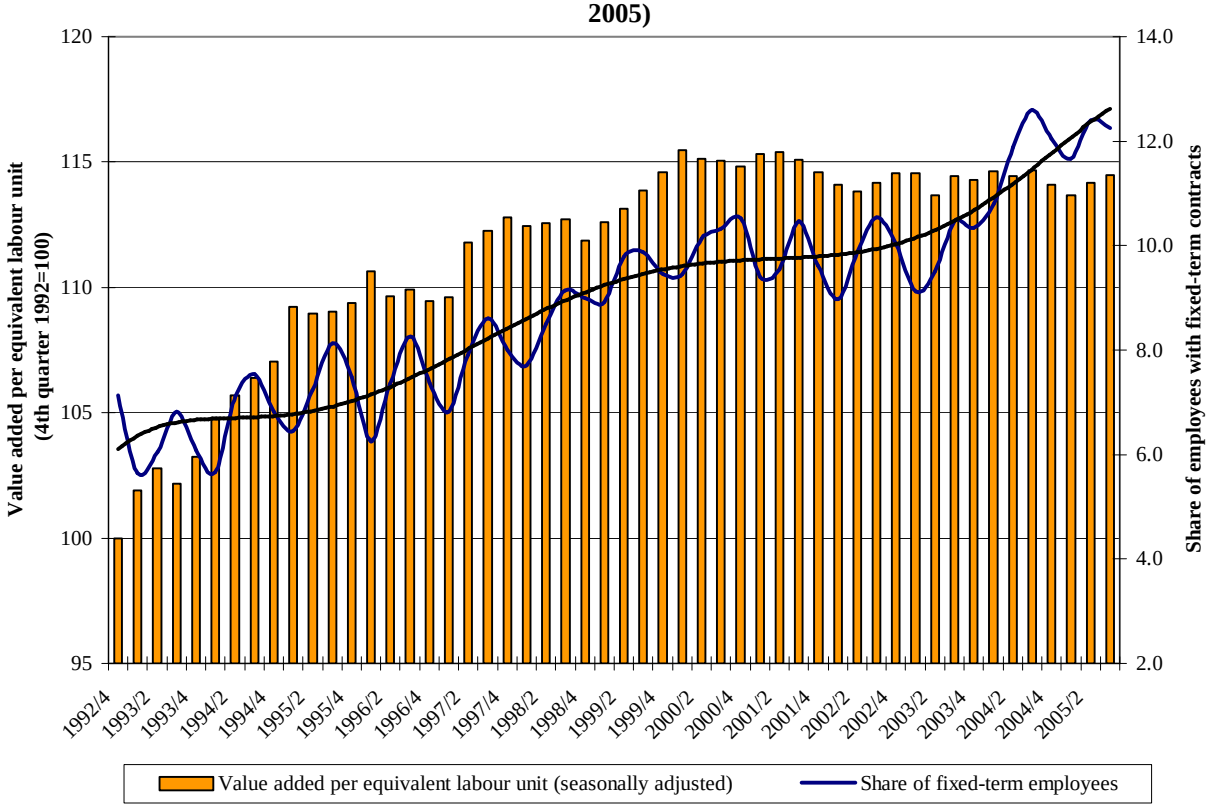
Wage moderation and external labour flexibility appear, therefore, to be among the main institutional changes occurred in the Italian labour market in the last fifteen years. However, if their role on the employment boost has been emphasized (on the quantitative size; conversely, the debate on the "quality" of the new jobs is still open), their impact on the productive system seems to have been neglected, both from a theoretical and from an empirical viewpoint. More generally, an exiguous or only indirect role has been usually attributed to the impact of labour market institutions on the adoption and diffusion of innovative technologies by firms, with subsequent effects on productivity growth[4].

[3] The values are not fully comparable due to a break in ISTAT labour force survey in 2004.
[4] An important exception concerns the impact of unions on economic performance, that was object of extensive studies during the 1980s.

In the present context, in particular, labour market reforms do not appear to be neutral with respect to the productivity slowdown. There are various theoretical arguments to hypothesize that the prolonged period of wage moderation and the increased numerical flexibility curbed the incentives of firms to innovate, while providing incentives to compete following "low road" practices, by cutting labour costs, maintaining low-productive jobs, and reducing the scope for training activities and high quality human resource management practices. Different elements also prove that these phenomena may be not only short-term (due, for example, to a static substitution, in the neoclassical sense, between capital and labour, without effects on technology), but may produce permanent effects.

Some first glance illustration of the potential trade-off between flexibility and productivity growth is given in Figures 3 and 4, where the correlation between the slowdown of labour productivity growth and the increased incidence of fixed-term contracts appears evident.

Figure 3. Evolution of labour productivity and share of fixed-term contracts (1992-2005)

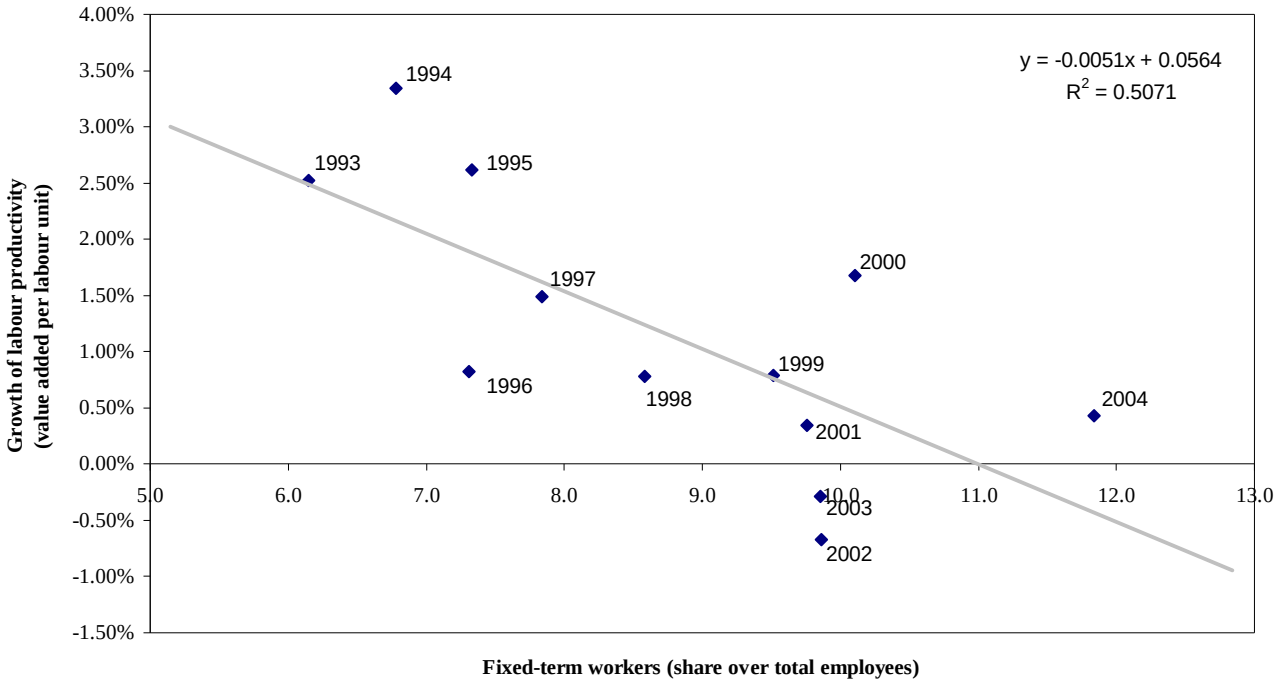


Source: Istat. (Note: a break in LFS series occurred in 2004).

Of course, a more complex analysis is needed in order to provide robust evidence about these events, and empirical testing using firm-level data appears the most adequate strategy in this context. This paper, therefore, presents results of productivity growth estimates using data

from the 9th "Indagine sulle imprese manifatturiere" by Capitalia Bank Research Centre (formerly Mediocredito Centrale), which covers the period 2001-2003, where "flexibility" indicators are included among the factors explaining labour productivity growth.

Figure 4. Labour productivity growth vs. share of fixed-term workers (1993-2004)



Source: Istat. (Note: a break in LFS series occurred in 2004).

The outline of the paper is as follows. In Section 1 I provide a theoretical background for the linkage between wage moderation, labour flexibility (specifying what I mean for these concepts), innovative activity and productivity growth. The dataset and the variables used for the empirical estimation are described in Section 2, while the model and the discussion of the results are presented in Section 3. A concluding section summarizes and sketches some directions for future research.

1. Theoretical background

Different theories point at the existence of a (negative) relationship between labour flexibility and wage moderation, on the one hand, and firm performance, as measured by labour productivity, on the other hand. Before going further, it is important to specify what we

intend with these concepts in this context. Various kinds and sources of 'labour flexibility' can be identified. In particular, it is common to divide labour flexibility practices into three categories (Beatson, 1995): 'numerical' (external) flexibility, which implies the scope for firms to easily adjust the number of employees in response to changes, and primarily depends on the strictness of legislation about hiring and firing, fixed-term contracts and working hours; 'functional' (internal) flexibility, which concerns the possibility of internal reorganization of the workforce, relying on internal training and the development of multi-skilled employees; 'wage' flexibility, which concerns the responsiveness of wages to external shocks (however, it is commonly perceived as "downward" flexibility), largely depending on the features of wage setting institutions.

The reforms occurred in Italy over the last fifteen years concerned respectively the first and the last of these aspects. However, if the increase of numerical (inward) flexibility is unambiguous, due to the effects of weaker regulation about fixed-term and part-time contracts and the introduction of "atypical" contracts, the issue of wage flexibility appears indeed more complex. In fact, even if the changes in wage setting institutions at the beginning of the 1990s gave more room to wage flexibility at the firm level, by explicitly providing for firm-level bargaining (not compulsory, however), what can be observed fifteen years later is rather a long period of generalized wage moderation (Zenezini, 2004; Tronti, 2005; Brandolini et al., 2005).

In effect, the introduction of second level bargaining had originally the purpose of distributing company-level productivity increases to workers (by paying wages higher than those set by national contracts), therefore allowing "upward" wage flexibility. However, decentralized bargaining remained largely unapplied (in particular among smaller firms), contributing to the wage restraint period; moreover, the Italian wage setting system still remains highly centralized (at least for the inflation compensation).

Another key explanation for wage moderation should be therefore acknowledged in the new attitude of industrial relations which, after a prolonged period of harsh conflicts, gradually became more cooperative since the beginning of the 1990s. The new industrial relations environment during the 1990s surely fostered wage moderation, by allowing a systematic underestimation of forecasted inflation, which is at the heart of the new bargaining system (Brandolini, et al., 2005): the slow growth of real wages was a direct consequence. Hence, wage moderation grounds on institutional roots, and only partly can be explained by the increased wage flexibility at firm level (Zenezini, 2004).

Once clarified these aspects, it seems important to specify that the remainder of the paper will focus on external flexibility and wage moderation as possible explanations for the poor productivity performance of Italian firms, by meaning with the latter a broader concept than wage flexibility[5]. There is not a bias in considering these two causes *a priori* positively correlated at the firm level: from a theoretical point of view, in fact, the correlation could take place in both directions. If temporary contracts are directed mainly to low-skilled or low-productivity workers, or provide for lower social security contributions on the firm side, then the increase of external flexibility will be indeed correlated with a reduction of firms' wage bill; however, an opposite case could occur if workers accepting a temporary job, *ceteris paribus*, are likely to demand higher wages in order to compensate the risk of not being hired at the end of the contract (compensating differentials theory). Nonetheless, empirical evidence from other countries (Segal and Sullivan, 1995; Sànchez and Toharia, 2000; Booth et al., 2002; McGinnity and Mertens, 2004; Addison and Surfield, 2005; Kleinknecht et al., 2006) and from Italy (Picchio, 2006) shows that fixed-term workers, on average, earn less than regular workers even after controlling for observed and unobserved personal characteristics. Moreover, preliminary evidence on Italian companies, presented in Appendix B, shows that the use of temporary workers seems to guarantee savings on the wage bill of firms.

On these bases, it seems possible to identify four major headings under which theories positing a direct or indirect effect of wage growth and labour flexibility on productivity growth could be classified. In particular, these four channels consider the effects on firms' innovative activity, internal training, workplace cooperation and on patterns of aggregate demand.

Under the first heading, according to Sylos Labini (1984, 1993, 1999), wage increases (in particular, with respect to the price of "machinery") may represent a major stimulus to adopt technological innovations saving labour both in absolute terms (by increasing workplace efficiency) and in relative terms (by dynamically substituting labour with capital[6]). This process is influenced by firms' market power, in particular by the capacity to transfer labour cost increases on prices, by means of mark-up pricing. In a competitive environment, therefore, the incentive for entrepreneurs to enhance labour productivity in order to preserve

[5] Functional flexibility has not been considered in this analysis due to the absence of information in the dataset used for the empirical estimation. However, different studies (Bassanini and Ernst, 2002; Michie and Sheenan, 2003; Kleinknecht et al., 2006) suggest that the linkage between functional flexibility and productivity growth may act with an opposite sign, i.e. providing a favourable environment for productivity increases.

[6] Note that the dynamic substitution between capital and labour, in this context, differs from the static substitution, with constant technology, implied by the neoclassical theory as a response to the relative variation in the prices of factors. The former, in fact, involves technological change incorporated in new capital goods (Sylos Labini, 1993).

their profit share will be higher. Bhaduri (2006) recently proposed a model of endogenous growth built on an analogous mechanism.

Moreover, in a Schumpeterian view, one could argue that high real wage growth and labour market rigidity may foster to a certain extent the process of *creative destruction* and favour the adoption of innovations by firms (Kleinknecht, 1998; Naastepad and Kleinknecht, 2004; Kleinknecht et al., 2006). In this view, innovative firms are supposed to compete better in a context of higher costs (both labour costs and adjustment costs due to stricter regulation); on the contrary, looser regulation and (downward) wage flexibility can be considered as a "grant" to low-productive firms, competing through "low-road" practices such as passive price strategies, to be achieved by cutting labour costs, and limited innovative activity (for "high road" and "low road" practices, Antonucci and Pianta, 2002 and Pianta, 2003). The outcomes from innovation are uncertain, while the gains in competitiveness coming from a cut in labour costs, both explicit (due to wage moderation) and implicit (due to the reduction of firing costs), are immediate and unquestionable, even if (presumably) short-termed. Therefore, slack labour market regulation may constitute an important incentive to entrepreneurs with a short time horizon to follow the "low road" path, preferring cost scrapping to innovation. Ramazzotti (2005) proposes a detailed analysis of different firm strategies and choices in this context.

The standard view on this point generally suggests an alternative position, according to which higher labour market rigidity could have negative effects on productivity, by reducing the reallocation process of labour "from old and declining sectors to new and dynamic ones" (Nickell and Layard, 1999). However, while such an effect could be detected at a higher level of aggregation, it is unlikely to be relevant when considering the performance of individual firms within a given sector. Some authors also argue that the adjustment costs following the adoption of a new technology may inhibit the innovative process itself (Scarpetta and Tressel, 2004); the same principle can also hold for wage dynamics, if decentralized unions appropriate the rents deriving from productivity gains (this is the classical hold-up problem; for literature surveys, Metcalf, 2003 and Menezes-Filho and Van Reenen, 2003). Nonetheless, the real occurrence of these effects strongly depends on the degree of centralization and coordination of wage setting actors, on the nature of industrial relations, on the possibility of internal reassignment of employees ('functional' flexibility) and on the scope for outsourcing. Moreover, even part of the neoclassical literature has proposed a positive relation between employment protection and innovative activity: for example, a model that explicitly links the

presence of firing costs to a higher scope for process innovation has been developed by Saint-Paul (2002).

Turning to the second heading, the impact of high labour flexibility on training and human capital accumulation appears quite straightforward. If labour relationships are expected to be short-lived, little incentives are provided for firms to invest both in general and in specific training of their workforce (an adequate pay-back period is needed by firms in order to recover the investment costs); conversely, also workers will be reluctant to acquire firm-specific skills if they do not feel a long-term commitment to their employers (Bélot et al., 2002). Similar lines of reasoning apply if we make the hypothesis that higher labour flexibility (in particular, along the wage dimension) reduces the compression of the wage structure (both within and between firms), which is one of the main causes for the provision of training by firms (Acemoglu and Pischke, 1999; Agell, 1999). The result of higher labour flexibility could be, therefore, an underprovision of on-the-job training, with potentially negative effects on productivity growth[7].

Empirical evidence of a correlation between fixed-term employment and lower probability of receiving work-related training has been provided for the UK by Arulampalam and Booth (1998) and Booth et al. (2002).

As for the effects of labour flexibility on productivity via workplace cooperation, a strand of the literature supports the idea of productivity-enhancing effects coming from 'high trust' or 'high road' human resources management practices, and from cooperative labour relations (Huselid, 1995; Buchele and Christiansen, 1999; Lorenz, 1999; Michie and Sheenan, 2001, 2003; Naastepad and Storm, 2005). According to these theories, higher on-the-job protection and subsequent cooperative relationships between management and employees may affect positively firm performance, encouraging innovative activity and promoting efficiency gains.

Finally, it is important to notice that wage moderation and labour flexibility may have negative effects on aggregate demand both directly and indirectly (for example, through increases of precautionary saving by employees on temporary jobs) and, through this channel, negatively affect labour productivity growth. Various theories, in fact, posit a direct relationship between demand growth, innovation and labour productivity growth, both in the context of dynamic increasing returns (via the so-called 'Verdoorn-Kaldor law') and in a *demand-pull* hypothesis for innovative activity (Schmookler, 1966; Brouwer and Kleinknecht, 1999).

[7] If technical progress has a skill-biased nature, there appears also to be a correspondence between insufficient incentives of firms for technological change and for skill acquisition under flexible arrangements.

A number of empirical analyses was performed with regard to the relationship between labour flexibility and productivity behaviour (both measured as labour productivity and TFP) or the innovative activity of firms. However, if the majority of them focuses on country or sectoral level (Buchele and Christiansen, 1999a, 1999b; Nickell and Layard, 1999; Bassanini and Ernst, 2002; Scarpetta and Tressel, 2004; Auer et al., 2005; Naastepad and Storm, 2005)[8], only few report firm-level evidence. In particular, Michie and Sheenan, (2001, 2003) studied the impact of various flexibility practices on innovation indicators for British firms, evidencing a negative effect of external flexibility and a positive effect of functional flexibility; similar results are found with reference to labour productivity growth by Dekker and Kleinknecht (2004) and Kleinknecht et al. (2006) for Dutch firms. Finally, Arvanitis (2005) found a positive relationship between functional flexibility and labour productivity for a sample of Swiss companies, but a not significant effect of external flexibility.

2. The data

The data used for the empirical analysis come from the 9th survey of the "Indagine sulle imprese manifatturiere" by Capitalia Bank Research Centre (formerly Mediocredito Centrale), which covers the period 2001-2003. The sample, which includes 4289 firms, is representative of Italian manufacturing companies with more than 10 employees; firms are selected according to a stratification method by industry, geographic area and firm size.

The survey provides information on different headings. In particular, it includes full information about workforce composition by contract type (full-time or part-time, permanent or temporary), hirings and lay-offs, sales, investments in fixed capital, R&D expenditure and other innovation indicators. Unfortunately, it does not contain information about working hours, while information about agency and free-lance workers are only provided for 2003, therefore they cannot be used for the analysis[9].

[8] Most of these studies observe a positive effect of employment protection (measured by the OECD index or other indicators) on productivity growth or innovation indicators. Auer et al. (2005) find a positive (though decreasing) relation between job stability, measured as average tenure, and labour productivity. The paper of Scarpetta and Tressel, however, verifies a negative effect of employment protection, mainly in countries with sectoral and uncoordinated wage bargaining. The distinction among different industrial relations models is also considered by Bassanini and Ernst (2002), who assert that EPL strictness is significantly correlated to technological specialization in countries with coordinated relations.

[9] At the moment, it has not been attempted a merge with the previous wave of the survey (which covers the period 1998-2000) because, given the high incidence of missing values in relevant variables in this survey, the number of firms with full information over the six year becomes remarkably low (around 350). This magnitude, however, is usual in other studies that combined two successive waves of the Capitalia survey for a panel

While in the previous surveys a subsample of firms was usually provided with full balance sheet information, these data for the 2001-2003 survey were not made available to me at the moment of the delivery. Therefore, I used the Bureau Van Dijk AIDA dataset (which contains balance sheet data for firms with turnover higher than 500,000 euros) to make an extraction of some variables necessary for the empirical analysis (in particular, value added and labour costs) and merged them to the Capitalia dataset using fiscal code as unique identifier. The number of firms with complete balance sheet data for the three years is 3351. As it appears evident from Table 1, this operation did not produce relevant modifications in the composition of the sample by size class, geographic area and sector (according to the Pavitt taxonomy). In particular, modest differences can only be observed in the geographic dimension, with a light over-representation of firms in the North-East (plus 2%) and an even smaller under-representation of Southern firms (minus 1.7%). Anyway, taking into account the presence of missing values in some of the variables of interest, the total number of firms furthermore reduces according to the different specifications of the model, until around 2,600 firms when using a full specification (see Section 3 for details).

Tab. 1. Percentage composition of the sample by size class, geographic area and sector (according to the Pavitt taxonomy)

	Full sample (n=4289)	**With balance sheets (n=3351)**
11-20 employees	20.9	20.2
21-50 employees	30.9	31.7
51-250 employees	37.0	37.1
251-500 employees	5.2	5.0
More than 500 employees	6.1	6.0
Total	**100.0**	**100.0**
North-West	35.9	35.3
North-East	30.1	32.1
Centre	17.6	18.0
South	16.4	14.7
Total	**100.0**	**100.0**
Traditional sectors	51.2	51.1
Scale sectors	17.6	17.5
Specialized supply	27.1	27.5
High technology	4.1	3.8
Total	**100.0**	**100.0**

analysis. Nonetheless, evidence from the long sample (also attempting some method for the treatment of missing data) is supposed to be a future step of the research.

In order to estimate productivity regressions, monetary variables have been standardized by the number of employees (value added, investments, labour costs) or by the amount of sales (R&D expenditure) and deflated using the appropriate price deflators[10]. Moreover, two labour flexibility indicators (share of fixed-term contracts and total labour turnover) have been created. Variables have been cleaned from extreme and unreliable values by using a trimming procedure, excluding observations falling out the first and last 0.5 percentiles (working on the Capitalia survey, an analogous method has been used, for example, by Parisi et al., 2005 and Benfratello et al., 2005). A complete list of the variables, with detailed information and descriptive statistics is reported in Appendix.

3. The model

The approach used for the estimation of productivity equations is a modification of Sylos Labini's (1984, 1993, 1999) equations for the determinants of labour productivity growth, adapted to the use with microdata and amended with the inclusion of variables not considered in the original model (in particular, with two indicators of external labour flexibility). Differently from models based on the production function, Sylos Labini explained productivity growth by means of three components. Specifically, productivity increases depend on the variation of wages relative to the price of investment goods ('Ricardo effect'), on the growth of aggregate demand, in order to verify the occurrence of dynamic increasing returns ('Smith effect', corresponding to the Verdoorn law) and on investment expenditure, in order to consider the impact of new technology incorporated in new fixed capital and not captured by the other factors. The model was estimated (at macro level) with different lag structures to consider delayed effects of the explicative variables on productivity growth.

The application of this model to microdata offers three sorts of considerations. First of all, monetary variables need to be standardized in order to take firm dimension into account (as explained in section 2). Second, the absence of information about working hours constrains to use value added per employee (and not per worked hour, as it could be suitable) as a measure of labour productivity[11]. Third, and most important, right-hand variables present a relevant

[10] Alternative specifications of the model without deflating variables do not change the results significantly.

[11] This limitation would be heavier if trying to explain the determinants of labour productivity *level*, instead of the *variations*. However, some attempts to keep into account the number of part-time employees in measuring labour productivity (e.g. considering a part-time worker as a half full-time) did not produce relevant changes in

degree of endogeneity, which appears to be critical for wages (at least theoretically, since in Italy productivity-related wage increases appear to be limited and are likely to occur only in medium-large firms). At the moment, considering the shortness of the panel (three periods are available, but only two observations per firms remain when taking year-to-year variations for value added per employee), the solution chosen to minimize endogeneity problems has been to simply carry out OLS cross-section regressions for productivity growth in the period 2001-2003 using lagged values (taken in 2001) of the regressors. This solution appears to be valid in the absence of autocorrelation of the residuals inside units, which, however, cannot be tested in a cross-section framework. Moreover, this approach consents to partially control for the volatility of labour productivity at the firm level (labour hoarding is likely to appear in this context, since firms are not able or not willing to adjust their labour force in the short term), by considering a longer three-years variation (2001-2003) for productivity. It also allows to account for a lag before effects of right-hand variables on productivity growth become observable.

However, a longer panel would allow to control more easily for endogeneity (by using lagged variables as instruments) and for unobserved heterogeneity, which is not possible in this context. Unfortunately, as specified in section 2, merging two waves of the Capitalia survey in order to have a six periods panel dramatically diminishes the number of observations, due to the high incidence of missing data in the 1998-2000 sample. Anyway, a future step of this work will focus on the longer sample, in order to use more sophisticated panel methodologies.

The empirical specification of the model modifies Sylos Labini's original equation by taking into consideration different aspects. First of all, the initial level of value added per employee has been included among the regressors, in order to allow for technological catch-up among firms[12]. As for the 'cost-driven' increases of productivity, at the moment it has not been constructed an index of wages relative to the price of investment goods, while it has been used an indicator of real labour costs per employee[13]. In order to avoid endogeneity

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the coefficient estimates. Therefore, in order to avoid too demanding assumptions, the straightforward indicator of value added per employee has been used for the estimations.

[12] The inclusion of lagged productivity, which always results highly significant, probably allows to control also for the (unobserved) variation in the utilisation of productive capacity during the period. This consideration can be easily explained. If a firm, for instance, shows an abnormally low (or high) productivity level at the begin of the period for transitory reasons (e.g. restructuring, temporary difficulties, etc.), and then turns to its "normal" level, one could erroneously infer that its productivity has strongly increased (decreased), while the variation has been mainly induced by the fluctuation in the utilisation of its productive capacity. The inclusion of lagged productivity, at least theoretically, could allow to control for this phenomenon.

[13] Sylos Labini (1984, 1993) considers both indicators in the theory, while excluding one of them in the empirical analysis due to their high collinearity.

problems, two strategies have been adopted, namely to consider alternatively the lagged (2001) level of real labour costs per employee or its variation (taken from balance sheet data) in the period 1998-2000. For what concerns 'demand-driven' effects on productivity growth, the growth of sectoral value added at 2-digit level (taken from ISTAT national accounts) has been included, in order to consider the effects on firm of markets expansion[14]. Estimations have been conducted with or without this variable, excluding industry dummies in the former case to avoid collinearity problems. As for the 'investment-driven' effects on productivity growth, investments in equipment and machinery per employee have been considered. The baseline model has been completed by including R&D expenditure over sales as an indicator of innovative activity inside firms.

As for the specific purposes of this paper, two indicators of external labour flexibility have been considered among right-hand side variables, namely the share of employees under a temporary contract and a measure of total labour turnover (the sum of hirings and layoffs divided by the number of employees). Finally, dummies for industry, size class, geographic area and firm age have been included as controls.

The empirical specification of the model, therefore, is:

$$\Delta_{01-03} \ln \pi_{ijt} = \alpha + \beta_1 \ln \pi_{ijt-2} + X_{ijt-2} \mathrm{B}_2 + FLEX_{ijt-2} \mathrm{B}_3 + \beta_4 \Delta_{01-03} \ln Y_{jt} + D_i \Gamma + \varepsilon_{ijt},$$

where the growth of value added per employee between 2001 and 2003 in firm *i* belonging to sector *j* (measured as a logarithmic difference) is explained by the lagged level of (log) value added per employee, by a vector of lagged variables X_{ijt-2} (including investments per employee, R&D/sales and one of the two indicators for real labour costs per employee), by a vector of lagged flexibility indicators $FLEX_{ijt-2}$ (the share of employees under fixed-term contracts and the indicator of total turnover), by the growth of sectoral value added $\Delta_{01-03}\ln Y_{jt}$ (in alternative to industry dummies) and by a vector of firm-specific time-invariant dummies D_i. Robust standard errors have been calculated (the White/Koenker statistic always rejects the null of no heteroskedasticity).

In a second step, it has been allowed for heterogeneity in the flexibility coefficients, by making them interact with a dummy for firms performing R&D activity (as in Kleinknecht et

[14] This variable has been considered as exogenous, assuming as irrelevant the effect of the single firm's performance on industry value added. Of course, this could be false for larger firms and in more concentrated sectors. Nonetheless, all the specifications have been also estimated without this variable, in order to make a comparison possible.

Tab. 2. Determinants of labour productivity growth (value added per employee) between 2001 and 2003

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log value added per worker (2001)	-0.323***	-0.337***	-0.335***	-0.335***	-0.280***	-0.278***	-0.278***
	(0.026)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
Investment per worker (2001)	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log labour cost per worker (2001)	0.129***	0.149***	0.148***	0.143***	0.115***	0.113***	0.110***
	(0.035)	(0.037)	(0.038)	(0.038)	(0.036)	(0.037)	(0.037)
R&D/Sales (2001)		-0.033	-0.054	-0.012	0.256	0.221	0.271
		(0.419)	(0.406)	(0.420)	(0.434)	(0.421)	(0.435)
Share of employees with fixed-term contract (2001)		-0.178***		-0.159**	-0.159***		-0.138**
		(0.059)		(0.062)	(0.060)		(0.065)
Total labour turnover (2001)			-0.068**	-0.038		-0.068**	-0.040
			(0.032)	(0.033)		(0.032)	(0.035)
Growth of sectoral value added (2001-2003)					0.918***	0.901***	0.918***
					(0.112)	(0.112)	(0.113)
Size: 21-50 employees	0.021	0.012	0.014	0.013	0.011	0.013	0.012
	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)
Size: 51-250 employees	0.047***	0.041***	0.042***	0.042***	0.037**	0.038**	0.038**
	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Size: 251-500 employees	0.063**	0.059**	0.059**	0.059**	0.067**	0.066**	0.066**
	(0.027)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Size: more than 500 employees	0.113***	0.104***	0.106***	0.106***	0.110***	0.112***	0.112***
(reference: less than 21)	(0.028)	(0.036)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
Age: 25-40 years	-0.045***	-0.042***	-0.043***	-0.042***	-0.045***	-0.045***	-0.044***
	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Age: more than 40 years	-0.057***	-0.052***	-0.053***	-0.052***	-0.048***	-0.049***	-0.048***
(reference: less than 25)	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Constant	0.890***	0.857***	0.860***	0.874***	0.666***	0.667***	0.678***
	(0.094)	(0.100)	(0.101)	(0.102)	(0.081)	(0.081)	(0.082)
Sector dummies	Yes	Yes	Yes	Yes	No	No	No
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3017	2661	2654	2639	2661	2654	2639
F-test (p-value)	12.12 (0.00)	10.45 (0.00)	10.39 (0.00)	10.05 (0.00)	14.10 (0.00)	13.90 (0.00)	12.97 (0.00)
White/Koenker (p-value)	94.31 (0.00)	82.43 (0.00)	84.64 (0.00)	82.86 (0.00)	62.54 (0.00)	64.51 (0.00)	63.02 (0.00)
R-squared	0.18	0.19	0.19	0.19	0.14	0.13	0.13

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

Tab. 3. Determinants of labour productivity growth (value added per employee) between 2001 and 2003.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log value added per worker (2001)	-0.303***	-0.314***	-0.312***	-0.316***	-0.274***	-0.272***	-0.275***
	(0.024)	(0.026)	(0.027)	(0.027)	(0.025)	(0.026)	(0.026)
Investment per worker (2001)	0.002***	0.003***	0.002***	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Growth of labour cost per employee[1] (1998-2000)	0.033**	0.037***	0.035**	0.035**	0.030**	0.028*	0.028*
	(0.013)	(0.014)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)
R&D/Sales (2001)		0.276	0.276	0.294	0.604	0.599	0.610
		(0.440)	(0.433)	(0.441)	(0.456)	(0.448)	(0.457)
Share of employees with fixed-term contract (2001)		-0.271***		-0.248***	-0.231***		-0.207***
		(0.065)		(0.069)	(0.065)		(0.071)
Total labour turnover (2001)			-0.091**	-0.047		-0.087**	-0.048
			(0.038)	(0.039)		(0.037)	(0.039)
Growth of sectoral value added (2001-2003)					1.020***	0.907***	0.924***
					(0.100)	(0.124)	(0.125)
Size: 21-50 employees	0.006	-0.004	-0.001	-0.002	-0.002	0.001	-0.001
	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Size: 51-250 employees	0.048***	0.041**	0.041**	0.041**	0.035**	0.035**	0.035*
	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)	(0.018)	(0.018)
Size: 251-500 employees	0.045	0.040	0.039	0.041	0.048	0.048	0.048
	(0.041)	(0.042)	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)
Size: more than 500 employees	0.161***	0.134***	0.139***	0.137***	0.130***	0.135***	0.133***
(reference: less than 21)	(0.030)	(0.032)	(0.032)	(0.032)	(0.031)	(0.032)	(0.032)
Age: 25-40 years	-0.039**	-0.036**	-0.037**	-0.035*	-0.036*	-0.037**	-0.035*
	(0.017)	(0.018)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)
Age: more than 40 years	-0.046**	-0.041**	-0.043**	-0.041**	-0.032	-0.033	-0.032
(reference: less than 25)	(0.020)	(0.020)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Constant	1.018***	1.223***	1.054***	1.237***	0.925***	1.016***	1.027***
	(0.120)	(0.125)	(0.158)	(0.127)	(0.124)	(0.101)	(0.102)
Sector dummies	Yes	Yes	Yes	Yes	No	No	No
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2396	2153	2145	2135	2153	2145	2135
F-test (p-value)	9.18 (0.00)	7.84 (0.00)	7.72 (0.00)	7.58 (0.00)	11.35 (0.00)	11.13 (0.00)	10.51 (0.00)
White/Koenker (p-value)	83.25 (0.00)	85.80 (0.00)	88.04 (0.00)	85.24 (0.00)	73.24 (0.00)	75.20 (0.00)	72.91 (0.00)
R-squared	0.21	0.22	0.22	0.22	0.17	0.17	0.17

[1] From balance sheet data (AIDA). Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

al., 2006), in order to verify different response patterns to flexibility practices in innovating versus non-innovating firms[15]. In fact, it is possible to hypothesize that in innovative, more dynamic firms external flexibility does not necessarily configure a "low-road" practice. Indeed, for R&D firms more flexibility is likely to ease the acquisition of knowledge from the exterior, by facilitating the hiring of high-skilled workers (for whom mobility could not necessarily represent a "bad"), opposed to traditional firms where it appears to be essentially a mean to save on labour costs.

Several specifications of this model have been estimated. Table 2 shows the estimations outcomes using the *level* of real labour costs per employee among the regressors. The first column reports the coefficients of the baseline model, without R&D and flexibility indicators, in order to have a benchmark with the highest number of observations (more than 3000). As it is observable from Table 2, all the coefficients exhibit the expected sign and are strongly significant. In particular, there appears to be a negative effect of the initial productivity level, suggesting that firms ranking behind at the beginning of the period are actually growing faster, i.e. some catch-up process could be working. The effect of investments in fixed capital (expressed in thousands of euros, without taking logarithms in order to avoid the exclusion of not investing firms) is positive as expected, and so is the effect of the initial labour cost per employee. The latter evidence indicates that firms facing higher labour costs at the beginning of the period display, on average, a higher productivity growth, consistently with the theoretical considerations previously sketched.

As for the other controls, significant scale effects appear to be operating: firm size (over 50 employees) matters on labour productivity growth, with increasing magnitude along the firm dimension. There is also a strong evidence that younger firms (under 25 years old) perform significantly better than older ones, suggesting an (expected) higher dynamism in acquiring market shares opposed to the incumbents. Coefficients on regional dummies (4 macroareas) are never reported for their insignificance at the conventional levels, while industry controls (also not reported) show an outperforming result of refinery, chemical and pharmaceuticals, rubber and plastics products, and basic metal companies against the reference industry (food products).

[15] Different innovation indicators have been tested in order to include these interactions terms, in particular two dummies for firms declaring the introduction of process or product innovations during the reference period. However, the dummy for firms performing R&D activities appears to better discriminate between the coefficients under the two headings, maybe because it better reflects the attitude to continuous innovative activity inside firms.

The baseline model is then completed with R&D and flexibility indicators. As it is evident from Table 2, R&D expenditure over sales never shows a significantly positive effect on labour productivity growth. However, this could simply stem from a bad measurement of this variable (firms may include other kinds of expenditures into declared R&D or, on the contrary, add some R&D expenditures into current accounting), or from the fact that higher R&D expenditure by itself does not necessarily imply the adoption of innovative processes or products (i.e. 'successful' R&D).

For what concerns labour flexibility variables, on the other hand, the estimates show that both the incidence of fixed-term contracts and total labour turnover, when taken separately, are negatively (and significantly) correlated with productivity growth. However, when both variables are included, the effect of fixed-term share seems to dominate that of labour turnover, which becomes insignificant, although this effect could be explained by the high level of correlation among the two variables (rho=0.37)[16]. This evidence, therefore, provides some support for the hypothesis of a trade-off between *external* flexibility and productivity growth at the firm level.

Going further, the model is re-estimated replacing industry dummies with the growth of sectoral value added (the last three columns of Table 2). The coefficients estimates suggest a very strong (almost one-to-one) effect of market expansion on firm-level productivity dynamics, providing evidence for what Sylos Labini (1984, 1993) called 'Smith effect', meaning the existence of dynamic increasing returns in manufacturing, according to the Verdoorn law. Anyway, some considerations suggest caution about the magnitude of this coefficient, which could be biased due to endogeneity, or simply capture short-term variations in the degree of utilisation of productive capacity (testing the hypothesis of dynamic increasing returns probably needs a longer time dimension). This consideration holds, in particular, when considering the modest growth of value added in the 2001-2003 period. Moreover, the inclusion of sectoral demand growth does not affect the estimates concerning the other variables, inducing only a slight reduction in the size of the coefficients on lagged productivity and labour cost per employee; the R&D coefficients become positive, yet not significant (this is probably due to the removal of industry dummies, given the high specificity of R&D expenditure by sectors).

Table 3 shows the estimation of the same regressions using past growth of labour cost per employee (in the period 1998-2000) among the right-hand side variables in place of its level

[16] This consideration suggests the creation of a comprehensive flexibility indicator as a future direction of the analysis.

Tab. 4. Determinants of labour productivity growth (value added per employee) between 2001 and 2003, with interaction terms.

	(1)	(2)	(3)	(4)	(5)	(6)
Log value added per worker (2001)	-0.337***	-0.336***	-0.335***	-0.280***	-0.278***	-0.278***
	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
Investment per worker (2001)	0.003***	0.003***	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log labour cost per worker (2001)	0.149***	0.148***	0.143***	0.115***	0.113***	0.109***
	(0.037)	(0.038)	(0.038)	(0.036)	(0.037)	(0.037)
R&D/Sales (2001)	-0.097	-0.164	-0.120	0.171	0.097	0.144
	(0.422)	(0.414)	(0.427)	(0.437)	(0.430)	(0.442)
Fixed-term share (2001) * R&D firm	-0.057		-0.050	-0.010		0.007
	(0.088)		(0.106)	(0.089)		(0.108)
Fixed-term share (2001) * Non R&D firm	-0.240***		-0.210***	-0.235***		-0.206**
	(0.074)		(0.079)	(0.077)		(0.084)
Labour turnover (2001) * R&D firm		-0.031	-0.022		-0.027	-0.028
		(0.035)	(0.041)		(0.035)	(0.042)
Labour turnover (2001) * Non R&D firm		-0.095**	-0.055		-0.097**	-0.056
		(0.043)	(0.045)		(0.044)	(0.046)
Growth of sectoral value added (2001-2003)				0.923***	0.907***	0.926***
				(0.112)	(0.112)	(0.113)
Size: 21-50 employees	0.011	0.013	0.012	0.011	0.013	0.012
	(0.016)	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)
Size: 51-250 employees	0.040***	0.040**	0.040**	0.036**	0.036**	0.036**
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Size: 251-500 employees	0.058**	0.057*	0.057*	0.065**	0.064**	0.064**
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Size: more than 500 employees	0.102***	0.103***	0.103***	0.108***	0.109***	0.108***
(reference: less than 21)	(0.036)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)
Age: 25-40 years	-0.043***	-0.043***	-0.042***	-0.045***	-0.046***	-0.045***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Age: more than 40 years	-0.052***	-0.054***	-0.052***	-0.047***	-0.049***	-0.048**
(reference: less than 25)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Constant	0.856***	0.862***	0.875***	0.669***	0.670***	0.682***
	(0.101)	(0.101)	(0.102)	(0.081)	(0.081)	(0.082)
Sector dummies	Yes	Yes	Yes	No	No	No
Regional dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2661	2654	2639	2661	2654	2639
F-test (p-value)	10.26 (0.00)	10.14 (0.00)	9.60 (0.00)	13.51 (0.00)	13.16 (0.00)	11.81 (0.00)
White/Koenker (p-value)	82.79 (0.00)	84.99 (0.00)	83.32 (0.00)	62.92 (0.00)	64.90 (0.00)	63.48 (0.00)
R-squared	0.19	0.19	0.19	0.14	0.14	0.14

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

in 2001; it is important to notice that this variable grounds uniquely on balance sheet information (from the AIDA dataset), therefore the number of employees (used as denominator) may not be fully comparable with that declared by firms in the Capitalia survey[17]. Also in this case, the results display a positive effect of past 'wage push' on productivity growth. The inclusion of this variable does not affect the coefficients on lagged productivity level and investments per worker; moreover, the negative impact of fixed-term share and labour turnover appears stronger, even if the latter remains not significant in the full specification. Replacing industry dummies with sectoral demand growth lowers the effect of past wage increases, but essentially leads to the same interpretations previously outlined.

Finally, Table 4 reports a re-estimation of the model with lagged labour costs where flexibility indicators are interacted with a dummy for firms performing R&D activities during the period 2001-2003. The results show quite clearly that the negative effect of numerical flexibility on productivity growth is limited to non R&D firms, where the exploitation of flexibility practices appears more likely to be correlated with a reduction of costs than to be functional to knowledge-intensive processes.

Concluding remarks

The results from the previous section provide quite robust evidence about the existence of a firm-level trade-off between external labour flexibility and wage moderation, on the one side, and labour productivity growth, on the other. In particular, firms exhibiting a higher share of temporary workers among their workforce and a higher rate of labour turnover displayed a slower growth of value added per worker in the period 2001-2003. This occurrence seems to be stronger for non-innovative firms, where the utilisation of flexible practices appears to be functional to save on labour costs. The reduction of the wage bill, in turn, makes worthwhile the preservation of low-productive jobs and labour-intensive productive processes, postponing their modernization and the adoption of new technologies. From a Schumpeterian viewpoint, the process of 'creative destruction' is then hampered; even if positive effects can hold in the short run (increase in employment, though by the creation of low-quality jobs), longer term negative effects on economic growth are evident. Therefore, these considerations cast some doubts about the sustainability of continued wage restraint policies, and suggest a rebalance of employment protection legislation in order to make

[17] The number of employees in AIDA is counted as an average over the whole year, while in the Capitalia survey it measures the stock at the end of the year.

temporary jobs not less costly to firms than permanent ones. Quoting Sylos Labini (1999), "...when labour market is too rigid there are troubles, but troubles of a different kind can arise when flexibility is unlimited. Here, too, there is a problem of achieving an optimal level".

Anyway, the analysis needs further developments; in particular, a longer sample would be needed to control for unobserved heterogeneity, but, unfortunately, the previous wave of Capitalia survey presents a lot of missing data in the relevant variables, which significantly reduce the number of observations. Moreover, an analysis at sectoral level could allow to verify the impact of external flexibility on productivity in services, where the increase of temporary employment has been higher in the last years (taking into account the difficulties in measuring productivity in services).

Appendix A – Labour productivity decomposition

This appendix aims at explaining briefly the labour productivity decomposition presented in Figure 2. Since labour productivity, at an aggregate level, is a weighted average of sectoral productivity levels with weights corresponding to the employment shares of each sector, its trend depends both on the variation of productivity in each sector and on the variation of the sectoral composition of employment. Therefore, productivity growth between two periods can be algebraically decomposed into a *between* component, a *within* component and a residual. The first component represents the contribution to productivity growth coming from the reallocation of labour from low-productive to high-productive industries, corresponding to the increase of productivity that would be observed maintaining productivity levels constant within sectors. The second identifies the growth of productivity merely due to intra-sectoral increases, in the absence of labour reallocation. Finally, the residual captures the interaction effects between productivity and employment at the industry level, taking a positive sign if the two variables are positively correlated, a negative one in the opposite case. The formula used for the decomposition is the following:

$$\frac{\pi_t - \pi_0}{\pi_0} = \frac{\sum_{i=1}^{n} \pi_{it} q_{it} - \sum_{i=1}^{n} \pi_{i0} q_{i0}}{\sum_{i=1}^{n} \pi_{i0} q_{i0}} = \sum_{i=1}^{n} \left[\frac{q_{it} - q_{i0}}{\pi_0} \pi_{i0} + \frac{\pi_{it} - \pi_{i0}}{\pi_0} q_{i0} + \frac{(\pi_{it} - \pi_{i0})(q_{it} - q_{i0})}{\pi_0} \right]$$

where π_t is aggregate labour productivity at time *t*, π_{it} is labour productivity in sector *i* at time *t*, and q_{it} is the share of employed in sector *i* at time *t*. The first term in square parentheses is the 'structural change' (*between*) effect in sector *i*; the second term is the 'productivity growth' (*within*) effect in sector *i*; finally, the last term is the interaction effect in sector *i*.

The decomposition between 1984 and 2004 (by 5-years intervals) has been performed using value added per equivalent labour unit (at constant prices) as labour productivity index, and sectors have been selected according to the Ateco 2002 classification at 1-digit level (sections and subsections, 30 sectors). Table 5 summarizes the results of the analysis.

Table 5. Decomposition of average annual labour productivity growth

	1984-1988	**1988-1992**	**1992-1996**	**1996-2000**	**2000-2004**
Structural change	1.21	0.51	0.27	0.45	0.15
Intra-industry productivity growth	0.92	0.69	1.63	0.61	-0.05
Interaction effects	-0.27	-0.13	-0.04	-0.11	-0.08
Total	**1.86**	**1.08**	**1.87**	**0.95**	**0.02**

Source: own composition on Istat data.

Appendix B – A focus on the effects of external flexibility on labour costs at firm level

This appendix provides preliminary estimations of labour costs equations, at the firm level, in the period 2001-2003. The main hypothesis we intend to test here is that the use of temporary contracts allowed savings on firms' wage bill, i.e. that the increased external flexibility and the wage moderation episode can be considered correlated, in opposition to what hypothesized by the compensating differentials theory. Differently from the studies introduced in Paragraph 1, the unit of analysis here is not the individual worker, but the firm. An equation for the determinants of (log) labour cost per worker has been estimated, including among the explicative variables two indicators of external labour flexibility (share of fixed-term workers[18] and total labour turnover). As controls, we considered the proportion of part-time workers (in order to take into account working hours, whose information is not included in the dataset), the skill composition of the workforce, the share of workers in R&D and training activities and, in the OLS specification, some time-invariant variables such as sector, size, region, firm age, group affiliation and use of temporary agency workers (unfortunately, their amount is available only for 2003).

The availability of three periods (2001-2003) for the estimation of the equation in levels allowed, in this case, the use of standard panel data methodologies in order to take into account unobserved heterogeneity among firms. Missing values have been excluded so as to obtain a balanced panel with 2987 firms. Estimates are shown in Table 6, which presents respectively pooled OLS estimations with robust standard errors (clustering observations by firms) with and without time invariant controls, random effects and fixed effects estimations. When allowing for individual effects (as recommended by the Breusch-Pagan test), the FE specification appears to be preferred, as suggested by the Hausman statistic and by the F-test on the joint significance of the fixed effects[19].

As it appears from Table 6, the effect of the proportion of temporary workers on labour costs per employee always results negative, in line with our expectations and with the evidence from other authors on wage differentials for temporary workers. This means that temporary contracts do not only allow to increase numerical labour flexibility inside the firm, but also guarantee savings on wage costs, with no trade-off between the faculty of easily adjusting the internal workforce and higher compensations for workers on fixed-term

[18] Only full-time fixed-term workers have been considered in this occasion.

[19] This can be interpreted with the existence of firm-level unobservable characteristics influencing wage levels (such as union coverage, relevance of non-monetary benefits in workers' earnings, attitude of the management towards high-wages policies, and so on) and correlated with the right-hand side variables.

arrangements. The magnitude of the coefficient, however, decreases when considering unobserved heterogeneity, in particular in the FE estimate.

The effect of total labour turnover on wages appears more ambiguous: in fact, while in the OLS specifications this variable is not significant, it turns to be significantly positive once controlling for individual effects, meaning that "churning" in the workforce is correlated with an increase of labour costs. Some observations are worthy about this point. First of all, this outcome does not seem to be attributable to the composition of labour inflows and outflows, since another indicator of labour turnover that should take explicitly into account this issue (the minimum between labour inflow and outflow at firm level) brings to analogous results. Second, a time lag could be needed before changes in the amount of employees have effects on the wage bill: when considering lagged labour turnover, its coefficient turns to be negative, yet this action causes the loss of one period in our already short panel. Third, some endogeneity problems could occur: labour turnover could not be exogenous to external shocks on labour costs (for example, to changes in the industrial relations environment).

Though the matter of endogeneity has not been specifically addressed in this context, it could be relevant indeed; nonetheless, an instrumental variables estimation has been attempted for a cross section in 2003, taking our labour flexibility indicators as endogenous and using their lagged values (in 2002 and 2001) as instruments. While according to the Hansen-Sargan statistic the instruments can be considered valid, i.e. uncorrelated with the error term (p-value=0.30), testing for the endogeneity of the single variables by the Wu-Hausman statistic leads to accept the hypothesis of exogeneity only for the share of fixed-term workers, but not for total labour turnover. Its coefficient, indeed, results significantly negative, contrary to the baseline OLS estimate, where it does not significantly differ from zero[20]. This outcome suggests an upward bias of the coefficient on labour turnover in the estimates presented in Table 6.

As for the other explicative variables, the skill composition of the workforce seems to have the expected effect on labour costs: higher shares of skilled workers are significantly correlated with higher labour cost per worker, with scale increasing along with the skills. The share of workers on training courses presents a not significant coefficient in the OLS estimate with time-invariant controls and in the FE estimate, which is our preferred; the positive sign in the RE estimate is somehow against our priors, according to which workers under training

[20] Results available upon request.

Table 7. Determinants of labour cost per worker, 2001-2003

	OLS (1)	OLS (2)	RE	FE
Share of fixed term workers	-0.347***	-0.377***	-0.320***	-0.228***
	(0.075)	(0.079)	(0.050)	(0.070)
Total labour turnover	-0.035	-0.018	0.041***	0.064***
	(0.029)	(0.029)	(0.014)	(0.016)
Share of part time workers	-0.764***	-0.923***	-0.428***	0.564***
	(0.099)	(0.104)	(0.092)	(0.153)
Share of low-level white collars	0.519***	0.604***	0.568***	0.377***
	(0.034)	(0.035)	(0.029)	(0.068)
Share of high-level white collars	0.828***	1.330***	1.240***	0.621**
	(0.169)	(0.174)	(0.139)	(0.277)
Share of managers	1.674***	1.921***	1.916***	1.553***
	(0.184)	(0.198)	(0.154)	(0.291)
Share of workers in training courses	0.036	0.107***	0.050**	0.007
	(0.034)	(0.037)	(0.024)	(0.030)
Share of R&D workers	0.031	0.076	0.142**	0.199*
	(0.072)	(0.079)	(0.066)	(0.102)
Dummy: use of agency workers	0.009			
	(0.010)			
Dummy: group affiliation	0.058***			
	(0.011)			
Firm age	0.002***			
	(0.001)			
Firm age squared	-0.00002***			
	(0.000)			
21-50 employees	0.049***			
	(0.013)			
51-250 employees	0.107***			
	(0.013)			
251-500 employees	0.156***			
	(0.025)			
more than 500	0.176***			
(reference: less than 21)	(0.029)			
North-West	-0.016			
	(0.010)			
Centre	-0.047***			
	(0.014)			
South	-0.130***			
(reference: North-East)	(0.017)			
Constant	3.003***	3.031***	3.021***	3.053***
	(0.025)	(0.011)	(0.009)	(0.018)
Observations	8742	8961	8961	8961
R-squared	0.34	0.21	0.21	0.15
Breusch-Pagan test for RE (p-value)			6206.04 (0.00)	
F-test on FE (p-value)			16.19 (0.00)	
Hausman test (p-value)			98.85 (0.00)	

* significant at 10%; ** significant at 5%; *** significant at 1%.
OLS estimations with robust standard errors (observation clustered by firms). Time dummies included. Sectoral dummies included in the OLS (1) specification.

should receive lower wages (however, the data do not specify if they are recently hired workers or tenured people who are just updating their skills). On the other hand, the share of workers in R&D activities shows a positive (even if not highly significant) correlation with labour costs per worker, meaning that R&D firms pay on average higher wages (and/or R&D workers receive higher compensations).

A somehow surprising result comes from part-time employment. The share of part-time workers has been included in order to control for the absence of information about working hours: we expected that a higher share of part-time workers, *ceteris paribus*, was associated with lower labour costs per worker paid by the firms, due to the lower amount of worked hours. This result is evident in the pooled OLS and in the RE specifications, where the share of part-time workers enters with negative sign. However, when turning to a fixed effects specification, the sign on this variable switches to positive, maintaining its significance. Therefore, it seems that while *between* firms a higher proportion of part-time job is correlated with lower wage costs per employee (as expected, and confirmed by a between estimate, not presented), an opposite effect prevails *within* firms (i.e., firms increasing their share of part-time workers exhibit an increase of labour costs per worker). This occurrence needs further investigation. On the one hand, it could ground on institutional reasons, which could make part-time job (in equivalent labour units) more costly than full-time. Additional evidence on this point would be necessary, but is beyond the purposes of this paper. On the other hand, however, this result could stem from specification problems. First of all, our data do not allow to know the skill composition of part-time workers, and controlling for that of the whole workforce could be insufficient. For example, if an increase of the part-time share inside a firm mainly involves white collars workers (as it is supposable), the effects on average labour cost per worker is likely to be positive. Second, we are not able to control for working hours: if an increase of the share of part-time workers comes along with an increase of their working hours, the overall effect on labour costs may well be positive. Finally, there could be an identification problem in the FE estimation due to the very little variation of part-time share at the firm level in the period 2001-2003: a variance decomposition of this variable shows that its *within* standard deviation is 0.008, while the *between* one is 0.042.

Finally, it seems noteworthy to analyse the effect of the time-invariant variables which are included in the OLS specification, even if the coefficients from this estimate could be biased. The level of labour costs per employee increases along with the firm size, taking firms until 20 employees as reference group; moreover, affiliation to a group exhibits a positive effect on it. Average labour costs also increase together with firm age, but at decreasing rate. Looking

at regional differences, and taking firms from the North-East as reference group, it emerges a negative differential in labour costs per employee in the Centre, and an even larger one in Southern Italy. This implies that even if wage setting is substantially operated at national level, Southern firms obtain savings on real labour costs[21]. However, for sake of completeness and as a future step of the research, it would be interesting to compare at regional detail wage levels with productivity and price levels.

[21] The diffusion of irregular economy in the South of Italy cannot be claimed in this context, since our data refer only to regular employment.

Appendix C – Variables definitions and descriptive statistics

Value added per worker: value added is calculated as the value of production (net sales +/- variation of inventories, + capitalized costs) less net consumption (materials +/- variation of inventories) and services. It is deflated using value added deflator disaggregated at 2-digit level, and divided by the number of workers declared by firms in the questionnaire. Firms reporting negative or zero value added have not been considered.

Investment per worker: investment in equipment and machinery as declared in the questionnaire, deflated with the gross investment deflator at 2-digit level of disaggregation and divided by the number of workers.

Labour cost per worker: labour costs deflated with the consumer price index and divided by the number of workers. When considered in the interval 1998-2000, the average number of employees during the year (taken from balance sheet data) has been considered.

R&D/Sales ratio: R&D expenditure divided by the amount of sales, both derived from questionnaires.

Share of fixed term contracts: percentage of workers (both full-time and part-time) under fixed-term arrangements (in Appendix B, only full-time workers are considered).

Share of part-time contracts: percentage of workers under part-time arrangements.

Total labour turnover: sum of hirings and layoffs divided by the number of workers.

Table 7. Descriptive statistics (full sample, 2001-2003)

Variable	Mean	Median	Std. Dev.	Min	Max
Value added per worker (thousands of euros)	46.094	40.905	23.785	3.432	195.180
Growth of value added per worker (2001-2003)	-0.025	-0.017	0.336	-2.444	2.772
Investment per worker (thousands of euros)	5.197	2.210	8.162	0.000	65.944
Labour cost per worker (thousands of euros)	26.403	25.341	8.535	4.267	74.022
R&D/Sales (thousands of euros)	0.006	0.000	0.016	0.000	0.134
Share of fixed-term contracts	0.032	0.000	0.098	0.000	0.944
Share of part-time contracts	0.026	0.000	0.045	0.000	0.417
Total labour turnover	0.143	0.095	0.197	0.000	1.875

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