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Labor Productivity and Labor Cost Dynamics in Italy: the Role of Wage Bargaining

by

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Abstract

In this paper we present an empirical analysis of the Italian wage bargaining system through the period 1983-1998 for a panel of 134 manufacturing sectors. In particular, we evaluate how centralized and decentralized collective wage bargaining agreeements face aggregate and idiosyncratic shocks to labor productivity at different frequencies of the cycle. Our results suggest that it is necessary to preserve both the levels of wage negotiations since they accomplish two different tasks: while the contractual wage dynamics allows to take into account permanent shifts in labor productivity, mainly due to techological progress, the wage drift dynamics permits to take into account transitory changes in labor productivity, due to cyclical fluctuations in sectoral demand. However, because of the high heterogeneity in the sector-specific labor productivity dynamics, our results also suggest that the decentralized level of wage negotiations needs to be expanded.

1 Introduction[1]

A prominent opinion in the debate about the functioning of the Italian wage bargaining system states that wage bargaining decentralization leads to a reduction of labor compensation in those sectors or regions where labor productivity is lower than the national average and makes labor compensation more sensitive to the changes in aggregate demand. At the same time, centralized wage bargaining is supposed to not allow a flexible adjustment to the dynamics of labor productivity by leading to potential unemployment.[2]

In line with this debate, the aim of this paper is to evaluate the functioning of the Italian system of industrial relations with respect to the nature of the productivity shocks.

The underlying intuition is that an efficient wage bargaining system is a system where the wage dynamics is strongly related to the labor productivity dynamics. Hence, a centralized wage bargaining system is efficient if the labor productivity dynamics is homogeneous across sectors or regions (i.e. aggregate shocks are prevalent), while a decentralized wage bargaining system is efficient if there is a high degree of sectoral or regional heterogeneity in the labor productivity dynamics (i.e. idiosyncratic shocks are prevalent).

In the case of Italy, centralized wage bargaining occurs at the industry level while decentralized wage bargaining occurs at the firm level. As a matter of fact, the current system of industrial relations is organized according to a two-stage wage setting process which is described as follows: at the first stage collective agreements negotiated by unions and employers representatives at the industry level establish minimum pay scales, while at the second stage unions and employers negotiate at the company-level for improvements on the minima laid down at the industry level.

To evaluate the functioning of each wage bargaining level with respect to the nature (aggregate or sector-specific) of the productivity shocks we estimate a *dynamic factor model* by using time-series data on labor cost and labor productivity for a large cross-section of Italian manufacturing sectors. This statistical model, recently used by Forni and Reichlin (1996, 1998, 1999), decomposes each variable of interest into two orthogonal components: one

[1]We would like to thank Giuseppe Bertola, Mario Biagioli, Luigi Brighi, Salvatore Curatolo, Marcello D'Amato, Sergio Destefanis and Andrea Ginzburg for useful comments and criticisms. We also thank Mario Forni and Jorge Rodrigues for helpful suggestions and for supplying us with the program to estimate the dynamic factor model. Finally, we are greateful to Luigi Bidoia (Prometeia) for providing us with the dataset. The usual disclaimer applies.

[2]See for example ASAP (1994), Brunetta et al. (1994), Prosperetti (1995), CNEL (1997), CESOS (1997,1998), Commissione Giugni (1998), Manghi (1998), Boeri (1999).

that is common across all the units of the analysis and one that is specific (i.e. idiosyncratic) to each of the different units.[3]

The main reason why we adopt this model is that, together with the use of a large panel of data representative of the Italian manufacturing industry, it allows us to make inferences about some of main features of both centralized and decentralized collective bargaining in Italy. Our approach is especially relevant for a general discussion about the functioning of the second level of wage negotiations: as a matter of fact, most of the recent empirical analyses about the Italian system of decentralized wage bargaining have been so far only limited to specific areas or firms.[4]

In our framework, the decomposition in common and idiosyncratic components is important since it allows us to identify the dynamics of the labor cost common component with the dynamics of the contractual wages and the dynamics of the labor cost idiosyncratic components with the dynamics of the wage drifts.[5] At the same time, in the case of labor productivity, this decomposition allows us to estimate the contribution of both aggregate and idiosyncratic shocks to the labor productivity dynamics.

Finally, contrary to static factor models, which are extensively used in the labor market literature,[6] the dynamic specification we use is crucial because it is able to model not only the different sectoral propagation mechanisms of the labor productivity shocks (e.g. the sectoral dynamic heterogeneity in the diffusion of technological progress) but also important stylized facts like the staggering of collective bargaining agreements and the cross-industries interactions in wage determination.

The remainder of the paper is organized as follows. In the next section we introduce the main results of a simple two-stage theoretical model of wage bargaining: this model allows us to infer that common wage dynamics are related to common productivity dynamics while idiosyncratic wage dynamics are related to idiosyncratic productivity dynamics. Section 3 is devoted to the empirical investigation of the relationships between wage and produc-

[3]A factor model can be estimated both in a static and in a dynamic framework. In Appendix B we review the main features of static and dynamic factor models by showing the advantages of the latter with respect to the former. In Appendix B we also present an adapted version of the estimation procedure proposed by Forni and Reichlin (1999).

[4]One of the most recent analyses of local wage bargaining in Italy is Pini (2000). See also the references therein.

[5]The contractual wages (*retribuzioni contrattuali*) are the wages which are set at the central wage bargaining level (i.e. the first level of wage negotiations). The wage drift represents instead the wage increases arising from firm-specific wage bargaining (i.e. the second level of wage negotiations).

[6]Applications of static factor models to the analysis of the labor market are in Blanchard and Katz (1992), Decressing and Fatas (1995) and Bentolilla and Jimeno (1995).

tivity dynamics: after a detailed description of the data we use, we firstly describe the dynamic structure of our statistical model, then we present our results. The conclusions follow in section 4. The appendices illustrate in details our theoretical model (Appendix A) and review the main differences between static and dynamic factor models by illustrating as well the estimation procedure we adopt (Appendix B).

2 A simple two-stage bargaining framework

In this section we presents the main results of a simple two-stage bargaining model which reproduces the key features of the Italian wage bargaining system.[7] We refer to Appendix A for a detailed description of the model and of its main assumptions.

As we said before, the Italian wage bargaining system is characterized by two levels of wage negotiations: a central level, which occurs at the industry level, and a decentralized level, which occurs at the firm level. The wages set at the central level are the contractual wages (*retribuzioni contrattuali*), which act as tariff wages for decentralized wage negotiations.[8]

Following the above specification, in our framework the wage of the i-th firm ($i = 1, ..., n$) is defined as follows:

$$W_i = W_C + WD_i \tag{1}$$

where W_C is the wage set at the central level of wage negotiations and WD_i is the wage drift in the i-th firm, which arises from the decentralized level of wage negotiations and which represents the wage increases arising from firm-level bargaining. Since W_C acts as a tariff wage, $W_i \geq W_C$.

The reference bargaining model is a typical efficient bargaining model where firms and unions bargain over both wages and employment (McDonald and Solow, 1981).

Wage negotiations are articulated as follows: at a first stage (i.e. centralized wage bargaining) unions and employers bargain at the industry level by setting a binding wage for the negotiations at the second stage, while at

[7]The theoretical analysis of two-stage wage bargaining is relatively recent in the labor economics literature. The most prominent contributors in this field have been the Scandinavian economists (see for example Holden, 1989, Holmund and Skedinger, 1990, Holden, 1998). Among the Italian contributors, Brunello (1994), Lucifora (1991), Lupi and Ordine (1993), Ordine (1996) and Mulino (2000) focused on the wage drift dynamics in Italy both from a theoretical and from and empirical point of view.

[8]See Erickson and Ichino (1995) for an illustration of the typical wage structure of a worker belonging to the Italian private industry and for an indication of the levels at which the main wage components are bargained.

a second stage (i.e. decentralized wage bargaining) unions and employers bargain at the firm level by setting a wage which must be greater or equal to the wage set at the previous stage. The two bargaining levels are not reciprocally interrelated: the underlying assumption is that at the first stage the social partners do not take into account the results of the bargaining at the second stage.[9]

The optimal wage arising from decentralized (i.e. firm-level) wage negotiations is:

$$W_i = \mu Q_i + (1-\mu) A_i. \tag{2}$$

According to expression (2), the wage set in the i-th firm is a weighted average between the firm-specific value added per worker (Q_i) and the firm-specific workers' alternative income (A_i). The relative weights are given by the union bargaining power (μ) and the firm bargaining power $(1-\mu)$.[10]

The optimal wage arising from centralized (i.e. industry-level) wage negotiations is:

$$W_C = \mu \overline{Q} + (1-\mu) B. \tag{3}$$

According to expression (3), the wage set at the central level is a weighted average between the average value added per worker within the industry ($\overline{Q}$) and the unemployment benefits (B). The relative weights are still represented by the union bargaining power (μ) and the firm bargaining power $(1-\mu)$.

Finally, by plugging results (2) and (3) in definition (1), the wage drift of the i-th firm (WD_i) results as follows:

$$WD_i = \left\{ \begin{array}{ll} \mu\left(Q_i - \overline{Q}\right) + (1-\mu)\,\phi\left(W_i^a - B\right) & if\ \left(Q_i - \overline{Q}\right) > S \\ 0 & otherwise \end{array} \right\}. \tag{4}$$

where $S = \frac{(1-\mu)}{\mu}\left(B - W_i^a\right).$[11]

Expression (4) tells us that the wage drift of the i-th firm is a weighted average between the deviation of the firm-specific value added per worker

[9]This typical *open loop* framework can be justifyied for example by the hypothesis of imperfect information between the social partners at the different negotiation levels: the local contractors have presumably more information about their own economic conditions than the central contractors.

[10]In an efficient bargaining framework, Blanchflower, Oswald and Sanfey (1996) show the existence of a correlation between wages and profit per employees.

[11]Note that since S is negative (see Appendix A), the wage drift can be positive even in the case the firm-specific value added per worker (Q_i) is less than the industry average value added per worker ($\overline{Q}$), provided that their difference is greater than S.

from the industry average value added per worker, $(Q_i - \overline{Q})$, and an expression which depends on the rents that a worker can get outside the firm, $(\phi (W_i^a - B))$. Once again, the relative weights are given respectively by the union bargaining power and the firm bargaining power.

To sum up, according to this simple two-stage bargaining framework, at each of the two levels of wage negotiations there exists a distinct relationship between wage dynamics and productivity dynamics: as a matter of fact, while the wage set at the central stage depends on average labor productivity ($W_C = W_C(\overline{Q}, .)$, from (3)), the wage increases arising from the second stage of wage negotiations are related to the deviations of the firm-specific labor productivity from the industry average labor productivity ($WD_i = WD_i((Q_i - \overline{Q}), .)$, from (4)).

3 Dynamic factor models and wage bargaining system

In this section we present the empirical analysis of the Italian wage bargaining system whose aim is to analyze the relationship between wage dynamics and productivity dynamics at the two different levels of wage bargaining. In other words, in line with the results of the previous theoretical model, we check whether the dynamics of the contractual wages is related to common productivity dynamics and whether the wage drift dynamics is related to idiosyncratic productivity dynamics.

This analysis allows us to give some insights about the optimality of the current degree of wage bargaining centralization with respect to the heterogeneity of the productivity dynamics, the potential for an expansion of the decentralized wage bargaining level (i.e. the second stage of wage negotiations) and the role of the wage drift in the wage dynamics.

3.1 Data and stylized facts

We analyze labor productivity and labor cost data in a sample of sectors belonging to the Italian private industry: we focus in particular on the manufacturing industry (*industria manifatturiera*: 134 sectors) and on the basic metal industry (*metalmeccanico*: 53 sectors). The data are annual time series ranging from 1983 to 1998. Labor productivity is defined as nominal value added at market prices divided by the number of workers while labor cost is the nominal labor cost per worker.

The data were supplied by Prometeia, which grouped in 173 sectors the data of the Centrale dei Bilanci survey. This survey collects balance-sheet information from a sample of 40000 medium-large firms belonging to the Italian private industry.

This dataset is particularly useful for our analysis because, as recently pointed out by Corneo and Lucifora (1997), decentralized wage bargaining in Italy occurs mainly in medium-large firms of the manufacturing industry. Related to this, it is important to point out that, even if we use sectoral data instead of firm-level data, we will make general inferences on firm-level wage bargaining: the justification for this approach lies on the availability of highly disaggregated sectoral data.

Note also that we use the labor cost series instead of the series of the actual wages to make inferences on the functioning of the wage bargaining system. The justification for this approach lies on the fact that the dynamics of labor compensation is the main determinant of the growth rate of labor cost, which is the variable we analyze.[12]

A brief look at our data reveals that the labor productivity dynamics has been more heterogeneous than the labor cost dynamics (Figure 1)

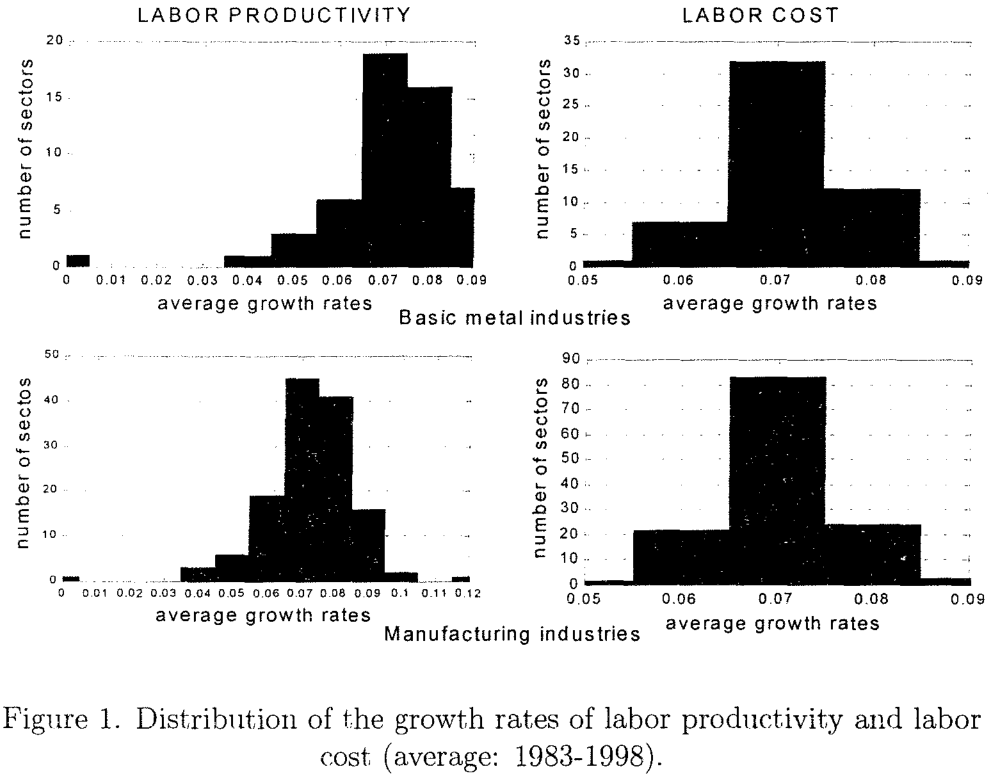

Figure 1. Distribution of the growth rates of labor productivity and labor cost (average: 1983-1998).

[12]See ISTAT, *Costo del lavoro e retribuzioni nette su base contrattuale*, Informazioni n.7, 1999.

As we can see from Figure 1, the dispersion of the average growth rates of labor productivity has been greater than the dispersion of the average growth rates of labor cost: this evidence is valid both for the manufacturing industry as a whole and for the basic metal industry.

To sum up, our data indicate that in the face of highly differentiated sectoral labor productivity dynamics there has been a relative compression of sectoral labor cost dynamics. Hence, under the assumption that an efficient wage bargaining system is a system where the wage dynamics is related to the labor productivity dynamics, the data suggest the need to reorganize the current system of industrial relations in Italy. It is important to point out that the way in which this reorganization must occur depends on the evaluation of the actual functioning of both the existing levels of wage negotiations: this is the reason why in our empirical investigation we will analyze separately the features of both centralized and decentralized collective agreements.

3.2 The dynamic specification: institutional factors and data structure

In the following we present in details the dynamic factor models we use to analyze labor productivity and labor cost fluctuations: we focus in particular on the model dynamic structure, that emerges both from institutional considerations and from statistical analysis (i.e. from the Akaike information criterion analysis).[13] The detailed estimation procedure and the comparison between the dynamic and the static version of the model is presented in Appendix B.

We consider the two following dynamic factor models:

$$Q_{i,t} = a_i(L)q_t + b_i(L)q_{i,t} \qquad (5)$$

$$W_{i,t} = c_i(L)w_t + d_i(L)w_{i,t} \qquad (6)$$

where $Q_{i,t}$ and $W_{i,t}$ are respectively the growth rate of labor productivity and the growth rate of labor cost in sector i ($i = 1, ..., n$) at time t. More precisely, $Q_{i,t}$ is the first difference of labor productivity (in logs) and $W_{i,t}$ is the first difference of labor cost (in logs). We take the first differences of the variables because the series are I(1) processes.[14]

[13]There are various model selection criteria that trade off a reduction in the sum of squares of the residuals for a more parsimonious model. One of the most commonly used criteria is the Akaike information criterion (AIC). For details, see for example Enders (1995).

[14]The results on the degree of integration of the variables are available on request.

$q_t, w_t, q_{i,t}, w_{i,t}$ are all *white-noises* mutually uncorrelated at all leads and lags. In particular, while q_t and w_t are common shocks across sectors respectively to the growth rate of labor productivity and to the growth rate of labor cost, $q_{i,t}$ and $w_{i,t}$ are idiosyncratic (i.e. sector-specific) shocks. These shocks define the common components, $a_i(L)q_t$ and $c_i(L)w_t$, and the idiosyncratic components, $b_i(L)q_{i,t}$ and $d_i(L)w_{i,t}$.

Following the estimation procedure in Appendix B, models (5) and (6) can be estimated by OLS equation by equation by using $\overline{Q}_t$ (i.e. the arithmetic mean of $Q_{i,t}$) to proxy for the common shock q_t and $\overline{W}_t$(i.e. the arithmetic mean of $W_{i,t}$) to proxy for the common shock w_t. The idiosyncratic components of the growth rate of labor productivity $(b_i(L)q_{i,t})$ and of labor cost $(d_i(L)w_{i,t})$ are the estimated OLS residuals.

Note that, as pointed out by Forni and Reichlin (1996, 1998, 1999), the dynamic specification of the propagation mechanism of models (5) and (6) is very general since it implies that the sectoral responses to a *common* shock can be characterized by completely heterogeneous sectoral impulse response functions. In particular, according to these models, the sectoral responses to an aggregate shock can be different in magnitude, in sign, but also in timing.

We identify the dynamics of $c_i(L)w_t$ (i.e. the common component of labor cost) with the contribution of centralized wage bargaining to sectoral wage dynamics and the dynamics of $d_i(L)w_{i,t}$ (i.e. the idiosyncratic component of the labor cost) with the contribution of decentralized wage bargaining to sectoral wage dynamics. Hence, a common shock to the growth rate of sectoral labor cost identifies a shock due to the renewal of collective bargaining agreements at the central level,[15] while an idiosyncratic shock to the growth rate of sectoral labor cost identifies a shock due to renewal of collective bargaining agreements at the firm level.

In this case, the dynamic specification we use is crucial because it allows us to take into account some important stylized facts like the staggering of collective bargaining agreements,[16] the existence of interactions both across industries and across sectors in the process of wage determination (due for

[15]Note that the labor cost common components are estimates for the contractual wages (*retribuzioni contrattuali*). Our estimated contractual wages fit very well the official data available (see ISTAT, *Lavoro e retribuzioni*, various years). In particular, the comparison between the ISTAT contractual wages and our estimates suggests that the time evolution of the two series is the same, while the only difference is the scale. The labor cost common components overestimate the official data by about one percentage point.

[16]The phenomenon of the staggering of collective bargaining agreements is typical of the Italian industrial relations system because the collective bargaining renewals do not arise from synchronized bargaining round. As a result, each year some collective agreements are signed.

example to the wage leadership hypothesis)[17] and the autocorrelation of the wage increases within each sector.[18] To capture all these phenomena, we estimate the common component of the growth rate of labor cost with one lead and one lag. This lag structure is also confirmed by the Akaike information criterion analysis.

In the case of labor productivity, we identify the contribution of aggregate and idiosyncratic shocks to sectoral labor productivity dynamics by using respectively the common component $a_i(L)q_t$ and the idiosyncratic component $b_i(L)q_{i,t}$.

In this case, the dynamic specification of the common component allows us to take into account the possibility that a common productivity shock (e.g. a technological shock) may generate a certain kind of response in one sector at a specific moment and a response (of the same or of different sign and magnitude) in another sector after a certain time. To capture a similar phenomenon (e.g. the heterogeneous dynamic diffusion of the technological progress), we estimate the common components of the growth rate of labor productivity with one lead and one lag. This lag structure is also confirmed by the Akaike information criterion.

3.3 Results

The estimate of models (5) and (6) leads to isolate the common and the idiosyncratic components of both labor cost and labor productivity. By analyzing these components and the relationships among them it is possible to obtain the following two classes of results:

1) Results concerning the dynamic correlation among common and sector-specific components of labor cost and labor productivity (see Section 3.3.1): these results allow us to evaluate the actual functioning of the two levels of wage bargaining in Italy with respect to the nature of the productivity cycles.

2) Results concerning the relative weight of common and sector-specific components of each variable (see Section 3.3.2): these results allow us to evaluate the actual weight of wage bargaining decentralization with respect to

[17] About the phenomenon of wage leadership in Italy see Destefanis (1999) and Gavosto and Sestito (1991).

[18] The autocorrelation of the wage increases within each sector is due to the fact that in Italy collective bargaining agreements last more than one year. This stylized fact is also confirmed in many empirical analyses about wage dynamics in Italy, where the lagged wage dynamics shows to be significant in explaining the current wage dynamics (see for example Cucchiarelli and Tronti, 1992, where the wage growth of the previous two years is significant in explaining the current wage dynamics).

the heterogeneity of labor productivity dynamics by assessing as well whether it is necessary to expand the second level of wage negotiations.

3.3.1 Dynamic correlations

In this section we analyze the comovements among common and sector-specific components of labor cost and labor productivity. To this aim, we use an index of comovement, known as *dynamic correlation*, that has been recently proposed by Croux *et al.*(1999). We now provide an intuition about this concept.

The dynamic correlation index, from now on $c(\lambda)$, allows us to identify not only the average degree of comovement between two series (in the same way as simple correlation), but also the degree of comovement between them at different frequencies, λ, that is at different moments in time. In particular, $c(\lambda)$ ranges from 0 to 1 as the simple correlation index but it is defined on all the frequency domain, $\lambda \in (-\pi, \pi)$.[19]

This implies that $c(\lambda)$ can be used to study business cycle dynamics as well as the long-run features of the data. For example, $c(0) = 1$ implies that the series comove in the long run[20] while $c(0) = -1$ implies that the series diverge in the long run. The so-called "business cycle" is instead related to short-run growth cycles, which are around $\lambda = 2$. For example, $c(2) = 0.9$ implies that the series are strongly and positively correlated at three-years growth cycles.

The importance of this comovement index can be captured in the following example, which was proposed by Croux *et al.*(1999). Let us consider two series that have no contemporaneous comovements (zero correlation) but that are strongly correlated in the long run. In this case, the dynamic correlation index is "on average" equal to zero as the simple correlation measure, but at the zero frequency (corresponding to trends) it will be equal to 1 ($c(0) = 1$), thus suggesting the true feature of the data: the presence of large positive long-run comovements canceling out with large short-run negative comovements.

[19]Notice that, with annual data, frequencies close to 3.14 correspond to short-run growth cycles (i.e. short-run periods): in particular, the frequency $\lambda = 3.14$ corresponds to two-years growth cycles. Frequencies close to 0 correspond instead to long-run growth cycles: for example, $\lambda = 0.63$ corresponds to ten-years growth cycles while $\lambda = 0$ corresponds to trends. On the spectral analysis see Priestley (1981).

[20]Note that the long-run dynamic correlation is related to the parametric concept of stochastic cointegration. Hence, a dynamic correlation equal to 1 means that the variables are cointegrated: in other words, the variables comove in the long run.

Wage bargaining and productivity cycles

In the following we present the dynamic correlation analysis *across* models, that is considering model (5) versus model (6). This analysis allows us to evaluate the actual functioning of the two levels of wage bargaining with respect to aggregate and sector-specific productivity shocks.

In this case, the following correlations are possible: (i) correlation between labor cost common components and labor productivity common components (Figure 2: first column); (ii) correlation between labor cost idiosyncratic components and labor productivity idiosyncratic components (Figure 2: second column). The comovements can be positive, negative or null (see Section 3.2).

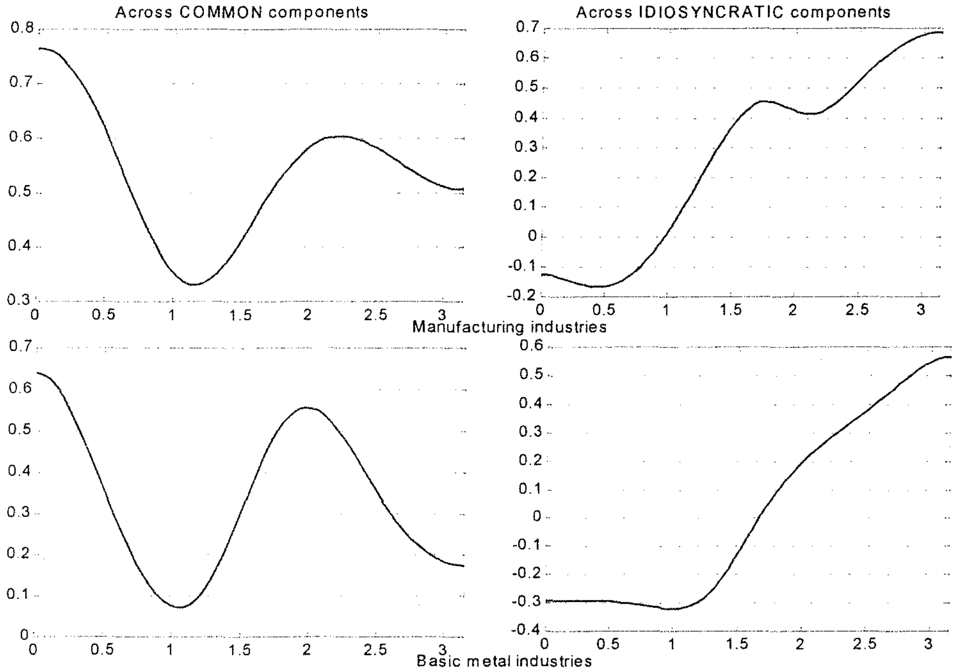

Figure 2. Dynamic correlation across common components and across idiosyncratic components of labor cost and labor productivity (average across sectors): 1983-1998

The two plots in the first column of Figure 2 show that the long run comovement among the labor cost common components and the labor productivity common components is around 0.8, $c(0) \simeq 0.8$, for the manufacturing industry, while it is around 0.7, $c(0) \simeq 0.7$, for the basic metal industry.[21]

[21]Cucchiarelli and Tronti (1992) investigate the relationship between wage dynamics and productivity dynamics in a regression framework by using data about the Italian

The existence of these high positive comovement implies that in the long run centralized wage bargaining has been able to maintain a tight correspondence between the growth rate of labor cost and the growth rate of labor productivity in all sectors.[22]

The two plots in the second column of Figure 2 suggest instead that for both the aggregates considered there is high comovement between the idiosyncratic components of the variables in the short run, while there is no comovement at all in the long run. In particular, while for the manufacturing industry the dynamic correlation is positive only till around $\lambda = 1$, which corresponds to six-years cycles, for the basic metal industry is positive only till around $\lambda = 1.5$, which corresponds to four-years cycles. This means that decentralized wage bargaining has been able to maintain a relatively strong correspondence between the growth rate of labor cost and the growth rate of labor productivity only in the short run: in other words, the wage drift dynamics has been related to the business cycle.

To sum up, these results suggest that the two levels of wage negotiations accomplish two different tasks: the wage drift dynamics permits to take into account transitory changes in labor productivity due to cyclical fluctuations in sectoral demand, while the contractual wage dynamics allows to take into account permanent shifts in labor productivity, mainly due to technological progress.

3.3.2 The relative weight of common and idiosyncratic components

In this section we present the relative weight of common and idiosyncratic components in the growth rates of labor cost and labor productivity. Since

private sector during the period 1970-90. The OLS estimates for the whole sample show a strong influence of previous wage dynamics and current productivity dynamics on current wage dynamics while the estimates for each single sector do not reveal the existence of a clear relationship between wage growth and productivity growth. Moreover, since in the estimates for the whole sample the positive coefficient of the previous wage dynamics is almost totally compensated by the negative coefficient of the constant term, the authors conclude that in the whole economy in the long run wage growth is totally explained by labor productivity growth.

[22]The two plots in Figure 2 also show a peak around $\lambda = 2$, which implies the presence of common cycles of period around three years in manufacturing wages. Note that three years is the average duration of collective agreements at the industry level in the period considered . In particular, these agreements generally lasted three years until 1993 (exceptions: one-year contracts for the textile sector in 1983 and 1987 and four-years contracts for engineering in 1986 and 1987). Since 1993, the collective agreements at the industry level have normally lasted four years, but the renewal of the economic part of them (which includes the treatment of labor compensations) have occurred every two years.

we focus in particular on the weight of the second level of wage negotiations with respect to the heterogeneity of the labor productivity dynamics due to sector-specific shocks, these results allow us to assess whether it is necessary to expand the second level of wage negotiations.

Is it necessary to expand the second level of wage negotiations?

Table 1 shows that the growth rate of labor cost and the growth rate of labor productivity are mainly due to sector-specific shocks: as a matter of fact, the variance of the idiosyncratic components of each variable is always greater than the variance of the common components ($\sigma^2_{idio}/\sigma^2_{total}$ is always greater than 55%). Hence, under the assumption that idiosyncratic shocks to the labor cost dynamics are identified with shocks due to firm-level wage bargaining and that common shocks to the labor cost dynamics are identified with shocks due to centralized wage bargaining (see Section 3.2), the data show that the wage increases at the firm level (i.e. wage drift) are the main determinants of the wage growth.[23]

Table 1. Variance decomposition (average across sectors)*

	LABOR COST		PRODUCTIVITY	
Manufacturing industry	comm.	idio	comm.	idio
	0.42	0.58	0.30	0.70
Basic metal industry	comm.	idio	comm.	idio
	0.45	0.55	0.45	0.65

*Note: comm. $=\frac{\sigma^2_{comm}}{\sigma^2_{total}}$, idio $=\frac{\sigma^2_{idio}}{\sigma^2_{total}}$

Table 1 also reveals that the variance of the labor productivity idiosyncratic component is greater than the variance of the labor cost idiosyncratic component. In particular, while for the basic metal industry the idiosyncratic shocks account for 55% of the labor cost variance and 65% of the labor productivity variance, for the manufacturing industry the sector-specific shocks account for 58% of the labor cost variance and for 70% of the labor productivity variance.

Hence, under the assumption that a decentralized wage bargaining system is more efficient with respect to a centralized one in the case labor productivity dynamics is mainly due to sector-specific shocks, the current degree of wage bargaining decentralization is not optimal with respect to the heterogeneity of the labor productivity dynamics coming from idiosyncratic shocks. In other words, the data suggest that the second level of wage negotiations needs to be expanded.

[23]A similar result on a panel of Italian firms is in Dell'Aringa e Lucifora (1994).

3.4 Conclusions

In this paper we have analyzed wage and productivity dynamics in the Italian manufacturing industry. In particular, by using a dynamic factor model, we have studied the functioning of both the centralized and the decentralized level of wage negotiations with respect to the heterogeneity of the labor productivity dynamics.

Our results show that centralized wage bargaining has been able to maintain a tight correspondence between the growth rate of labor cost and the growth rate of labor productivity in the long run, while decentralized wage bargaining has been able to maintain a strong correspondence between the labor cost and the labor productivity dynamics only in the short run. Our empirical investigation also shows that the current degree of wage bargaining decentralization is suboptimal with respect to the heterogeneity of the labor productivity dynamics due to sector-specific shocks.

To sum up, this paper suggests the necessity to maintain both the existent levels of wage negotiations even if the second level needs to be expanded. The reason why it is worth preserving a two-stage wage bargaining system lies on the fact that the two levels of wage negotiations accomplish two different tasks: as a matter of fact, while the wage drift dynamics permits to take into account transitory changes in labor productivity due to cyclical fluctuations of sectoral demand, the contractual wage dynamics allows to take into account permanent shifts in labor productivity, mainly due to technological progress.

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Appendix A: Theoretical model

The utility of the union associated with the i-th firm ($i = 1, ..., n$) is represented by:

$$U_i = N_i (W_i - A_i)$$

where N_i is the level of employment hired by the firm, W_i is the wage of the i-th firm and A_i is the alternative income of a worker belonging to firm i, which is defined as

$$A_i = \phi W_i^a + (1 - \phi)B$$

where ϕ is the (exogenous) probability of finding a job outside the firm, W_i^a is the outside reference wage (i.e. the expected value of the wage that a worker can gain in the other firms belonging to the same sector) and B are the unemployment benefits. Without loss of generality, we assume that W_i^a is strictly greater than B.

The profit function of the i-th firm is:

$$\Pi_i(N_i) = R_i(N_i) - W_i N_i$$

where $R_i(N_i)$ is a value-added function which is different across firms and which is a function only of the amount of labor hired.

The bargaining process has two stages, which are described as follows: at the first stage the social partners bargain at the industry-level while at the second stage the social partners bargain at the firm-level.[24]

At the firm level, the Nash bargaining function to be maximized is:

$$\Omega_i = (U_i - U_{0i})^{\mu} (\Pi_i - \Pi_{0i})^{1-\mu} \tag{A.1}$$

where $(U_i - U_{0i})$ is the surplus of union associated with the i-th firm and $(\Pi_i - \Pi_{0i})$ is the surplus of the i-th firm. The union and the firm bargaining power are respectively μ and $(1 - \mu)$. The elements of expression (A.1) are defined as follows:[25]

$$\begin{aligned} U_i &= N_i (W_i - A_i) \\ \Pi_i &= R_i(N_i) - W_i N_i \\ U_{0i} &= \Pi_{0i} = 0 \end{aligned}$$

[24] The two bargaining levels are not reciprocally interrelated (see Section 2).

[25] Note that we fix at zero the firm outside option: the underlying assumption is that strikes are allowed at the workplace. For a model of two-tiered bargaining with strike threats at the local level see Flanagan (1993).

The maximization of expression (A.1) with respect to wage and employment leads to the following first order conditions:

$$W_i \; : \; W_i = \mu Q_i + (1-\mu)\, A_i \tag{A.2}$$
$$N_i \; : \; R_i'(N_i) = A_i \tag{A.3}$$

where $Q_i = R_i(N_i)/N_i$ is the value added per worker in the i-th firm.

At the central level, the Nash bargaining function to be maximized is:

$$\Omega = (U - U_0)^{\mu} (\Pi - \Pi_0)^{1-\mu} \tag{A.4}$$

where U is the utility of the central union, Π are the profits of the employers' confederation and U_0 and Π_0 are the revenues in case of disagreement. Union and firm bargaining power are the same as before.

At this stage, the central union maximizes its rents over the unemployment benefits (we assume labor immobility across industries). At the same time, the employers' confederation maximizes the average industry profits: the justification for this assumption lies on the fact that at the central stage the employers' confederation must bargain at the same time for all the different firms.

Hence, the elements of expression (A.4) are defined as follows:

$$\begin{aligned} U &= N\,(W_C - B) \\ \Pi &= \overline{R} - W_C N \\ U_0 &= \Pi_0 = 0 \end{aligned}$$

where W_C is the wage set at the central level, N is the total level of employment and $\overline{R}$ is the average (across firms) value added defined as

$$\overline{R} = \frac{1}{n} \sum_{i=1}^{n} R_i(N_i).$$

The maximization of expression (A.4) with respect to wage and employment leads to the following first order conditions:

$$W_C \; : \; W_C = \mu \overline{Q} + (1-\mu)\, B \tag{A.5}$$
$$N \; : \; R'(N) = B \tag{A.6}$$

where $\overline{Q} = \overline{R}/N$ is the industry average value added per worker.

Appendix B: Statistical Model

1. Static vs dynamic factor models

A simple *static factor model* can be characterized as follows:

$$X_{i,t} = a_i x_t + b_i(L) x_{i,t} \tag{B.1}$$

where $a_i x_t$ are the common components and $b_i(L)x_{i,t}$ are the idiosyncratic components. x_t and $x_{i,t}$ are *white-noise* shocks with unit variance which are mutually uncorrelated at all leads and lags: in particular, x_t is a shock that is common to all the units of analysis, while $x_{i,t}$ is a shock that is specific to each single unit, where the index i represents the cross-sectional dimension. From now on we will refer to index i as the index of the i-th sector ($i = 1, ..., n$), thus following the specification of our previous empirical investigation (see Section 3).

As it is possible to see from model (B.1), all the sectoral responses ($a_i x_t$) to a common shock x_t have the same propagation mechanism across sectoral units up to a multiplication by a scalar a_i: this means that the static model (B.1), by imposing strong restrictions to the sectoral responses to a *common* shock, determines also restricted sectoral responses to each idiosyncratic shock. In other words, an unsuitable static filtering procedure may induce spurious dynamics in the idiosyncratic components.

A simple *dynamic factor model* can instead be characterized as follows:

$$X_{i,t} = a_i(L) x_t + b_i(L) x_{i,t} \tag{B.2}$$

where $a_i(L)x_t$ are common components and $b_i(L)x_{i,t}$ are the idiosyncratic components. As in (A.1), x_t and $x_{i,t}$ are respectively common and idiosyncratic *white-noise* shocks with unit variance and mutually uncorrelated at all leads and lags.

As we can see from model (B.2), the common components exhibit a dynamic structure: this means that a dynamic factor model allows to decompose the series into common and idiosyncratic components by taking into account a more general dynamics of the sectoral responses.

As in Forni and Reichlin (1996, 1998, 1999), the dynamic specification of the propagation mechanism implies that the sectoral responses to a *common* shock can be characterized by completely heterogeneous sectoral impulse response functions. In particular, according to this model, the sectoral responses to an aggregate shock can be different not only in sign and magnitude but also in timing.

2. Dynamic factor models: estimation procedure

To estimate models like (B.2), it is possible to use a modified version of the procedure proposed by Forni and Reichlin (1999). To get an intuition of this procedure, let us consider the following simplified version of the model:

$$X_{i,t} = x_t + x_{i,t}. \tag{B.3}$$

Let us now rewrite model (B.3) by using the arithmetic means of the variables:

$$\frac{1}{n}\sum X_{i,t} = x_t + \frac{1}{n}\sum x_{i,t}. \tag{B.4}$$

Note that, if the cross-sectional dimension is large, when aggregating across sectors the idiosyncratic component should be small in variance as compared to the common one. In particular, when the cross-sectional dimension tends to infinity the variance of the second term on the RHS of equation (B.4) tends to zero: $var(\overline{X}_t - x_t) \rightarrow 0$ (i.e. convergence in variance), so that:

$$\lim_{n\rightarrow\infty}\frac{1}{n}\sum X_{i,t} = x_t. \tag{B.5}$$

According to result (A.5), $\overline{X}_t = \frac{1}{n}\sum_i X_{i,t}$ (i.e. the arithmetic mean of $X_{i,t}$) is the asymptotic aggregate for the unobservable factor x_t. This means that when the cross section is large the unobservable common component x_t can be proxied by the (observable) arithmetic mean of the variables $\overline{X}_t$.[26]

A similar argument applies to the general dynamic model (B.5): the unobservable dynamic common component $a_i(L)x_t$ can be proxied by using $a_i(L)\overline{X}_t$. Hence, model (B.5) can be estimated by OLS equation by equation by treating the residuals as the idiosyncratic components and by using *model selection criteria* to determine the correct lead and lag structure.

[26]When the cross section is not large, the unobservable component can be estimated by using a weighted average, where the optimal weights minimize the variance of the idiosyncratic components. For details on this estimation procedure see Forni and Reichlin (1999). Empirical applications are in Forni and Reichlin (1996, 1998, 1999), D'Amato and Pistoresi (1999) and Fuss (1997).

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