LABOUR MARKET
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16

The effects of profit-sharing schemes on enterprise performance in France

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Contents

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Foreword

Micro-level labour market analysis is often a messy business. This is in part due to the complex data requirements, especially given the need to provide adequate control variables and empirical proxies for the causal relationships that the theorist wishes to examine. It is also partly because data for testing hypotheses are rarely available.

For many years, "profit sharing" in one form or another has been subject to widely divergent interpretations. Some have been suspicious or hostile, perhaps seeing it as a means of intensifying *income insecurity* for workers. Others have seen it as the means of raising productivity, imparting wage flexibility and reducing unemployment.

This paper is an interesting analysis of several aspects of this important debate, utilising a rich source of data on French enterprises. It is a sophisticated analysis that deserves to be noted by those concerned with labour market and enterprise performance.

While many economists also believe that, *properly designed*, profit sharing systems could benefit workers directly, an important point about this type of research is that it shows that profit sharing benefits enterprises. Therefore, there is no real need for subsidies or tax incentives, because it is something firms should wish to introduce. Why, in that case, are so many firms reluctant or unwilling to introduce profit sharing? This is an issue that deserves further investigation. One reason is surely lack of information among employers about the probable benefits. If so, then knowledge of empirical findings should be disseminated as widely and as effectively as possible.

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Abstract

France has one of the most extensive sets of legislative provisions in favour of profit-sharing and one-third of all non-government employees are covered by at least one subsidised scheme. Subsidised, regulated schemes include statutory profit-sharing (*participation*) which is compulsory in all firms with 50 employees or more, and voluntary profit-sharing (*intéressement*). The paper assesses the effects of voluntary profit-sharing on total factor productivity and the importance of the context in which the schemes are implemented. A production function is estimated on a representative five-year panel of around 5,000 French firms a year in industry and services, with entry and exit. Voluntary profit-sharing is found to significantly increase total factor productivity. Some of the effects may be due to other forms of employee involvement introduced together with profit-sharing. The effect of the voluntary scheme is greater in firms also required to have a statutory scheme. In these larger firms, profit-sharing and close supervision of blue collar and clerical employees may have conflicting effects if they are combined. Finally, profit-sharing is found to increase total factor productivity both generally and by affecting the shape of the technology. The form of the productivity effect is such that the associated employment impact is unambiguously positive at the firm level.

1. Introduction

An old pay system, profit-sharing has attracted considerable attention in the past decade after Weitzman (eg 1984, 1985) argued that it could cure unemployment without creating inflation. More traditionally, profit-sharing has been regarded as a way of improving employee motivation and performance (see eg ILO, 1984) or simply of redistributing to employees a share of the wealth they contributed to create. These ideas are known to have motivated legislation encouraging enterprises to set up profit-sharing schemes in several countries, in some cases dating back to the post-war reconstruction era. A substantial proportion of private sector employees are currently covered by profit-sharing plans in a number of countries. These include Japan, France, the United Kingdom, Canada and Italy but also Mexico, where profit-sharing in compulsory, and perhaps India (see Uvalic, 1991; Estrin, Pérotin, Robinson and Wilson, 1996; OECD, 1995; Deshpande, 1995; Vaughan-Whitehead, 1995).

Profit-sharing also touches on several important current debates about enterprise organization and employment and labour practices. As a system that partly relates pay to collective performance, profit-sharing can be viewed as one of several incentive pay schemes, the relative effectiveness of which may vary with the context in which the schemes are implemented (see eg Blinder, 1990). As a pay system that involves a variable element, profit-sharing implies that employees bear a financial risk; yet it may still be chosen by negotiating parties if there is a trade-off between pay flexibility and employment flexibility (see Jackman, 1988; Zylberberg, 1989). In addition, profit-sharing is a little more than a pay system in that, unlike other pay systems, it makes employees "residual claimants" in the firm by entitling them to a portion of enterprise profits. As such, it is a weak form of employee participation and links in to discussions of economic democracy, the high performance firm (US Department of Labor, 1994) or the human development enterprise (Standing, 1995).

At the enterprise level, profit-sharing may affect employment in three ways. By introducing a wedge between the level of pay and the marginal cost of labour to the firm (the fixed wage), it may increase the level of employment at a given pay level. This is the essence of the hypothesis put forward by Weitzman (1984) and before him by Vanek (1965).[1] Profit-sharing may also limit employment flexibility, especially downwards. Besides these direct effects, profit-sharing schemes may affect the employment level of the firm indirectly, by improving enterprise performance.

This paper focuses on the effect of profit-sharing on the enterprise's productive efficiency by measuring the effect of the existence of a profit-sharing scheme on total factor productivity. The general approach we use was developed in the context of research on the effects of various forms of employee participation on enterprise performance (see eg Estrin, Jones and Svejnar, 1987). This approach can also be used to investigate the relationship between other aspects of company organization, employee protection or information schemes and enterprise performance.

[1] By making part of pay dependent on a percentage of profit that does not vary with the number of employees, profit-sharing effectively reduces to the fixed part of pay the cost that the firm has to provide for if it hires an extra worker (the rest of the remuneration will depend on the profit level). For a given total pay level, this implies that the marginal cost of labour to the firm is lower than if pay was entirely fixed and the firm's demand for labour should be higher.

Our findings are consistent with a growing body of evidence suggesting that profit-sharing, along with other forms of employee involvement, does have positive effects on productivity (see Estrin et al., 1996). However, the estimated magnitudes of these effects vary across authors and countries, and so do the channels through which these effects are thought to operate (see eg Cable and Wilson, 1989, 1990). Little empirical work on this subject has been done on France since Defourny, Estrin and Jones's work (1985) on the effects of various forms of participation in French workers' cooperatives (see Vaughan-Whitehead, 1992; Cahuc and Dormont, 1992). Recent estimates on French data only allow for an upward shift of the production function under the effect of profit-sharing. Yet, profit-sharing may just increase total factor productivity or also affect the technology itself and/or interact with characteristics of the firm's organization and industrial relations. The precise form of the effect has implications for the employment level of the firm. An overall increase in total factor productivity (disembodied effect) should be associated with a higher level of employment if the firm's sales can increase, whereas if the firm's technology is altered (embodied effects) the direction of the associated employment effect may be ambiguous.[2]

The estimates presented in this paper use a large representative sample of French firms and both embodied and disembodied effects are allowed for. The use of unbalanced panel estimation techniques enables us to control for persistent, unobserved characteristics in which sharing and non-sharing firms may differ, while retaining a representative sample of French firms. Given that small and large firms have different legal obligations in matters of profit-sharing, we also test for the possibility that voluntary profit-sharing does not have the same effect on productivity in the two groups of firms. Finally, we are able to control for "efficiency wage" practices, which may also increase productive efficiency.

In sections 2 and 3, we summarise the situation of profit-sharing and financial participation in France and outline the main existing hypotheses about the effects of profit-sharing on total factor productivity. The data and estimation methods are the subject of section 4 and empirical results are presented in section 5. Conclusions are summarised in the final section.

2. Profit-sharing in France

Profit-sharing is understood here in the Weitzman sense of a scheme under which a part of employees' pay takes the form of a bonus that varies with the level of company profit or some related measure of performance at the enterprise level. The remaining part of pay is primarily composed of a fixed wage and may also include other bonuses (eg bonuses linked to individual performance, discretionary bonuses etc.). Under profit-sharing, the rules for determining the total share of profit to be allocated to employees as well as its distribution among employees individually are known in advance. The bonuses themselves may be paid out in cash, invested into employee accounts or trusts, actual payment being deferred for several years, and/or paid in the form of company shares.

We do not include here other financial participation schemes such as pure employee share ownership, where the initial benefit (such as an allocation of shares) is independent of company performance. However, firms that have profit-sharing plans may also have

[2] These employment effects associated with total factor productivity enhancement are in principle distinct from the Vanek-Weitzman effect mentioned above.

employee share ownership schemes. The primary reason for operating this distinction is that as the types of incentives provided to employees differ (individual vs collective incentives, schemes with or without an ownership component) the effects on employee motivation and behaviour and firm performance may also vary. Thus, for example, profit-sharing schemes never involve sharing losses, unlike employee share ownership schemes, under which the share value may drop. At the same time, profit-sharing itself does not entitle employees to any share in decisions which may affect the level of their future bonuses, whereas employee-owned shares may carry voting rights. For similar reasons, all the schemes considered here cover most employees in the establishment. Executive schemes apply to people with better access to information, career prospects and income levels (and thus presumably lower risk-aversion) than other employees and in our opinion should be approached differently altogether.

France has one of the oldest and most extensive sets of legislative provisions in favour of profit-sharing. There exist two types of subsidised profit-sharing schemes in France. *Intéressement*, introduced in 1959, is voluntary and commits the firm, once a contract has been signed with the workforce, to allocating to employees an annual sum determined by collective performance. The measure of performance used, the way of calculating the total allocation and individual bonuses and eligibility criteria are all set out in the contract.[3] *Intéressement* has spread fast since the revision of the legislation in 1986-90 and is the main scheme we'll look at in the paper. *Participation*, the second scheme, was introduced in 1967. This scheme is compulsory in all firms with 50 employees or more (100 employees or more in the years for which we have the data) and voluntary otherwise. We will take this difference into account by testing whether *intéressement* affects small and large firms differently. In contrast to the *intéressement* scheme, *participation* leaves very little choice to negotiating parties regarding the measurement of performance (profit), the formula used to compute total and individual benefits or eligibility criteria. All are defined in the legislation and apply even to firms that adopt *participation* voluntarily (ie small firms). In particular, *participation* bonuses have to be related to the share of wages in value added, hence to the level of employment. *Participation* and *intéressement* bonuses are exempt from social security contributions and corporate and payroll taxes.[4]

In 1992, around 7000 French firms had *intéressement* schemes, covering nearly 2 million employees (or one-fifth of all non-government employees). Of these schemes, about 80% used a measure of profit as the indicator of company performance that determined the total profit-sharing bonus. The same year, about 14,000 firms had *participation* plans, covering 5 million employees (see Estrin et al., 1996). About a third of *participation* plans had been set up voluntarily by small firms. In the last decade, average *participation* and *intéressement* bonuses have fluctuated around 3% of wages for each scheme in firms that made sufficient profits to pay out bonuses. In individual firms, the level of *intéressement* can be substantially higher in certain years (though there is a legal maximum) especially in small firms. Overall, the total share of profit allocated to employees by firms that do pay

[3] See Vaughan-Whitehead (1992) for examples of *intéressement* schemes set up in large French companies.

[4] Under *participation*, workers' co-operatives benefit from slightly higher tax concessions than other firms and often make use of the possibility offered by the law to pay out higher than statutory *participation* bonuses. The French legislation in this area is described in Uvalic (1991) and summarised in OECD (1995).

out bonuses in a given year is quite high – over 20% for *intéressement* – even if it appears low in comparison to the wage bill.

3. Effects on productivity: Theory and specification

The relationship that may go from profit-sharing to employee motivation to firm performance is complex and its precise mechanisms are little known (see Pendleton, Wilson and Walley, 1991). In the absence of employee attitude survey data, we focus on the ways in which the presence of profit-sharing may affect X-efficiency in general and the technology of the firm. The following discussion summarises arguments that have been extensively reviewed (see eg Weitzman and Kruse, 1990; Jones and Pliskin, 1991; Weitzman, 1995).

The starting point of the argument is that profit-sharing may resolve a conflict of interests between employers and employees. In cases where it is costly to monitor employees' actions, it may be in employees' interests to use their informational advantage at the expense of the firm. For example, they may not put enough effort into their job. One possible solution to this incentive problem for the firm is to tie pay to performance. In this old system, which goes back to sharecropping, the incentive is provided by transferring some risk from the employer's profit on to the employee's pay, since observed performance may also be affected by random factors beyond the employee's control (see eg Stiglitz, 1974; Arrow, 1986). In addition, firms may want to use a *collective* incentive such as profit-sharing, where pay is partly dependent on collective performance, if individual output is not easy to observe (see Fama, 1991). Thus, profit-sharing may generally encourage employees to work more and better.

It has been argued that the collective nature of the incentive would generate "free riding" behaviour on the part of the workers, since the benefits resulting from one employee's effort would have to be shared with others (see Alchian and Demsetz, 1972). However, if the game between the workers is repeated, a cooperative solution, which yields higher benefits for all employees, can emerge (see Weitzman and Kruse, 1990). Profit-sharing provides employees with an incentive to monitor each other and put pressure on would-be "shirkers" (see Jones and Svejnar, 1982) with the use of information not available to management. Furthermore, profit-sharing may foster cooperation among employees and between employees and management by providing common collective goals (FitzRoy and Kraft, 1987). It may provide workers as well as managers with an incentive to circulate information, which in turn may create an atmosphere of trust enhancing efficiency and limiting resource-wasting conflicts (see Cable, 1984). Finally, profit-sharing schemes may enhance employee motivation and effort in return for what they could perceive as the company's fairness in committing itself to sharing success. This "gift exchange" process would make the schemes possible substitutes for efficiency wage practices (see Akerlof, 1982; Sessions, 1992).

It should be noted, however, that profit-sharing has no built-in mechanism to correct asymmetries that may become sources of conflicts between employees and management. Managers have access to information about company performance that is not available to other employees. In addition, certain measures of performance, such as accounting profit, are to a significant extent determined by management decisions, for example over provisions and reserves. If employees have limited trust in management, the latter may be suspected of manipulating performance figures. Thus, unless sufficient and clear

information is regularly provided to the workforce, profit-sharing schemes may result in conflicts and have short-lived or even negative effects on performance, especially if past or expected bonuses are low.

Another potential source of conflicts lies in the fact that profit-sharing plans do not have to involve employee participation in decision-making. Employees' pay may therefore be affected by non-random elements over which they have no control, such as investment decisions. It has been argued that this problem would lead employees to demand to participate in decisions (Nuti, 1988). It may also simply counter the positive incentive aspects of profit-sharing schemes or even negatively affect performance.

In addition to affecting productive efficiency generally and shifting the production function, profit-sharing may affect the technology itself and the output elasticities of labour and capital. It may improve and/or intensify employees' use of capital equipment and alter the choice of technology if previously private, relevant information is released by employees. Similarly, profit-sharing may provide employees with incentives to build up firm-specific human capital.[5]

We follow a well established tradition and estimate a production function, allowing for disembodied and embodied profit-sharing effects[6] as well as some interaction with organization and skills. As usual, since we do not have individual firms' product prices, there is a risk that we identify price differences as profit-sharing related efficiency advantages. To alleviate this problem, we control for the firm's market share on its main product market. We also control for skills. Some contexts may be more favourable than others, and profit-sharing may have more positive effects if it is associated with certain organizational features. Here we look at the role of the degree of supervision of manual and clerical employees (MONITOR). We expect a lower level of supervision to enhance the productivity effects of profit-sharing as employees have more autonomy and discretion.

Even limiting ourselves to employee incentives, it is clear that schemes other than profit-sharing may improve productivity. If the presence of these schemes is correlated to that of profit-sharing, not taking them into account may lead us to overestimate the impact of profit-sharing on productivity. Unfortunately, we have no information concerning participation in decision-making or employee share ownership, two forms of employee involvement that may not only improve X-efficiency on their own but may also enhance profit-sharing schemes' incentive effects when associated with those schemes (see Conte and Svejnar, 1988, 1990). As far as employee share ownership is concerned, this deficiency is unlikely to introduce a large bias in estimates for France. The little information available on the incidence of employee share ownership suggests it is present in considerably less firms than profit-sharing. Thus, even if the two forms of financial participation tend to be correlated, this cannot explain large, significant average productivity differentials between firms with and without profit-sharing. The situation is less satisfactory in the case of employee information schemes and participation in decision-making. The use of panel estimation techniques enables us to control to a certain extent for the effects of a systematic but unobserved presence of such schemes in firms that adopt

[5] This effect may be reinforced if profit-sharing also makes employment more stable over the cycle, enabling the firm to retain human capital.

[6] The disembodied effect will be constant and affect the intercept of the estimated function, whereas embodied effects will vary with the input levels.

profit-sharing, prior to that adoption. However, it cannot distinguish the effects of implementing a profit-sharing scheme from those of other schemes that may be adopted *at the same time* as profit-sharing as part of a form of employee involvement "package" (eg employee information programmes).

One form of incentive that we are able to control for is the practice of efficiency wages. Whether to reduce labour turnover, to raise the cost of shirking (if discovered) or as part of a "gift exchange" relationship, it is thought that certain firms may pay above-market clearing wages in order to increase productivity. Following Levine (1992) we introduce in the equation an indicator of the firm's average (fixed) wage level relative to the mean wage level in its main product industry (RELW). This variable may also reflect rent-sharing practices. It may act as an additional control for skills.[7]

All the sample firms with 100 employees or more have statutory profit-sharing (*participation*) in addition to the voluntary profit-sharing scheme we are looking at (*intéressement*). Because of this legal obligation, voluntary profit-sharing schemes may not have the same effects in these firms than in smaller firms. *Participation* and *intéressement* may be substitutes. In this case, *intéressement* would be expected to have a lower impact on productivity in firms that also have statutory *participation*. On the other hand, many firms with a statutory scheme do choose to have voluntary profit-sharing as well. Perhaps the two schemes play different roles. The effects of *intéressement* may actually be strengthened in those firms. The appropriate bargaining and information dissemination structures have already been set up under the statutory scheme. Both management and workers have an experience of profit-sharing, so that the voluntary scheme may be set up more efficiently and may be regarded with less suspicion on the part of the workforce. Firms that have a statutory scheme and decide to add a voluntary one may generally be more participatory firms than either those that merely meet their statutory obligations or the smaller firms that have a voluntary scheme.[8]

Voluntary profit-sharing may also have different effects in firms with and without statutory schemes simply because of the size difference. There may be less free-riding behaviour in smaller firms, making profit-sharing more effective. On the other hand collective incentives may be more necessary and more effective in larger firms, where the schemes may foster a greater sense of belonging and "company spirit". Profits may also be less affected by demand-related risk in large, diversified companies. This may appeal to risk-averse employees. Finally, large firms may have more resources to devote to the design of effective schemes.

To take into account the existence of statutory profit-sharing, we estimate the production function separately on firms with and without statutory profit-sharing as well as on the whole sample. Finally, we include a time trend to control for productivity changes over the cycle that may coincide with the spread of profit-sharing due to the revision of the legislation in 1986.

[7] The variable RELW concerns the fixed wage. If profit-sharing also raises the expected level of total pay (whether or not the fixed wage is higher than pay in the industry) it may have greater incentive effects than if it doesn't, both for efficiency wage reasons and because it could compensate risk-averse employees for the additional risk.

[8] Only a minute proportion of small firms set up a *participation* scheme. This information is not available in our data set, but is unlikely to concern more than a handful of firms in our sample.

We estimate a Cobb-Douglas production function of the following form:

$$\text{Log } Q = A + \beta_1 \text{ INTER} + (\alpha_1 + \beta_2 \text{ INTER}) \text{ Log } L + (\alpha_2 + \beta_3 \text{ INTER}) \text{ LogK} + (\alpha_3 + \beta_4 \text{ INTER}) \text{ MONITOR} + \alpha_4 \text{RELW} + Z\theta + \text{IND } \delta_1 + \delta_2 \text{ TIME} + U$$

where INTER is a profit-sharing dummy, β_1 is the coefficient of the production function shift associated with profit-sharing (disembodied effect), β_2 and β_3 are the coefficients of the embodied effects, β_4 is the coefficient of the effect of the interaction between profit-sharing and the organizational environment, RELW is the firm's wage level relative to the industry average, Z is a vector of market structure and skills controls and IND is a vector of industry dummies.

4. Data and estimation

The initial data set we use comprises five years (1986-90) of firm-specific, accounting, skills and profit-sharing information on a sample of about 12,000 firms a year (N=63,700 in total) in industry and services representative of the population of French firms as a whole each year. The data set was put together by merging a firm panel constructed by the French National Statistics Institute (INSEE) with Ministry of Labour surveys.

Table 1 shows the compared means of a few variables for sharing and non-sharing firms in the sample years (see variable definitions in the appendix). The means have been computed for the whole sample and observations are unweighted, so that large firms are over-represented. The statistical significance of the difference between the mean values for the two groups is assessed with a t-test.[9] Profit-sharing firms are significantly larger and more capital intensive than other firms. They also hold on average a significantly higher share of their product market. It is not surprising, therefore, that they should pay significantly higher wages on average than non-sharing firms.[10] The proportion of supervisory staff (MONITOR) is higher in sharing firms and the difference is increasingly significant over the sample period. This evolution may reflect the diffusion of *intéressement* to more traditional manufacturing firms in those years. Capital intensity and market share comparisons would lead us to expect the average productivity of labour to be higher in profit-sharing firms. However, this difference is not statistically significant.

The data set used in the estimations covers a subsample of the firms included in the means comparisons. It comprises only those firms that are present in the sample for at least three years, of which at least two consecutive years. This selection and missing observations on some variables leave a sample of around 5,000 firms a year (about 23,000 in total). The sample is stratified by size and for the estimations observations are weighted by inverse sampling proportions, corrected for missing values. The data set takes the form of an unbalanced panel, with firms entering and exiting the sample.

[9] The t-test is preceded by an F-test to check for significant differences between the two groups in the variances of the variables considered. A separate-variance t estimate is used when the hypothesis of identical variances is rejected (see Hoel, 1984).

[10] For RELW, both averages are larger than one because larger firms are over-represented in the unweighted sample.

The estimation procedure has to take into account the unbalanced nature of the panel. A number of approaches have been proposed to deal with incomplete panel data (see Hsiao, 1986 for a survey). Here we use a general framework in which the dependent variable is only determined by the specified set of regressors. We start from a standard error components specification of the regression equation:

$$Y_{it} = X_{it}\beta + \mu_i + \nu_{it}$$

where μ_i and ν_{it} are normally and identically independently distributed. Provided there is no correlation between individual effects and explanatory variables, this equation can be estimated by feasible generalised least squares (FGLS) (see eg. Hsiao, 1986).

In the case of an incomplete sample group the variance-covariance matrix of the above is written as (see Verbeek and Nijman, 1992):

$$\Phi_i = \sigma_\mu^2 l_{T_i} l_{T_i}' + \sigma^2{}_\nu I_{T_i} I_{T_i}$$

where I_{Ti} is an identity matrix of rank T_i and l_{Ti} is a unit vector (T_i , 1) and T_i is the number of periods in which the individual is included in the sample. In the case where σ_μ^2 and σ_ν^2 are known the maximum likelihood estimator is written as:

$$\beta_{ML} = (\sum_{i=1,..,N} X_i' \Phi_i^{-1} X_i)^{-1} (\sum_{i=1,..,N} X_i' \Phi_i^{-1} Y_i).$$

Baltagi (1985) showed that this estimator can be obtained by applying OLS to the transformed data:

$$Y_{it}^* = Y_{it} - (1 - \sqrt{\theta_i}) Y_{i.}$$

where $Y_{i.}$ is the average for individual *i*. θ_i is defined by (see Baltagi, 1985, and Verbeek and Nijman, 1992):

$$\theta_i = \frac{\sigma_\nu^2}{\sigma_\nu^2 + T_i \sigma_\mu^2}$$

where σ_ν^2 and σ_μ^2 can be estimated from the residuals obtained from the "within-groups" and "between-groups" estimations. The standard within-group estimator applied to the variables expressed in deviations from individual averages is inefficient. The disturbance term of the regression in the within-groups estimation is actually $u_{it} - u_{i.}$. Its variance is given by

$$V(u_{it} - u_{i.}) = V(u_{it}) + V(\sum_i u_{it}/T_i) - 2\,\mathrm{Cov}(u_{it}, \sum_i u_{it}/T_i) = \sigma_\nu^2 (T_i - 1)/T_i.$$

Since the values of T_i vary across companies, a problem of heteroskedasticity arises. To solve this problem, it is sufficient to multiply the variables by: $\sqrt{T_i/(T_i - 1)}$ so that the variance of the disturbance is constant. If the within-groups estimation is applied to the equation (fixed effects model), the estimated variance of the residual will be:

$$\sigma_\nu^2 = (\sum_i T_i - N - k)^{-1} \sum\sum [(Y_{it} - Y_{i.}) - (X_{it} - X_{i.})\beta_{FE}]^2$$

The variances of the individual effects can thus be obtained from the between-groups estimation as:

$$\sigma_{\mu}^{2} = \frac{1}{N-k} \sum \left[(Y_{i.} - X_{i.} \beta_{Bet})^2 - (1/T_{i.}) \sigma_{\nu}^{2} \right]$$

If there is a correlation between the individual effects and the explanatory variables, the FGLS estimator is biased and the within-groups (or fixed effects) estimator should be preferred. However, Hausman specification tests are inconclusive here. With such a short time dimension relative to the size of the cross-section, it is reasonable to keep the GLS estimation, which is the most efficient (Hsiao, 1986). We report the between-groups estimates of the first specification for comparison with existing estimates in France.

Given the panel is unbalanced, there also is a possibility that an individual firm's disappearance from the sample in certain years is non-random, so that our estimations may be affected by a selection bias. We test for this bias and correct for it when it is present, using a procedure suggested by Verbeek and Nijman (1992). Two variables are introduced in the regression, representing the number of periods in which the firm is present in the panel (S), and whether or not the firm is present in all the years (TOT=1 if it is and 0 otherwise).[11]

The Cobb-Douglas specification for the production function performs better with our data than either the CES or the translog forms. The existence of a profit-sharing (*intéressement*) scheme in a firm in a given year is measured with a dummy variable taking the value one from the first year in which the scheme is in effect[12] and zero before the scheme is set up and, if relevant, after it is discontinued. Recent estimations, which use the profit-sharing bonus as a percentage of pay rather than a dummy, instrument the profit-sharing variable to take its endogeneity into account (see e.g. Cahuc and Dormont, 1992). In this estimation we do not instrument the profit-sharing dummy. More productive firms are likely to pay out higher bonuses, all else being equal. However, simultaneity bias is much less a problem when profit-sharing enters the equation in the form of a dummy variable as here. For example, probit regressions run on the manufacturing firms of this sample show that average labour productivity in the years before the introduction of profit-sharing has no significant relationship with the probability of introducing profit-sharing in or after 1988 or 1989 (see Estrin et al., 1996).[13] Other, unobserved individual effects are dealt with through panel estimation.

[11] Verbeek and Nijman use a third variable that is not necessary here because of the way the sample is constructed.

[12] In some firms profit-sharing contracts were signed with retroactive effect (of up to one fiscal year). In those cases the first year the profit-sharing dummy is equal to one is when the contract was signed, since no incentive effects could have been operating before then.

[13] In addition, instrumentation of the dummy variable is slightly problematic and, in our experience, yields poor results with these data. Given no detailed information is available on other forms of participation or on technology, the probit regressions that should be used here for instrumentation purposes have very poor fit and yield very low forecast probabilities of having a scheme for individual firms. This also means the coefficient of the instrumented profit-sharing variable is difficult to interpret.

The model is estimated first on the whole sample and then separately on smaller firms, which are not required to have statutory profit-sharing, and on larger firms.[14] Differences in technology, which warrant the separate estimations, are tested for.

5. Results

We first estimate a specification allowing the presence of a profit-sharing scheme to simply shift the production function (disembodied effect) without directly affecting the output elasticities of the inputs. Table 2 presents the estimates obtained by GLS for the whole sample as well as for small and large firms separately. For the whole sample estimation, we also report the between-groups estimates for comparison with other production function estimates for France[15].

In all the estimations reported in Table 2, the presence of profit-sharing (INTER) is found to be associated with a positive and significant total factor productivity differential. This result confirms existing studies on France and other countries (see Cahuc and Dormont, 1992; Vaughan-Whitehead, 1992; Estrin et al., 1996). According to our GLS estimates, profit-sharing may raise productivity by 6-7%. These results are consistent with estimations carried out on other sub-samples of the French survey data with different estimation methods, instrumenting the employment level or endogenising the existence of profit-sharing (see Estrin et al., 1996; Fakhfakh and Pérotin, 1992). The estimated output elasticities of labour and capital are in line with other estimates for France and the coefficients of the control variables are all significant at the 1% level and have the expected signs.

F- tests on coefficients obtained with a size dummy in a pooled regression reject the hypothesis that small and large firms have the same technology. The results of regressions run separately for the two size groups also suggest that the overall effect of profit-sharing on productivity is higher in larger firms. This would support the idea that the existence of a statutory profit-sharing scheme strengthens the effects of voluntary profit-sharing, or that profit-sharing is more effective as an incentive in larger firms.[16]

If the greater effect of voluntary profit-sharing in larger firms is due to the presence of another, statutory profit-sharing scheme in these firms, it is reasonable to think that other employee involvement schemes introduced together with profit-sharing may cause some of the productivity advantage associated with profit-sharing in firms of all sizes. In France, Fakhfakh (1995), finds that *intéressement* has higher productivity effects in firms where there is better communication between management and labour unions, and employee share ownership has been found to increase total factor productivity (Vaughan-Whitehead, 1992). Similar findings have been reported for the US (Svejnar, 1990) and the

[14] Firms that changed size class during the sampling period have been included in their initial groups, on the ground that the incentive effects of *intéressement* are most likely to be affected by the presence of *participation* at the outset.

[15] "Between-groups" estimates show roughly constant returns to scale, as is customary with cross-section estimates. It is rarely the case with time-series or GLS estimates. Reasons for these differences are discussed in Mairesse (1990).

[16] In this sense this finding is in contradiction with the estimates obtained by Bradley and Smith (1995) on the US computer industry. However, the two papers explore slightly different issues, which may cause the apparent disagreement (here embodied effects concern capital as well as labour).

UK (Robinson, 1996) suggesting that the effects of financial participation on productive efficiency are enhanced by employee participation in decision-making.

When sample selection is corrected for (Table 3) the difference between firms with and without statutory profit-sharing is confirmed and amplified. Compared to the estimates reported in Table 2, the estimated eslasticities and coefficients presented in Table 3 are quite stable. The exception is the estimated productivity differential associated with voluntary profit-sharing in firms that have a statutory scheme. While on average *intéressement* is still estimated to raise productivity by about 7%, the estimate for larger firms now is 12% (for smaller firms the estimated differential is stable at around 6%), suggesting sample selection led us to underestimate the effect earlier.

In our second set of estimations (see Tables 4 and 5) we allow the effects of voluntary profit-sharing to vary with the context in which the scheme is implemented. In this specification, the presence of a scheme may not only shift the whole production function but also affect the shape of the technology and depend on the input levels (embodied effects). In addition, we test for the possibility that the effectiveness of profit-sharing as an incentive is greater in workplaces where employees in the lower tiers of the hierarchy work under less strict supervision (interaction between INTER and MONITOR).

The GLS estimates presented in Table 4 indicate that voluntary profit-sharing shifts the production function upwards and has effects positively embodied in capital and negatively embodied in labour in both subsample of firms as well as on average. These findings are consistent with the idea that equipment may be used more efficiently in profit-sharing firms. The shift effect remains greater in larger firms. The negative embodiment in labour implies that profit-sharing is associated with a relatively higher level of employment, *ceteris paribus*. This particular effect could be due to the fact that *intéressement* bonuses are exempt from social security contributions, making labour relatively cheaper in profit-sharing firms in France. It could also be related to Weitzman-type effects on labour demand, which can't be separated out on the basis of a production function estimate alone.[17] In any case, disembodied and embodied effects taken together suggest that in France the employment impact of the productivity increases associated with profit-sharing is unambiguously positive at the firm level.

In large firms, hierarchical control and profit-sharing seem to have conflicting effects if they are combined. This finding supports the idea that the incentive effect of profit-sharing works by releasing creativity and information held by employees, a mechanism that can be hampered rather than fostered by too close hierarchical monitoring. This effect is found to be insignificant in small firms, possibly because there is little variation in this aspect of organization among firms with less than 100 employees.

Once again, correction for sample selection does not markedly alter our results (see Table 5). It again sharpens the contrast between firms with and without statutory profit-sharing. The positive shift in the production function associated with voluntary profit-sharing is significantly greater among firms required to have a *participation* scheme. Among the smaller firms, this disembodied effect is only weakly significant and it is possible that only embodied effects operate in that group.

[17] Estimations of labour demand equations yield conflicting results in France (see Vaughan-Whitehad, 1992; Cahuc and Dormont, 1992; Estrin et al., 1996).

6. Conclusions

Our finding that the presence of profit-sharing is associated with a significant productivity advantage in French firms confirms existing studies on firms from a number of countries, including France. The estimated total factor productivity differential in favour of firms with voluntary profit-sharing is substantial in France (around 7%). However, some of this effect may be due to the presence of other employee involvement schemes. As they set up profit-sharing schemes, firms may also adopt a "package" of measures improving employee information and participation, which may contribute to the observed improvement in total factor productivity.

Recent estimations on French data only look at the overall impact of voluntary profit-sharing on productive efficiency. Here we have also tested for the possibility that profit-sharing is associated with differences in technology and that the magnitude and form of the effect on productivity is related to the presence of statutory profit-sharing schemes in larger firms.

Our results suggest that some of the productivity effects of voluntary profit-sharing are context-dependent. The productivity advantage associated with the presence of voluntary profit-sharing (*intéressement*) is greater in firms required to have statutory profit-sharing (*participation* schemes) than in other, smaller firms. This suggests that the presence of a statutory scheme enhances the incentive effects of voluntary profit-sharing and/or that these incentive effects are stronger in larger firms.

Both in firms with statutory schemes and in smaller firms, voluntary profit-sharing is found not only to increase total factor productivity generally, shifting the production function upwards, but also to affect the technology of the firm (embodied effects). The pattern of these effects (positive embodiment in capital, negative embodiment in labour) is such that the overall employment impact associated with the productivity effects of voluntary profit-sharing is unambiguously positive in France. However, this result may be due in part to the subsidisation of labour costs under voluntary profit-sharing in France. Finally, we find that at least in larger firms, profit-sharing and tight supervision of blue collar and clerical employees may have conflicting effects if they are combined.

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Appendix

List of variables

Q	Log of value added
INTER	Profit Sharing dummy variable – INTER=1 if the firm has an *intéressement* (voluntary) scheme, 0 otherwise
Inputs	
K	Log of fixed assets at book value
L	Log of number of employees
Controls	
MKTSHARE	Ratio of value of firm's sales to total sales in main product industry (3-digit level)
MONITOR	Ratio of number of supervisory staff (foremen and above) to number of clerical and manual employees
RELW	Average gross wage in firm/average gross wage in industry (3-digit)
SKILLS	Skills index
Correction for Selection Bias	
S	Number of years in which the firm is present in panel
TOT	= 1 if the firm is present in all the panel years, 0 otherwise

Tables

Table 1. Characteristics of firms with and without *intéressement* (initial sample) (N=63,700)

Variable	1990 (N=10,452 to 13,468)			Direction and statistical significance of difference in other years[b]			
	Mean for profit-sharing firms	Mean for other firms	|t|[a]	1986 (N=7,953 to 12,388)	1987 (N=8,054 to 12,587)	1988 (N=7,880 to 12,323)	1989 (N=10,548 to 12,915)
L	1 233.00	341.00	5.04***	+*	+***	+***	+***
K/L[c]	240.34	165.16	2.39**	+	+**	+***	+**
VA/L[c]	172.20	148.93	1.41	+	+	+	+
MKTSHARE[d]	5.49	1.69	9.04***	+**	+***	+***	+***
MONITOR	0.21	0.19	3.62***	+	+	+**	+***
RELW[c]	1.08	1.02	5.41***	+*	+***	+***	+***

a * statistically significant at the 10% level
** statistically significant at the 5% level
*** statistically significant at the 1% level

b "+" indicates a higher mean value among profit sharing firms

c Values in thousands 1981FF

d %

Table 2. **Production function estimates – disembodied effect only**
1986-90 (N=23,125)
dependent var.: log value added – input variables in logs

	Whole sample				Small firms		Large firms	
	GLS		"Between-groups"		GLS		GLS	
CONSTANT	-2.157^{xxx}	(35.95)	-2.157^{xxx}	(22.46)	3.652^{xxx}	(39.71)	0.471^{xxx}	(4.30)
K	0.204^{xxx}	(63.76)	0.169^{xxx}	(37.91)	0.141^{xxx}	(31.27)	0.277^{xxx}	(63.39)
L	0.357^{xxx}	(79.10)	0.728^{xxx}	(94.19)	0.274^{xxx}	(41.01)	0.469^{xxx}	(65.35)
Disembodied effect								
INTER	0.067^{xxx}	(4.19)	0.139^{xxx}	(4.23)	0.059^{xxx}	(2.64)	0.071^{xxx}	(2.93)
Controls								
MKTSHARE	3.569^{xxx}	(25.90)	1.206^{xxx}	(7.63)	4.630^{xxx}	(9.85)	2.095^{xxx}	(18.43)
SKILLS	0.426^{xxx}	(17.85)	0.239^{xxx}	(7.40)	0.289^{xxx}	(8.27)	0.439^{xxx}	(13.72)
RELW	0.215^{xxx}	(29.66)	0.641^{xxx}	(34.03)	0.364^{xxx}	(22.37)	0.115^{xxx}	(15.03)
Time trend	0.011^{xxx}	(5.89)	0.140^{xxx}	(14.38)	0.043^{xxx}	(20.20)	-0.074^{xxx}	(16.19)
Industry dummies	YES		YES		YES		YES	
R^2	0.9935		0.8652		0.9940		0.9949	

Observations weighted by inverse sampling proportions with correction for missing values.
Small Firms: N= 9,117
Large Firms: N= 14, 008
t – ratios in parentheses
^{xxx} statistically significant at the 1% level.

Table 3. **Production function estimates – disembodied effect only**
with correction for selection bias
1986-90
dependent var.: log value added – input variables in logs

	Whole sample				Small firms		Large firms	
	GLS		"Between-groups"		GLS		GLS	
CONSTANT	2.424^{xxx}	(30.42)	-2.367^{xxx}	(22.56)	3.151^{xxx}	(27.81)	1.788^{xxx}	(16.35)
K	0.202^{xxx}	(63.18)	0.166^{xxx}	(37.10)	0.135^{xxx}	(30.13)	0.283^{xxx}	(64.05)
L	0.355^{xxx}	(78.26)	0.726^{xxx}	(94.35)	0.271^{xxx}	(40.79)	0.486^{xxx}	(67.24)
Disembodied effect								
INTER	0.072^{xxx}	(4.46)	0.135^{xxx}	(4.10)	0.057^{xxx}	(2.59)	0.123^{xxx}	(5.07)
Controls								
MKTSHARE	3.572^{xxx}	(25.99)	1.237^{xxx}	(7.86)	4.491^{xxx}	(9.62)	1.983^{xxx}	(17.70)
SKILLS	0.425^{xxx}	(17.85)	0.249^{xxx}	(7.74)	0.297^{xxx}	(8.57)	0.433^{xxx}	(13.26)
RELW	0.219^{xxx}	(30.04)	0.632^{xxx}	(33.57)	0.363^{xxx}	(22.48)	0.166^{xxx}	(20.37)
Time Trend	0.011^{xxx}	(6.05)	0.120^{xxx}	(11.82)	0.043^{xxx}	(20.40)	-0.067^{xxx}	(14.73)
Industry Dummies		YES		YES		YES		YES
Corr. for Selection								
S	-0.046^{xxx}	(3.14)	0.079^{xxx}	(5.14)	0.0139^{xxx}	(6.93)	-0.449^{xxx}	(17.10)
TOT	0.152^{xxx}	(6.19)	-0.064^{xxx}	(2.60)	-0.075^{xx}	(2.21)	0.640^{xxx}	(14.67)
R^2	0.9935		0.8665		0.9942		0.9951	

Observations weighted by inverse sampling proportions with correction for missing values.
Small Firms: N= 9,117
Large Firms: N= 14, 008
t – ratios in parentheses
^{xxx} Statistically significant at the 1% level
^{xx} Statistically significant at the 5% level.

Table 4. Production function estimates – embodied and disembodied effects
1986-90
GLS
dependent var.: log value added – input variables in logs

	Whole sample		Small firms		Large firms	
CONSTANT	2.374^{xxx}	(32.77)	3.829^{xxx}	(36.19)	0.802^{xxx}	(56.62)
K	0.201^{xxx}	(62.92)	0.139^{xxx}	(30.98)	0.271^{xxx}	(60.54)
L	0.366^{xxx}	(80.45)	0.277^{xxx}	(41.09)	0.480^{xxx}	(66.22)
Disembodied Effect						
INTER	1.675^{xxx}	(8.97)	0.707^{xx}	(2.09)	0.727^{xx}	(2.09)
Embodied Effect						
INTER x K	0.110^{xxx}	(7.56)	0.087^{xxx}	(3.84)	0.106^{xxx}	(3.71)
INTER x L	-0.212^{xxx}	(11.93)	-0.114^{xxx}	(4.13)	-0.113^{xxx}	(3.27)
Organizational Effects						
MONITOR x INTER	-0.036	(0.37)	-0.094	(0.71)	-0.825^{xxx}	(5.77)
Controls						
MONITOR	0.280^{xxx}	(5.68)	0.281^{xxx}	(4.20)	0.714^{xxx}	(8.43)
MKTSHARE	3.509^{xxx}	(25.53)	4.614^{xxx}	(9.83)	2.041^{xxx}	(18.10)
SKILLS	0.253^{xxx}	(6.32)	0.103^{x}	(1.80)	0.048	(0.78)
RELW	0.221^{xxx}	(30.39)	0.666^{xxx}	(22.52)	0.118^{xxx}	(15.40)
Time Trend	0.011^{xxx}	(5.86)	0.043^{xxx}	(20.17)	-0.074^{xxx}	(16.11)
Industry Dummies		YES		YES		YES
R^2		0.9935		0.9941		0.9950

Observations weighted by inverse sampling proportions with correction for missing values.
Small Firms: N= 9,117
Large Firms: N= 14, 008
t – ratios in parentheses
^{xxx} Statistically significant at the 1% level
^{xx} Statistically significant at the 5% level
^{x} Statistically significant at the 10% level

Table 5. Production function estimates – embodied and disembodied effects
1986-90
GLS with correction for sample selection
dependent var.: log value added – input variables in logs

	Whole sample		Small firms		Large firms	
CONSTANT	2.530^{xxx}	(29.00)	3.326^{xxx}	(26.57)	1.963^{xxx}	(13.94)
K	0.200^{xxx}	(62.37)	0.134^{xxx}	(29.85)	0.277^{xxx}	(62.23)
L	0.364^{xxx}	(79.55)	0.274^{xxx}	(40.86)	0.496^{xxx}	(67.73)
Disembodied Effect						
INTER	1.642^{xxx}	(8.82)	0.674^{xx}	(1.99)	0.928^{xxx}	(2.68)
Embodied Effect						
INTER x K	0.109^{xxx}	(7.47)	0.087^{xxx}	(3.84)	0.102^{xxx}	(3.60)
INTER x L	-0.209^{xxx}	(11.72)	-0.111^{xxx}	(4.06)	-0.113^{xxx}	(3.65)
Organizational Effects						
MONITOR x INTER	-0.012	(0.12)	-0.060	(0.46)	-0.670^{xxx}	(4.86)
Controls						
MONITOR	0.287^{xxx}	(5.82)	0.269^{xxx}	(4.07)	0.602^{xxx}	(7.14)
MKTSHARE	3.511^{xxx}	(25.62)	4.477^{xxx}	(9.61)	1.940^{xxx}	(17.41)
SKILLS	0.247^{xxx}	(6.19)	0.118^{xx}	(2.08)	0.101^{x}	(1.65)
RELW	0.225^{xxx}	(30.76)	0.365^{xxx}	(22.63)	0.165^{xxx}	(20.26)
Time Trend	0.011^{xxx}	(6.04)	0.043^{xxx}	(20.37)	-0.067^{xxx}	(14.68)
Industry Dummies		YES		YES		YES
Corr. for Sample Selection						
S	-0.046^{xxx}	(3.18)	0.138^{xxx}	(6.87)	-0.417^{xxx}	(15.88)
TOT	0.149^{xxx}	(6.09)	-0.074^{xx}	(2.19)	0.581^{xxx}	(13.27)
R^2	0.9936		0.9942		0.9951	

Observations weighted by inverse sampling proportions with correction for missing values.
Small Firms: N= 9,117
Large Firms: N= 14, 008
t – ratios in parentheses
^{xxx} Statistically significant at the 1% level
^{xx} Statistically significant at the 5% level
^{x} Statistically significant at the 10% level