Performance Related Pay and Firm Productivity: Evidence from a Social Pact.

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Abstract

This paper investigates the causal effect of a switch from fixed wages to collective performance-related pay on firm productivity, exploiting the reform of the institutional environment regulating collective bargaining triggered by a Social Pact. We find that the increase in firms' probability of adoption of collective performance related pay led to productivity gains up to 5 per cent. We show that these effects can vary substantially by firm size, industry affiliation and union density, and that the design of the scheme – in terms of number and type of parameters used – matters for firm's productivity.

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1. Introduction

The compensation packages of a growing proportion of firms, particularly in the private sector, include pay schemes linking pay to employee or company performance (Bloom and Van Reenen, 2011). The economic effect of pay incentives in firms have been extensively investigated and a large theoretical literature seeks to explain how firms should design compensation schemes to motivate workers in their job and maximize firm's profits (for a review, see Prendergast, 1999). These models suggest that individual incentives are likely to increase workers' effort – up to the point where the marginal cost of effort equals the marginal value of output –, while collective incentives are unlikely to have an impact on productivity as individual workers can only benefit from a relatively small share of total profits – due to the "1/N problem", where N is the number of employees in the firm. While several studies document the productivity gains associated to the adoption of individual performance-related pay (PRP) schemes, and in particularly piece-rates (Lazear, 2000; Shearer, 2004; Bandiera et al., 2005; Freeman and Kleiner, 2005), robust evidence on the impact of collective PRP on firm's productivity is still scarce. Some empirical studies show that collective PRP are able to generate productivity gains for the firm, albeit not so large as those found for individual PRP (Cahuc and Dormont, 1997; Piekkola, 2005; Origo, 2009; Gielen et al., 2010). Furthermore, recent studies based on firm-level panel data show that these productivity gains, albeit relatively small, benefit also the employees through higher earnings (Andrews et al., 2010; Long and Fang 2012).

One problem in comparing the above findings, however, lies in the different identification strategy generally used in the literature: while studies on collective PRP mentioned above usually exploit the panel structure of the data to estimate fixed effects

models, those on individual PRP exploit quasi-natural experiments occurring in the compensation scheme at a given firm. For example, Lazear (2000) studies the implementation of a new piece rate scheme at the largest installer of automobile glass in the USA, while Bandiera et al. (2005) focus on a switch from a relative incentive scheme to piece rates in an English fruit picking operation.

In both strands of literature there are limitations. On the one side, the approach based on panel data provides consistent estimates of the causal effect as long as changes in the pay structure are strictly exogenous, alternatively if all differences between treated and control firms can be attributed to firms-specific fixed effects. The strict exogeneity assumption is violated if firms choose to change their pay structure on the basis of past productivity levels, which is often the case. On the other side, the approach which exploits quasi-natural experiments, being mostly based on specific case studies, often lacks external validity for the results.

This paper improves upon the previous literature combining the two approaches: first, we use a very rich firm-level panel data-set for the Italian metal-engineering industry and implement a fixed effects model to account for firms' unobserved heterogeneity; second, we also exploit an exogenous change in the institutional setting – a reform in the bargaining structure framed as a Social Pact - which shifted firm-level collective bargaining from fixed wages to collective PRP.

Moreover, while in most previous studies the role of unions has been neglected - implicitly assuming that compensation schemes are freely chosen by management -, when unions are present at the firm level and have the power to share rents with employers, it seems more realistic to assume that pay determination is the outcome of a bargaining process between the firm and local union representatives (Corneo and

Lucifora, 1997; Checchi and Lucifora, 2002). The available evidence, for the UK and the US, shows that the returns of flexible pay systems are roughly the same in unionized and non-unionized firms (Booth and Frank, 1999; Brown, 1992; Black and Lynch, 2001): while the productivity effects of a shift in compensation are usually found to be smaller in unionized workplaces since wages are higher under any form of pay compensation (including fixed wages) and workers are often more productive even in the absence of incentive schemes (for example, because unions increase workers morale or because they improve communication between workers and management, Brown and Medoff, 1978). Comparable evidence for Italy shows that the effects of collective PRP on productivity are stronger in low unionized firms, while wage effects are larger in highly unionized firms (Origo 2009).[1]

In this respect, the Italian case can prove particularly interesting. Notably, while an extensive literature has documented the occurrence of Social Pacts and their effects on a number of macroeconomic outcomes, within the context of incomes policies (Hassel 2009, Visser and Rhodes 2011, Colombo et al. 2011); evidence on the effects of Social Pacts - involving a move to decentralized bargaining, variable pay schemes and flexible working conditions - on firms' productivity growth is still lacking.

The paper is organised as follows. In section 2, we illustrate the institutional setting and describe the quasi-natural experiment we exploit for identification of causal effects in our empirical analysis. In section 3, we present the data and some descriptive evidence, while the details of the econometric strategy are provided in section 4. We discuss our

[1] Differences in the institutional setting between Italy and the UK/US in the structure of collective bargaining – mainly at industry-wide national level, in Italy, and decentralised at the firm level, in the UK/US – can explain some of the above differences.

main results in section 5 and we present a number of robustness checks in section 6. The last section concludes.

2. The institutional setting

In 1993 the Italian government, national trade unions and employers' associations signed a tripartite agreement in the form of a "Social Pact" aimed at curbing the inflation rate in light of the EU Maastricht targets, introducing a two-stage bargaining system consisting of national-level and firm-level bargaining. The 1993 Social Pact stressed the need to make wages more flexible in order to avoid the wages-prices spiral that characterised the Italian economy in the 1980s and to prevent further unemployment increases by enabling negative macroeconomic shocks to be partially absorbed through wages adjustments. The first level of bargaining had a national coverage and was targeted to adjust for changes in inflation; the second level of bargaining concerned employers and local unions and was meant to ease the introduction of collective PRP schemes. The Social Pact changed the focus of bargaining from the central to the decentralised (firm) level, also introducing wage increases linked to specific indicators of productivity, profitability or other measures of firm performance. [2] While before 1993 wage increases determined at the firm level usually took the form of fixed premia, after 1993 variable pay schemes became the "norm". This occurred even without the introduction of formal sanctions for firms

[2] It could be argued that wage flexibility can be achieved also with the adoption of individual PRP. However, unions are more favourable to the adoption of collective PRP because they usually require collective bargaining at the local (firm) level, while individual PRP schemes are often bargained individually, particularly in the case of high skilled workers. This explains the focus on collective PRP in the 1993 Social Pact.

deviating from these recommendations and without strong fiscal incentives.[3] The institutional framework provided by the Social Pact facilitated the rapid and wide diffusion of collective PRP also making their design and implementation less costly -- i.e. firms could replicate or adapt to their needs the algorithm already implemented in other firms.[4] Furthermore, the design of the PRP premia meant that they could only improve (or be zero when performance targets were not met) upon the wage levels nationally bargained, thus making them more appealing to firm management than fixed wage premia. The implementation phase of the reform, within each industry, was scheduled with the timing of the new national industry-wide agreement and the elapsed length of the existing firm-level contracts: this meant that firms operating in the metal-engineering industry could start introducing collective PRP after 1994.[5] This feature introduced a staggered pattern of adoption of collective PRP since 1995, which was exogenously determined by both the timing of the last firm-level contract and its length (i.e. most firm-level contracts lasted two to three years). An *ad hoc* survey, carried out by the national statistical office on a representative sample of around 8,000 firms with at least 10 employees in both manufacturing and service sector in 1995-96, confirms that the introduction of collective PRP schemes replaced traditional fixed wage premia as a "top-up" to wage levels set by national industry-wide collective bargaining (Istat,

[3] A possible explanation is that the incentives to comply were shaped not only by legal, but also by social sanctions. There is also evidence showing that compliance can often be achieved with "mild laws" even when legal sanctions are non-deterrent (Kube and Traxler 2011).

[4] Firm-level contracts are official documents and are publicly available.

[5] Metal-engineering firms waited for their new industry-wide agreement in 1994 in order to see how their national unions and employers associations interpreted the changes in collective bargaining recommended by the 1993 Social Pact.

1999).[6] The amount of the premium is usually the same for all the workers involved, and when it differs it is proportional to the average wage for each occupational level[7], or to an indicator of individual absenteeism. On average, the actual incidence of collective PRP is close to 5-6 per cent of the total gross wage (Casadio, 2003; Brandolini et al., 2007).

3. Data and descriptive evidence

The empirical analysis uses a representative sample of Italian metal-engineering firms drawn from the annual survey carried out by the National Employers' Association of the metal-engineering industry (*Federmeccanica*). The survey is available from 1989 to 2007, but since some questions on firms' productivity were asked only until 1999, our estimates focus on the 1989-1999 period. On average around 3,000 establishments employing almost 450,000 employees are surveyed each year, corresponding to around 10 per cent of establishments and 25 per cent of workers in this industry. Over the period, almost two thirds of the establishments are surveyed at least twice, while over 10 per cent are present throughout the whole period. The survey provides information on firm's attributes such as industry, employment, sales, outsourcing, share of value added from export, union activity, firm-level collective bargaining, wage levels and their composition. Information is also available for each establishment, within each

[6] The Istat survey shows that failure to fulfil the performance targets usually implies a proportional reduction of total payment (44.6 per cent of total workers). The premium can actually be zero for 42.6 per cent of the workers involved. A minimum fixed payment is anyway guaranteed for the remaining 12.8 per cent.

[7] Metal-engineering workers are classified into two categories (blue and white collars) and eight occupational levels broadly defined in the national agreement for the metal-engineering industry. The basic pay is parameterized on these levels. The same kind of normalization is sometimes used to determine the actual amount of the PRP.

firm, on employment composition, turnover and working time arrangements. Since decentralised bargaining takes place mainly at the firm level, the latter will be considered as our unit of analysis.

Our variable of interest is whether the firm has introduced in a given year a collective PRP scheme. In this respect, the definition of collective PRP and the corresponding questions were changed in the surveys conducted after 1995. In the surveys from 1989 to 1994, the bargaining firms were asked whether wages were among the issues bargained in the year of the survey, and whether they had introduced variable pay schemes, either individual or collective, in the latter case distinguishing between department-level and firm-level schemes. We consider as firms adopting collective PRP those which declared that they signed a new firm-level contract in the year of the survey and answered positively to at least one of the questions related to the introduction of collective flexible pay schemes. Starting from the 1995 survey, in accordance with the institutional changes introduced by the 1993 Reform and the 1994 industry-wide agreement, the questions relative to flexible pay schemes were re-formulated using the same terminology proposed by the industry-wide agreement (which introduced the definition of collective PRP, "*premio di risultato*") and no longer differentiate between department-level and firm-level premia. Firms introducing collective PRP are then all the bargaining firms in each wave which declared that they had followed the industry-wide agreement by introducing some type of collective PRP scheme[8]. Figure 1 reports the evolution of firm-level bargaining and the adoption of collective PRP before and

[8] Regardless of the wave (and the definition) considered, information on the introduction of collective PRP is available only for the year in which the new contract is signed. We then assume that firms adopt a collective PRP also in the following years, unless a new firm-level contract without collective PRP is signed.

after the change in the collective bargaining setting. The first panel (1a) shows that, while roughly one firm out of two has a firm-level contract over the whole period, the share of firms with collective PRP grew from 10 per cent in 1989 to over 40 per cent in 2007, with a sharp increase in diffusion in 1995-1996.

This structural change in the bargaining setting is even more clear-cut when we restrict attention only to firms bargaining a new firm-level contract each year: the share of bargaining firms adopting collective PRP goes from 35 per cent in 1989-1994 to nearly 90 per cent in 1996 and stays about this level in subsequent years (see panel 1b). Hence, the data clearly highlights the existence of a discontinuity between 1994 and 1995.

[INSERT FIG 1]

Table 1 reports the mean values of productivity and other firm characteristics by firm type. Since collective PRP can be adopted only through firm-level bargaining, we consider three main groups of firms: those without a firm-level contract (and hence without collective PRP), those with a firm-level contract but without collective PRP and those with a firm-level contract and with collective PRP. Figures in the Table show that firms introducing collective PRP schemes differ from the other firms not only in terms of productivity (proxied by real sales per worker)[9], but also along many other dimensions, such as size, workforce composition, wage level, working time schedules, industrial relations. Although smaller in size, most of these differences are statistically

[9] Real values were obtained using the output deflator for the manufacturing sector at 2000 constant prices. We could not use a measure of hourly productivity (such as real sales per worker-hour) because of the lack of precise information on annual working time.

significant also when we restrict the comparison group to firms with a firm-level contract but without collective PRP.

[INSERT TAB 1]

Among firms with collective PRP, considerable heterogeneity emerges also in the nature of the PRP schemes themselves. Figure 2 shows the share of firms with collective PRP by type of parameter used to compute the amount of the collective PRP premium for the 1995-1999 period[10]. The most used indicators are productivity (almost two thirds of the firms), profitability (around 53 per cent of the firms) and product quality (almost 48 per cent of the firms). Collective PRP are much less parameterized on indicators of workers presence (i.e. absenteeism) and efficiency, which are used in approximately 36 and 25 per cent of the firms, respectively. Firms use more than one parameter, but they usually avoid too complex algorithms (the median number of parameters is two). Among the firms using only one parameter (around 25 per cent of the total), almost 40 per cent adopts a "pure" productivity premium (i.e., depending only on one indicator of productivity), while a "pure" profit sharing scheme (i.e., depending only on one indicator of profitability) is used by 26 per cent of these firms. The role of profits may be actually more crucial, since in the majority of the firms actual payment is conditional upon the existence of (positive) profits[11]. Finally, quality indicators are seldom used by themselves, but they are often combined with other parameters, particularly with productivity ones, with the aim to avoid that higher productivity is

[10] Detailed information on structure and payment of collective PRP is available only since 1995.

[11] The "conditional clause" is applied to the entire premium in one quarter of the firms with collective PRP while it conditions part of the total payment in one third of the firms.

obtained at the expense of product quality[12]. Overall, this evidence suggests that firms adopt quite different collective variable pay schemes, whose actual design is probably driven by firms-specific factors, such as availability of data to measure the relevant parameters, management quality and industrial relations climate.

[INSERT FIG 2]

4. The empirical strategy

Given the availability of firm-level panel data, we estimate the following model:

$$Y_{it} = \alpha PRP_{it} + \beta X_{it} + \theta_i + \tau_t + \varepsilon_{it} \qquad [1]$$

where Y_{it} is a measure of productivity of firm i at time t, PRP is a dummy equal to 1 if collective PRP is adopted by firm i in year t, X_{it} is a vector of time-varying control variables[13], θ_i are firm-specific fixed effects, τ_t the common time fixed effects and ε_{it} the usual error term. α and β are parameters to be estimated.

We start with the traditional approach by estimating model [1] with a FE estimator.

However, in the framework of the treatment evaluation literature[14], estimation of equation [1] by Fixed Effects (FE) - or First Differencing (FD) - provides consistent estimates of the causal treatment effect (i.e., the parameter α) as long as the treatment is

[12] A quality indicator is used by less than 5 per cent of firms using only one indicator, almost 45 per cent of those using two indicators (and half of them combines quality and productivity).

[13] See the Appendix for the variables used as controls.

[14] In our case, we can consider the introduction of collective PRP as the treatment; hence, the firms which introduce such premia can be considered as "treated", while the others may be part of the "control group".

strictly exogenous or under the assumption that the only difference between the treated and the control group are captured by the individual fixed effects θ_i (Ichniowski and Shaw, 2009). Correlation between the treatment and the error term causes inconsistency in both estimators, but the FE one has smaller bias than the FD one when we can assume contemporaneous exogeneity (Imbens and Wooldridge, 2009).

In our case, in order to account for any residual endogeneity in the adoption of collective PRP, not captured by firm-specific fixed effects (such as measurement error or reverse causality), in the empirical analysis we also exploit the quasi natural experiment provided by the institutional reform discussed above. Specifically, the reform was an exogenous shock to the probability of adoption of a collective PRP scheme that since 1995 altered the probability of collective PRP adoption in a random way – i.e. depending on both the elapsed time since the last firm-level contract and its length (see again Figure 1b). For this reason, we consider as "treated" only those firms which introduced the collective PRP scheme from 1995 onwards (i.e. the first to be able to do it after the 1994 industry-wide "metal-engineering" agreement).[15] Since we use a within estimator, the "control" group includes the same firms before the adoption of the collective PRP scheme and all firms which never adopted collective PRP schemes over the period considered.

[15] As a consequence of our identification strategy, we drop firms with collective PRP before 1995, for whom the introduction of such schemes is more likely to be endogenous and dependent from past productivity levels. This should not be the case after the 1993 Reform because, as discussed in section 2 and shown in Figure 1, most of the bargaining firms of the metal-engineering industry introduced some form of collective PRP since 1995. However, in Section 6 we perform a number of robustness checks also on the whole sample.

5. Main results

Table 2 presents the main estimates of the effect of collective PRP on labour productivity (proxied by the natural logarithm of real sales per worker) for the whole sample (columns 1-6) and based on the identification strategy discussed above (column 7). We used a linear fixed effects estimator with clustered standard errors. Using the whole sample and considering as "treated" all firms which introduced collective PRP schemes in any year over the 1989-1999 period, in column 1 we control for time and firm fixed effects; we then progressively add controls also for firm size (column 2), workforce characteristics (column 3), working time schedules (column 4) other firm characteristics (column 5) and industrial relations (column 6). Using the latter specification, in column 7 we exploit the exogenous reform discussed above and we consider as "treated" only firms introducing collective PRP since 1995. [16]

In the most parsimonious specification, with only firm-specific and time fixed effects, the estimated productivity gain is above 6 per cent. Once all controls are included, our estimates suggest that collective PRP increases productivity by 5.1 per cent and this effect is statistically significant. Overall the estimated productivity gain proves to be rather robust to model specification. When we estimate the full model using as "treated" firms only those which introduce collective PRP since 1995, the estimated productivity gain, albeit slightly smaller, remains positive (around 4.7 per cent) and statistically significant.

(TABLE 2 AROUND HERE)

[16] See the Appendix for a detailed description and basic statistics of the variables. Complete estimates are available upon request.

On the whole our results point out that the estimated productivity effect is much smaller than that found in the case of piece rates (which can reach 30-50 per cent), but it is not negligible. For example, if we consider the most conservative estimate in column 7, productivity gains deriving from collective PRP correspond to about 8 per cent of the overall increase registered in average productivity over the period considered. Such contribution is much larger (around 14 per cent) if we restrict our analysis to the four years around the reform.

Since identification strategy exploiting the 1993 Reform provides more conservative estimates than the traditional FE approach, in the remaining of this Section we report estimates based on the model specification in column 7.

In Table 3 we investigate the existence of heterogeneous effects by group of firms, specifically by firm size, sub-industry and union power. Our estimates by firm size show that only firms with more than 20 employees enjoy productivity gains following the introduction of collective PRP schemes. Furthermore, estimates by sub-industry show no statistically significant productivity effects in the case of firms providing technical assistance (see estimates for services in Table 3); a statistically significant effect is found for the other sectors, but productivity gains are larger in high tech sectors than in firms in low tech ones (6.3 per cent and 4.6 per cent respectively). Results by union presence confirm that positive productivity effects are larger in firms with a relatively low share of unionized workers, but a statistically significant positive effect is found also in firms with a high unionisation rate (albeit its size is less than half than that found for low unionized firms).

(TABLE 3 AROUND HERE)

Overall, these estimates suggest that productivity effects following the introduction of collective PRP are greatly influenced by firms characteristics like size, economic sector and union density.

Finally, we test whether the effect of collective PRP on productivity depends on the main features of the collective PRP scheme in terms of number and type of parameters used to actually compute the wage premium. We expect that PRP schemes characterized by complex algorithms or by the lack of parameters directly related to productivity may be less effective, in terms of productivity growth, than PRP schemes based on few parameters, including a productivity indicator. Table 4 reports the main estimates of the effect of collective PRP by number of parameters used in the algorithm of the premium (column 2), by type of parameters (column 3) and by type of payment (i.e., conditional or not on the existence of profits, column 4). Since this information is available only since 1995, the reported estimates refer to the 1995-1999 period. The productivity effect estimated for this sub-period and reported in the first column of Table 4 is around 2.7 per cent, two percentage points smaller than that estimated for the whole period. Estimates in columns 2 and 3 suggest that productivity effects are smaller in firms whose collective PRP scheme is relatively complex or linked to profitability indicators, but the estimated coefficients are not statistically significant. A statistically significant negative effect is found for collective PRP schemes whose actual payment is conditional upon the existence of (non-negative) profits; furthermore, the size of the estimated negative effect of such clause completely off-sets the productivity gains

generated by collective PRP.[17] If we interpret this "conditional clause" as a way to share the risk with workers, we can conclude that collective PRP schemes are less effective, in terms of firm productivity, if they are not exclusively targeted to extract workers' effort.

(TABLE 4 AROUND HERE)

6. Robustness checks

Our identification strategy relies on the exogenous shock to the adoption of collective PRP determined by the 1993 Reform and on the fact that the actual timing of introduction of collective PRP was mainly determined by the remaining duration of the firm-level contract already in place. In this perspective, productivity gains should not depend on the date of adoption of collective PRP: in our case the existence of heterogeneous effects by date of adoption of collective PRP may signal that some sources of endogeneity are not taken into account by our identification strategy. In order to test it, we split the firms introducing collective PRP after the 1993 Reform in two groups: the "early adopters" (which introduced collective PRP in 1995-96) and the "late adopters" (which introduced such schemes since 1997). The main estimates are reported in the first two columns of Table 5, where the estimated coefficient for the variable named *PRP 97-99* should be interpreted as the differential productivity effect between late adopters and early ones. According to our estimates, the differential effect for the late adopters is negative but not statistically significant, showing that productivity gains are not significantly influenced by the date of introduction of collective PRP.

[17] The F test on the sum of these two coefficients does not allow to reject the null hypothesis that this sum is equal to zero (F(1, 5029)=0.21 and corresponding p value=0.65).

Furthermore, since collective PRP are usually bargained with local unions and bargaining firms are on average larger and more unionized than non-bargaining ones, the probability of introducing a collective PRP scheme is highly correlated with the probability of adopting a firm-level contract, which in turn depends on firm size and union presence. Given this feature of the Italian bargaining system, in the remaining columns of Table 5 we restrict our sample to firms with a firm-level contract (columns 3 and 4) and to bargaining firms between 1989-99 (columns 5 and 6). Our main estimates show that the productivity gains deriving from the introduction of collective PRP remain positive and statistically significant and the size of the estimated effect (4.2 per cent when we consider all the firms with a firm-level contract, 4.7 per cent when we restrict to bargaining firms in the 1989-99 period) is very similar to that found in our preferred specification, when also non-bargaining firms are included in the sample (see last column of Table 2).

(TABLE 5 AROUND HERE)

Finally, using the whole sample we estimate a two-stage model in which we exploit the 1993 Reform as the exclusion restriction in the first stage to estimate the probability to adopt a collective PRP scheme. In practice, we are assuming that the 1993 Reform affects firm productivity only through its effect on the probability of adoption of collective PRP. We then implement a two-stage strategy, where in the first stage we estimate the probability of adoption of collective PRP and then use its predicted values in the second stage (our equation of interest) to replace the actual PRP dummy:

$$PRP_{it} = \alpha R_t + \beta X_{it} + \theta_i + t_t * I_i + v_{it} \qquad [2a]$$

$$Y_{it} = \alpha \hat{PRP}_{it} + \beta X_{it} + \theta_i + t_t * I_i + u_{it} \qquad [2b]$$

where *PRP*, as in equation [1], is a dummy capturing the adoption of collective PRP in firm i in year t, *R* is a dummy equal to 1 for the years following the reform of the collective bargaining system at the firm level (hence, since 1995) triggered by the Social Pact, *Xit* is the vector of time-varying control variables, *θi* is a vector of firm-specific fixed effects, and *vit* the error term. Since the Reform dummy is collinear with the vector of year dummies, in this specification we use industry-specific time trends for eleven industries ($t_t * I_i$, where t is the linear time trend and I is a dummy equal to 1 for the industry of firm i) instead of time fixed effects.[18] In the second stage, $\hat{PRP}$ is the estimated probability of adoption of collective PRP from the first stage and all the other variables have the same meaning as above.

The use of a fixed effects estimator in the first stage is complicated by the binary nature of the dependent variable. On the one side, the traditional linear Fixed Effects (FE) estimator allows to control for unobserved individual heterogeneity and provides consistent estimates also in the case of correlation between the regressors and the individual fixed effects, but it does not take into account that the dependent variable is binary; on the other side, the Random Effects (RE) probit provides consistent predicted probabilities only under the strong assumption that the individual fixed effects are not correlated with the regressors. A way to solve this problem is to augment the RE probit model with the means of all the time-varying variables by firm as additional regressors,

[18] Our main results still hold even if we use alternative specifications of the time trends (such as quadratic or cubic functions). Estimates are available upon request.

which should proxy individual fixed effects (Mundlak, 1978). We call this estimator "RE probit with Mundlak correction".

In light of these features, we estimate the first stage with three alternative estimators: a linear FE model (with linear predictions subsequently recoded into a binary variable)[19], a RE probit model and a RE probit model with Mundlak correction. We then always use the linear FE model in the second stage.

Table 6 reports the main estimates for the Reform dummy in the first stage and for the predicted PRP variable in the second stage computed with the three alternative estimators. All the three models point out that the 1993 Social Pact has significantly increased the probability of adoption of collective PRP. Furthermore, the second stage estimates confirm that the introduction of collective PRP increases productivity and this effect is statistically significant, between 4.4 per cent (with the linear FE model) and 5.6 per cent (with the "pure" RE probit). The comparison with the results in the last column of Table 2 shows that the size of the estimated productivity gain is slightly larger than that found with our preferred identification strategy when the "pure" RE probit is used in the first stage, while very similar estimates are obtained in the other two cases, particularly when the RE probit with the Mundlak correction is used in the first stage[20].

(TABLE 6 AROUND HERE)

[19] The predicted probability is equal to 1 if the linear prediction is greater than 0.5, 0 otherwise.

[20] The estimated PRP effect in the last column of Table 6 is identical to that reported in the last column of Table 2. Complete estimates are available upon request.

7. Concluding remarks

This study provides an estimate of the causal effect of a switch from fixed wages to collective PRP on firm productivity in the context of a Social Pact. In particular, we exploit a reform of the structure of decentralized collective bargaining, occurred in Italy in the mid-nineties, which generated an exogenous variation in the probability of firms to adopt a collective PRP scheme. Using a unique and very rich firm-level panel data-set for the Italian metal-engineering industry, we implement a fixed effects model combined with a quasi-natural experiment and show that the introduction of collective PRP led to productivity gains up to 5 per cent. This result proves to be very robust to a number of sensitivity checks. Productivity effects are also found to be heterogeneous across different firms types, such as: firm size, industry affiliation and union density. Our results show that productivity gains are larger in medium-large firms, high-tech industries and low unionized firms. Overall our findings show that, albeit on a different scale with respect to individual PRP, collective PRP do improve firm productivity. We also show that the design of the PRP scheme (in terms of number and types of parameters) does matter for firm performance. Productivity gains are smaller when complex PRP schemes (i.e. with a large number of parameters) are adopted, while no effects are found when a "conditional clause" is used – i.e. when the premium is paid only if the firm makes (non-negative) profits, no matter what the other targets are. Our interpretation of this result is that collective PRP schemes determine productivity gains only when used to incentive workers' effort, while they are not effective when introduced to share the risk with workers.

In terms of policy implications, this new perspective on Social Pacts suggests that changes in the institutional setting may be effective in promoting the diffusion of

decentralized bargaining over variable pay schemes, with significant effects on firms productivity. However, given the heterogeneous nature of pay arrangements within firms - which are likely to reflect differing managerial strategies, organization of production and work - any public incentive across the board may imply large deadweight losses. Public support to collective PRP should itself be flexible enough to allow each firm to adopt the most suitable collective PRP scheme, thus increasing the likelihood of productivity gains. In this perspective, the Italian 1993 Social Pact suggests that "a mild" law combined with social pressure, even in the absence of formal incentives or sanctions, may provide more flexibility and leeway – and hence more compliance - than stricter and more formal regulation issued by the Central Government without the support of the main social partners.

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Figure 1
Incidence of firm-level contract and collective PRP, 1989-2007

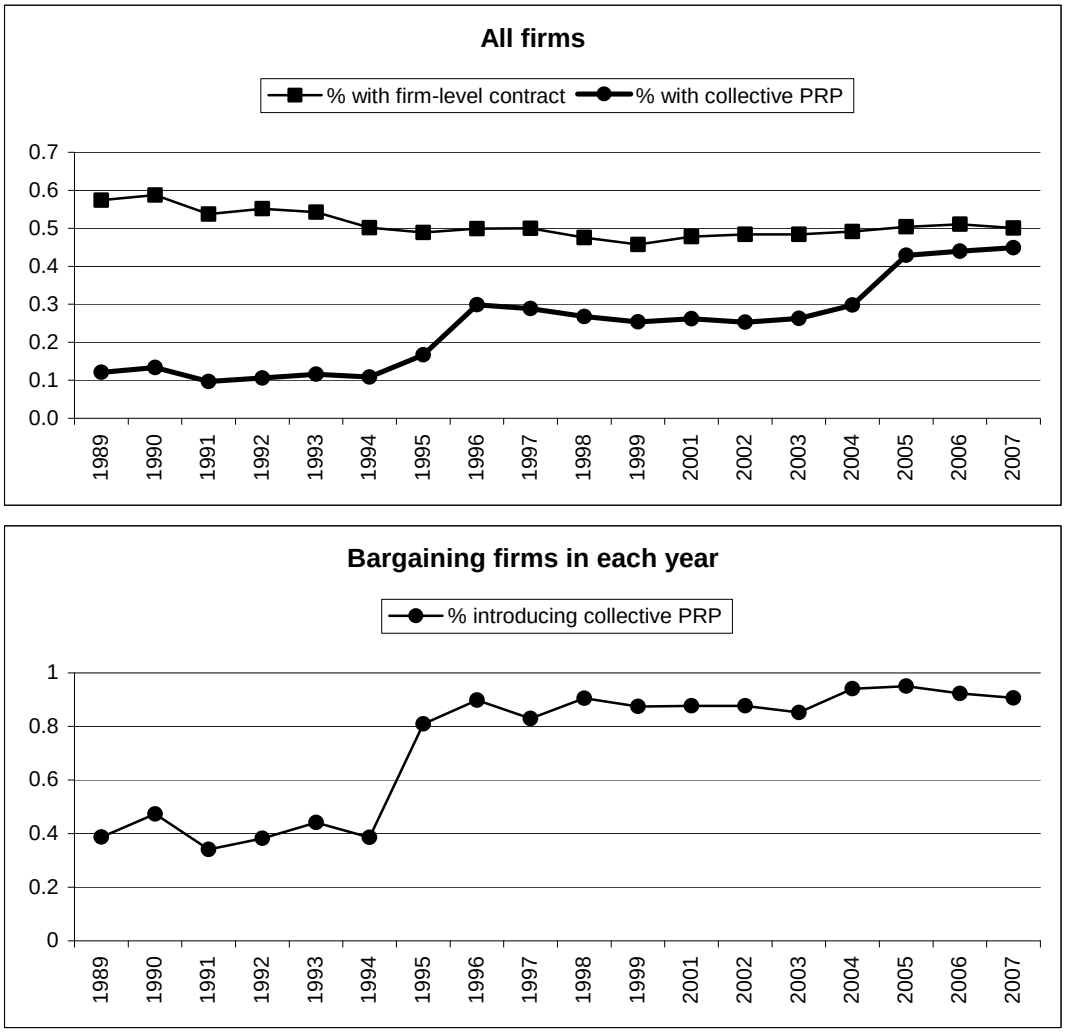

Figure 2
Parameters used to design the collective PRP, 1995-1999

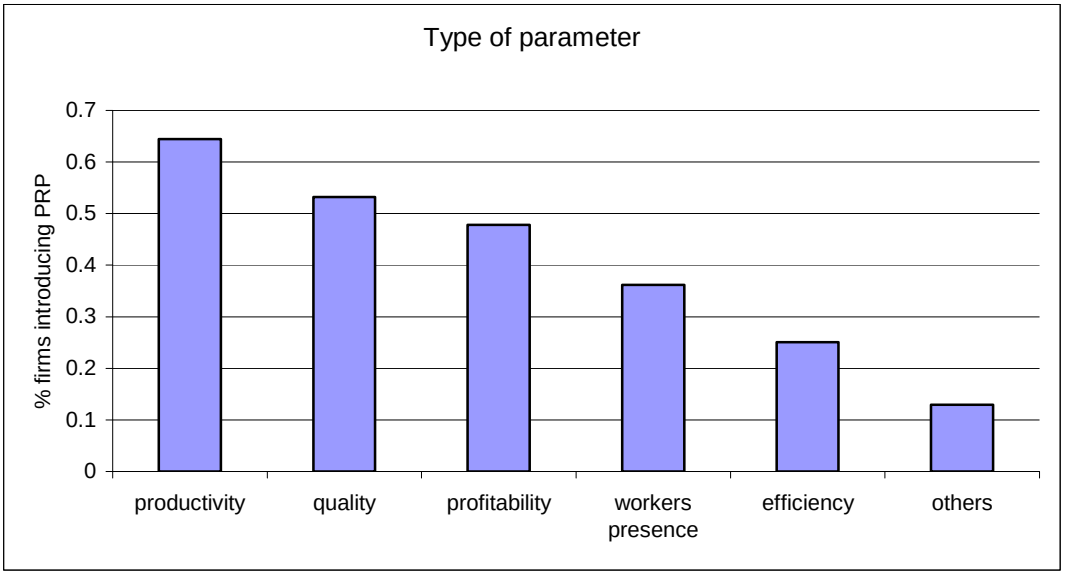

Table 1 - Differences by firm type
Pooled data, 1989-1999

	no PRP and no contract	no PRP and contract	PRP (and contract)	Differences	
	a	b	c	c-a	c-b
logprod	5.12	5.06	5.39	0.28 ***	0.34 ***
Other characteristics					
Firm size (n. employees):					
1-19	0.48	0.13	0.04	-0.44 ***	-0.09 ***
20-49	0.35	0.29	0.20	-0.15 ***	-0.09 ***
50-99	0.11	0.23	0.21	0.10 ***	-0.02 ***
100 and over	0.05	0.35	0.55	0.49 ***	0.19 ***
multiplant	0.21	0.18	0.41	0.20 ***	0.23 ***
Workforce composition					
% women	0.22	0.19	0.20	-0.02 ***	0.00
% white collars	0.34	0.32	0.33	-0.01 **	0.01 ***
% training contracts	0.06	0.04	0.04	-0.02 ***	0.00
% temporary workers	0.02	0.01	0.02	0.00	0.01 ***
% part-time workers	0.03	0.02	0.02	-0.01 ***	0.00
immigrants	0.43	0.32	0.63	0.20 ***	0.31 ***
Working time schedules					
flex time	0.04	0.08	0.11	0.07 ***	0.03 ***
shifts	0.13	0.37	0.56	0.43 ***	0.19 ***
overtime	66.1	74.7	68.4	2.29	-6.35 ***
temporary lay offs	0.11	0.23	0.17	0.06 ***	-0.05 ***
Industrial relations					
firm-level contract	0.00	1.00	1.00	-	-
unions	0.45	0.91	0.96	0.51 ***	0.05 ***
union density	0.14	0.41	0.40	0.26 ***	-0.01 ***
strike	0.15	0.60	0.62	0.47 ***	0.02 ***
Other firm characteristics					
logwage	9.74	9.77	9.79	0.04 ***	0.01 ***
outsourcing	0.52	0.63	0.68	0.16 ***	0.05 ***
export	0.50	0.71	0.78	0.28 ***	0.07 ***
investment	0.29	0.47	0.60	0.31 ***	0.13 ***
N obs	16087	10792	4658		

= statistically significant at 5% *= statistically significant at 1%

Note: see the Appendix for variable definitions

Table 2
Effect of PRP on labour productivity, 1989-99
Linear FE estimates; dependent variable: log of real sales per worker

	Whole sample						Treated firms introducing PRP since 1995
	1	2	3	4	5	6	7
PRP	0.064***	0.065***	0.066***	0.059***	0.057***	0.051***	0.047***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
firm size	No	Yes	Yes	Yes	Yes	Yes	Yes
workforce characteristics	No	No	Yes	Yes	Yes	Yes	Yes
working time schedules	No	No	No	Yes	Yes	Yes	Yes
other firm characteristics	No	No	No	No	Yes	Yes	Yes
industrial relations	No	No	No	No	No	Yes	Yes
R2 (overall)	0.234	0.226	0.266	0.284	0.309	0.309	0.315
N obs	29153	29153	27618	27618	26491	26455	25043
N firms	8604	8604	8212	8212	7894	7891	7741

Note: Robust standard errors in brackets.
= statistically significant at 5% *= statistically significant at 1%.

Table 3
The effect of collective PRP on labour productivity by firms group, 1989-1999
Linear FE estimates; dependent variable: log of real sales per worker

	by firm size (n. employees)		by sector°			by union density^	
	<20	>=20	low tech	high tech	services	low	high
PRP	-0.058	0.044***	0.046***	0.063**	-0.021	0.063**	0.031**
	(0.05)	(0.01)	(0.02)	(0.03)	(0.04)	(0.02)	(0.01)
time fixed effects	yes	yes	yes	yes	yes	yes	yes
firm characteristics	yes	yes	yes	yes	yes	yes	yes
R2 (overall)	0.273	0.338	0.356	0.264	0.248	0.269	0.356
N obs	6593	18450	14311	5962	4770	12201	12878
N firms	2637	5696	4549	2126	2013	4625	4243

Note: Model specification as in column 7 of Table 2. Robust standard errors in brackets.
= statistically significant at 5% *= statistically significant at 1%.

° Low tech sectors: foundries, metals, metallic tools and metal micro-parts; High tech sectors: precision tools, electronic equipment and transportation; Services: technical assistance and technical offices.

^ Based on the median unionization rate (24%).

Table 4
Effect of PRP on labour productivity by type of premium, 1995-1999
Linear FE estimates; dependent variable: log of real sales per worker

	1	2	3	4
PRP	0.027**	0.040**	0.028**	0.042***
	(0.01)	(0.02)	(0.01)	(0.02)
complex prp (3 or more parameters)		-0.027		
		(0.02)		
pure productivity premium			0.008	
			(0.04)	
pure profit sharing			-0.017	
			(0.04)	
prp payment conditional on positive profits				-0.053**
				(0.03)
time fixed effects	yes	yes	yes	yes
firm characteristics	yes	yes	yes	yes
R2 (overall)	0.056	0.056	0.056	0.056
N obs	11872	11872	11872	11872
N firms	5030	5030	5030	5030

Model specification as in column 7 of Table 2. Robust standard errors in brackets.
= statistically significant at 5% *= statistically significant at 1%.

Estimates for each type of scheme should be interpreted as the differential effect with respect to the general category PRP

Table 5
Estimates by time of adoption of PRP and for restricted samples
Linear FE estimates; dependent variable: log of real sales per worker

	All firms		Firms with a firm-level contract		Bargaining firms between 1989-1999	
PRP	0.069***	0.060***	0.053***	0.042***	0.058***	0.047***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)
PRP 97-99	-0.012	-0.015	-	-	-	-
	(0.01)	(0.01)				
time fixed effects	yes	yes	yes	yes	yes	yes
firm characteristics	no	yes	no	yes	no	yes
R2 (overall)	0.241	0.315	0.273	0.338	0.280	0.329
N obs	25043	25043	12468	12468	8811	8811
N firms	7741	7741	4064	4064	2135	2135

Note: Full model specification as in column 7 of Table 2. Robust standard errors in brackets. **= statistically significant at 5% ***= statistically significant at 1%.

Table 6
Two stage estimates
Dependent variable in second stage: log of real sales per worker

	1		2		3	
	First stage (linear FE)	Second stage	First stage (RE probit)	Second stage	First stage (RE probit-Mundlak)	Second stage
1993 Reform	0.081***	-	1.861***	-	2.030***	-
	(0.008)		(0.208)		(0.263)	
PRP°	-	0.044***	-	0.056***	-	0.047***
		(0.016)		(0.021)		(0.015)
time trend	yes	yes	yes	yes	yes	yes
firm characteristics	yes	yes	yes	yes	yes	yes
R2 (overall)	0.244	0.309	n.a.	0.309	n.a.	0.309
N obs	26455		26455		26455	
N firms	7891		7891		7891	

Note: In second stage model specification as in column 6 of Table 2, except for industry-specific time trends instead of year dummies. Robust standard errors in brackets.
= statistically significant at 5% *= statistically significant at 1%.

° Estimated PRP from first stage. With FE linear model, linear prediction from first stage transformed into binary variable (with estimated PRP =1 if linear prediction >0.5, 0 otherwise)

Appendix - Basic definitions and descriptive statistics
Pooled data, 1989-1999

	Definition	Mean	Standard deviation
logprod	log of real sales per worker	5.140	0.655
PRP	1 if firm adopts collective PRP, 0 otherwise	0.148	0.355
Other characteristics			
Firm size (reference group: 1-19 employees):			
20-49	1 if 20-49 employees, 0 otherwise	0.307	0.461
50-99	1 if 50-99 employees, 0 otherwise	0.164	0.370
100 and over	1 if 100 or more employees, 0 otherwise	0.230	0.421
multiplant	1 if multi-plant firm, 0 otherwise	0.227	0.419
Workforce composition			
% women	women/employees	0.207	0.175
% white collars	white collars/employees	0.333	0.222
% training contracts	workers on training contract/employees	0.050	0.103
% temporary workers	temporary workers/employees	0.020	0.078
% part- time workers	part-time workers/employees	0.024	0.065
immigrants	1 if any immigrant worker in the firm, 0 otherwise	0.425	0.673
Working time schedules			
flex time	1 if firm adopts flexible working hours, 0 otherwise	0.064	0.246
shifts	1 if firm adopts shifts, 0 otherwise	0.276	0.443
overtime	annual overtime hours per worker	69.380	91.800
temporary lay offs	1 if firms uses temporary lay-offs, 0 otherwise	0.160	0.363
Industrial relations			
firm-level contract	1 if firm has a firm-level contract, 0 otherwise	0.490	0.500
unions	1 if any unionized worker, 0 otherwise	0.683	0.465
union density	unionized workers/employees	0.274	0.266
strike	1 if any strike during the year, 0 otherwise	0.376	0.484
Other firm characteristics			
logwage	log of average real wage	9.758	0.150
outsourcing	1 if firm outsources part of the production, 0 otherwise	0.579	0.494
export	1 if exporting firm, 0 otherwise	0.614	0.487
investment	1 if new investments during the year, 0 otherwise	0.396	0.486