1-1-1998

The Effects of Gain Sharing on the Basic Wage: The Case of IMPROSHARE

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Abstract. Although gain-sharing plans are typically promoted to workers as a way of increasing total compensation, workers are often concerned that gain-sharing bonuses may become substitutes for future wage increases that would have occurred in the absence of the plan. I examine the theoretical and empirical interaction among wages, bonuses, effort, and productivity in firms that implemented IMPROSHARE, a well-known gain-sharing plan. Using longitudinal data obtained from a detailed survey questionnaire, I find that one can usually reject both the perfectly competitive model in which effort is held constant (in which case bonuses are a perfect substitute for wages) and the "pure gravy" model (in which bonuses completely complement the wage rate). There is no evidence that higher bonuses lead to higher relative wages. The results, however, are not very robust. Although the net effect of the bonuses on the wage rate is usually negative, it is not always statistically significant.

Gain-sharing plans are typically promoted to workers as a way of increasing total compensation. Workers, however, are often concerned that any gain-sharing bonuses may become substitutes for future wage increases that would have occurred in the absence of the plan. In this paper I examine the theoretical interaction among wages, bonuses, effort, and productivity to illustrate the conditions under which bonuses will act as substitutes or complements for wage gains. I then use longitudinal data obtained from a detailed survey questionnaire to estimate the effects of the implementation of IMPROSHARE, a well-known gain-sharing plan, on the base wage rate. By using data for individual firms both before and after they implement IMPROSHARE, I avoid the problem of firm heterogeneity that typically plagues previous studies that use cross-section data.

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Approved by the Editorial Board on May 13, 1998.

LABOUR 12 (3) 595–610 (1998) JEL J32, J33

IMPROSHARE

IMPROSHARE is a gain-sharing plan, which means that it is a group incentive plan in which employee compensation is linked via an explicit formula to some measure of improved company performance. Created by industrial engineer Mitchell Fein (1981), IMPROSHARE rewards all covered employees equally whenever the actual number of labor hours used to produce output in the current week or month is less than the estimated number it would have taken to produce the current level of output in the "base period". If the actual number of hours it takes to produce the current level of output is more than the estimated number it would have taken in the base period, no bonus is paid. All blue-collar and white-collar employees except managers are typically included in the plan.

In the absence of capital improvements the IMPROSHARE bonus can be expressed as one-half of the percentage change in the average physical product of labor between the base period and the current period.[1] Consequently, the compensation rate C consists of the basic wage rate w and any positive bonus:

$$C = \text{Max}\{w, w[1 + (1/2)(Q/L - Q_{BP}/L_{BP})/(Q_{BP}/L_{BP})]\} \quad (1)$$

where the subscripts BP denote the levels of output and labor hours in the base period. Thus, after a period in which physical productivity is five percent above the base period, all covered workers receive a bonus of 2.5% of their wage earnings. There are no negative bonuses; workers are never paid less than the basic wage rate.

The most commonly cited advantages of this form of physical productivity gain-sharing compared with the more well-known Scanlon and Rucker plans are: (1) it is easy for workers to comprehend, (2) physical productivity is something workers can control, and (3) management need not reveal sensitive corporate financial information. Although several studies have examined the changes in productivity following the introduction of IMPROSHARE plans [Fein (1983), Globerson and Parsons (1987), and Kaufman (1992)], no study has examined the effects of IMPROSHARE on the base wage rate.

Theoretical impact of bonuses on the base wage rate

Although there are numerous theoretical avenues by which gain-sharing bonuses might affect the basic wage rate, in this section I focus on three: the simple textbook competitive model in which effort is not explicitly considered, an imperfectly competitive model in which bonuses are treated as "add-on's", and a neoclassical perfectly competitive model in which effort is endogenous and included in the utility function.

In the simple textbook model of a competitive labor market, effort is not considered and worker utility depends solely on the compensation rate, which includes the basic wage plus any IMPROSHARE bonus. If the labor market is perfectly competitive and labor is homogeneous, all firms must pay the same market equilibrium compensation rate. Consequently, any IMPROSHARE bonus would result in an equal *reduction* in that firm's basic wage rate *relative* to the wages paid by other firms to comparable workers. This is sometimes known as the "no gravy" theory of bonuses because it implies that workers "pay" for bonuses in the form of lower wages and bonuses have no impact on compensation. Although it assumes perfectly competitive labor markets, it is often promulgated by labor union leaders who are concerned that firms will merely substitute bonuses for wage increases.

Most economists do not believe that labor markets are perfectly competitive auction markets with a unique market equilibrium compensation rate. Krueger and Summers (1988), for example, found persistent inter-industry differences in occupational wage rates and fringe benefits after controlling for differences in a host of human capital and demographic variables, and economists have replicated their results for other countries. In the absence of perfect competition and free entry, bonuses may reflect firm or industry rents and may not be accompanied by reductions in the wage rate even if productivity is unaffected. In this case bonuses may merely be "add-on's" or "pure gravy" and have no effect on relative wages.

Furthermore, IMPROSHARE itself may affect productivity, firm profits, and relative wages. Since IMPROSHARE bonuses are equal to only half of any productivity improvements, higher bonuses resulting from higher productivity might lead to *higher* profits and *higher* relative wage rates. Carruth and Oswald (1989) and Hildreth and Oswald (1997) present formal Nash bargaining models and modified competitive models in which firm profits and wages are

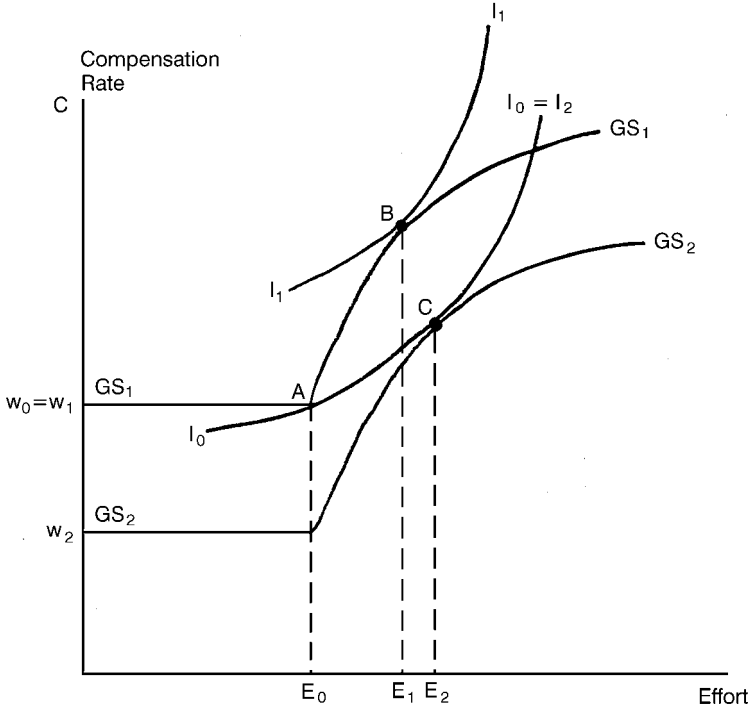
positively correlated. They also provide substantial empirical support for this proposition. This is also the view publicly espoused by those who market gain-sharing plans.

Finally, consider the effects of gain sharing when worker effort is endogenous. This can be analyzed in the context of either a market-clearing model or a bargaining model. Worker utility is then a function of both the compensation rate and effort:

$$U = U(C, \text{Effort}) \tag{2}$$

where $U_1 > 0$, $U_2 < 0$, $U_{11} < 0$, and $U_{22} < 0$. A diminishing marginal rate of substitution between the compensation rate and the complement of effort (which I shall call "on-the-job leisure") implies that the workers' initial indifference curve I_0 depicted in Figure 1 will be convex and positively-sloped. Thus, workers must receive progressively larger compensation rate increases to induce

Figure 1.



them to work harder. Let the initial equilibrium be Point A. Workers are paid a basic wage w_0 and expend an amount of effort per hour equal to E_0. While monitoring is difficult and costly, it is assumed that supervisors can identify those workers whose effort levels are less than E_0, and these workers are dismissed.[2] If there is a competitive labor market and no efficiency wages, workers can achieve the initial level of utility U_0, which is equal to the level of utility along I_0, in any firm.

The "Gain-sharing" curve GS_1, illustrates the combinations of compensation and effort that are available to the workers after the firm implements an IMPROSHARE plan. As workers provide greater effort, productivity rises. Since workers receive IMPROSHARE bonuses equal to half of any increases in average physical productivity, the compensation rate rises. Note that no bonus is paid until effort exceeds E_0, in accordance with the IMPROSHARE formula. Given the linkage between productivity and the IMPROSHARE bonus, the concavity of the Gain-Sharing Curve to the right of E_0 implies that there are diminishing returns to increased work effort. GS_1 is horizontal once the compensation rate falls to w_0 (at E_0) because workers are guaranteed the basic wage w_0 under IMPROSHARE even if productivity falls. Firms, however, are still able to dismiss workers if their effort falls below E_0.

In the current contract period the basic wage rate remains unchanged ($w_1 = w_0$), and workers can increase their utility by moving to Point B, at higher levels of effort (E_1) and compensation. Based on anecdotal evidence and the fact that productivity gains are split evenly between labor and management, it is assumed that movements along any *GS* curve to the northeast increase firm profits.[3]

In the next contract period, however, firms operating in a competitive labor market will have an incentive to reduce the basic wage, which will shift the Gain-Sharing Curve down. In Figure 1, for example, firms can earn higher profits at Point C, which lies on a lower Gain-Sharing Curve. Compared with Point B, Point C has a lower basic wage w_2, a lower rate of total compensation, and a greater level of effort E_2. Consequently, the level of worker utility returns to $U_2 = U_0$, which is the competitive market equilibrium level of worker utility. Although workers receive higher compensation at Point C than at Point A (since the gain-sharing bonus exceeds the reduction in the basic wage), they provide greater effort. Their level of utility is equal to that obtained at other firms, so they remain with

the firm. The situation depicted by the move to Point C is consistent with the concern of many workers that gain-sharing bonuses will result in wage rates being lower than they would have been otherwise. The model, however, predicts no decline in worker utility. In a competitive labor market workers can always choose to work elsewhere for the market equilibrium level of utility U_0. Note that along GS_2 (as well as along GS_1) bonuses are paid only if $E > E_0$, according to the IMPROSHARE formula.

Note also that the tangency between the Gain-Sharing Curve GS_2 and I_2 (which is the same as I_0) lies to the right of E_1. This is the result of the assumption that on-the-job leisure, or reduced work effort, is a normal good. Consequently, a reduction in real income following a cut in the basic wage will induce workers to cut back on their consumption of on-the-job leisure by providing more work effort. This also implies that firms will be unable to induce workers to exert more effort by increasing the basic wage rate without changing the gain-sharing formula.

Points B and C represent two extremes on an (undrawn) contract curve that connects them. At Point B workers are able to maximise their utility gains resulting from the implementation of gain sharing. At Point C workers do not benefit from the plan. Firms keep 50% of the productivity gains in any event, but gain sharing is even more profitable for the firm if worker utility returns to the competitive market equilibrium. The assumption of perfectly competitive labor markets implies that the long-run equilibrium is Point C. Whether this occurs in fact is an empirical question, and Point C need not be the long-run equilibrium in a bargaining model.

As Figure 1 illustrates, neoclassical models in which effort is endogenous predict that total monetary compensation will be higher in gain-sharing firms in order to induce workers to provide greater effort. Even under the valid "no gravy" scenario in which worker utility remains unchanged at the market equilibrium and the basic wage rate falls, the monetary compensation rate increases from Point A to Point C. Empirical findings that monetary compensation is higher in gain-sharing or profit-sharing firms neither prove nor disprove the "gravy" or "add-on" theory of gain-sharing bonuses. This model also predicts that the basic wage rate will remain constant or decline by somewhat less than the IMPROSHARE bonus.

The models presented in this section could be extended in a variety of directions. First, risk-averse workers will prefer a fixed

basic wage rather than a smaller wage and bonus with the same expected total present value because the bonus is uncertain. On the other hand, if gain sharing results in greater employment stability via Weitzman's (1984) vacuum effect,[4] the desirability of gain sharing would be enhanced and workers would prefer it to a normal (risky) job with the same average compensation rate. Finally, in a world with heterogeneous workers, firms with gain-sharing plans will be more attractive to workers who derive a smaller disutility from providing work effort.

Previous empirical results

Previous researchers have typically used a cross-section sample of firms, some of which utilize profit sharing, and regressed total compensation or wage earnings on a host of variables that control for the human capital attributes of the workers, firm size, industry, geographical location, etc. Mitchell, Lewin, and Lawler (1990), for example, use BLS industry wage surveys and find that workers in firms with monetary incentive systems receive 14% higher wages. Brown (1990) found similar results using establishment data. These estimates have been criticised, however, because they do not account for labor sorting, and the existence of profit-sharing plans was taken to be exogenous.

Hart and Hubler (1991) account for this endogeneity by using Heckman's procedure for correcting for sample selection bias. Using a sample of 3,628 German workers, of whom 196 participated in profit-sharing plans, they find that the level of profit sharing is positively related to regular wage and non-wage payments, and is therefore a complement rather than a substitute for basic wages. The independent variables that control for other differences among workers and firms, however, are incomplete.

Finally, Wadhwani and Wall (1988) estimated a fixed effects model using panel data from 96 manufacturing companies in the United Kingdom to control for individual firm influences on the wage rate over time. The fixed effects model was able to isolate the effects of profit-sharing in those 18 firms that implemented such plans because many of the 18 firms either introduced or discontinued their plans during the sample period. Wadhwani and Wall could not reject the hypothesis that profit-sharing bonuses had no effect on the basic wage rate. The current study is similar to

Wadhwani and Wall's in that I also use longitudinal data for individual firms to avoid the problem of heterogeneity. In addition, my sample includes a substantially larger number of firms, all with the same gain-sharing plan. Finally, the average bonus in my sample is about twice as big as that in Wadhwani and Wall's study. Therefore, any wage effects should be easier to detect.

The IMPROSHARE survey questionnaire

The firm-specific data used in this study were obtained from the repsonses to a survey questionnaire that was sent to all 273 known companies and divisions that had implemented IMPROSHARE from its inception in 1978 to April, 1988. 45% of those companies that were contracted either completely or partially completed the survey. While it is difficult to ascertain whether my sample is unbiased, Mitchell Fein has estimated that 15–20% of all companies that implemented IMPROSHARE eventually discontinued it. In my sample 23.2% of the plans were discontinued, suggesting that my sample is reasonably representative.

The survey data that are relevant for this study include: (1) the average hourly wage rate for production workers, excluding the IMPROSHARE bonus, at IMPROSHARE's start, and one and two years before and after its implementation; (2) the average IMPROSHARE bonus during the first and second full years after IMPROSHARE's implementation; and (3) the annual quit rates during the company's first year with IMPROSHARE and during the preceding year.

Respondents were also asked to list the major products or services produced within the plant as well as the relevant 4-digit SIC Code number. The wage rate for the corresponding 3 or 4-digit SIC Code Industry number was collected for the month in which IMPROSHARE was introduced and one and two years before and after this date using various issues of *Employment and Earnings.* SIC Codes were assigned to those firms that did not provide them by matching the firms's major products with code numbers in the *Standard Industrial Classifications Manuals* for 1972 and 1987. The relative wages for each firm at various points in time were then calculated by dividing the basic wage rate in the firm in each relevant month by the average wage rate in its industry for the same month.

Empirical results.

55% of the 97 American firms in my sample identified their principal products and provided data on the basic wage rate at the time of IMPROSHARE's introduction and one year later.[6] Among these 55 firms the average ratio between the individual firm's wage rate at the time it introduced IMPROSHARE and the then-prevailing wage rate in its industry was 90.91%. Although previous researchers have typically found wages to be higher in firms that use profit sharing or piece rates, my results were not surprising. Firms that implement IMPROSHARE tend to be experiencing either financial difficulties or some erosion in competitive position. In addition, firms that use IMPROSHARE have fewer employees than their industry average, and Brown, Hamilton, and Medoff (1990) have found that firm size is positively correlated with labor compensation after adjusting for observable differences in labor quality.[7,8]

There was a substantial amount of variation in the relative wage among the firms, and this is reflected in a large standard deviation of 18.90 percentage points. Among these 55 firms, 54 firms had wages between 62.7 and 129.5% of their corresponding industry wage in the month they implemented IMPROSHARE, and the remaining firm had a relative wage of 165.5%.

Although my survey did not provide data on the value of each firm's capital stock or the human capital composition of its work force,[9] a simple regression of the logarithm of the relative wage rates on a union dummy variable indicated that unionisation increased a firm's relative wage by 11–14 percentage points. This coefficient was statistically significant and within the range of estimates from more sophisticated techniques [Lewis (1986)].

In Table 1 I list the ratio of the firm to industry wage rates at several points in time. The number of firms in each comparison reflects the number of firms that provided wage data for the relevant periods. Among the aforementioned 55 firms, the average ratio of the wage rate as a percentage of the corresponding industry wage fell slightly from 90.91% at IMPROSHARE's introduction to 90.37% one year later, a difference that is not statistically significant. Median data also revealed no significant changes. The relative wage rose in 23 of these firms during the first year of IMPROSHARE and declined in the remaining 32. Among these same 55 firms, the average IMPROSHARE bonus paid during the first year was 6.7%. Even with the average 6.7% bonus, however, the average monetary

Table 1. Relative wage rates

Average ratio of firm wage divided by the prevailing industry wage (expressed as a percent) in the month

2 years before IMPROSHARE's introduction	1 year before IMPROSHARE's introduction	Of IMPROSHARE's introduction	1 year after IMPROSHARE's introduction	2 years after IMPROSHARE's introduction	No. of firms
		90.91	90.37		55
		(18.90)[a]	(19.25)		
90.92	90.81	91.31	90.75		53
(21.27)	(20.18)	(18.95)	(19.35)		
		91.41	90.78	90.69	40
		(17.36)	(16.88)	(16.61)	
91.34	91.55	91.99	91.32	91.24	38
(17.96)	(17.17)	(17.33)	(16.89)	(16.28)	

Note: [a]Estimated standard deviations in parentheses.

compensation rate among the IMPROSHARE firms was still less after one year than the average wage in the typical firm in its industry. These data also indicate that the relative wage in these firms had remained practically constant for at least two years prior to IMPROSHARE's introduction.[10]

It has been argued that gain-sharing plans that reward productivity will merely attract more productive workers. The average quit rate among the 51 firms that reported quit data was 13.07% the first year the company utilised IMPROSHARE. This was insignificantly less than the 13.17% quit rate during the preceding year. Although this evidence is not conclusive, the relative constancy of the quit rate may imply that no substantial labor sorting occurred.[11]

In Table 2 I test the hypothesis that changes in relative wages among IMPROSHARE firms will differ according to the size of the IMPROSHARE bonuses received by workers at these firms. The dependent variable in the regression in Table 2 is the logarithm of the ratio of the firm's wage rate divided by the average wage in its industry (i.e., the logarithm of the relative wage) one and two years after IMPROSHARE's introduction. Since the bonus is measured as a percentage of the basic wage, this specification allows me to estimate the percentage by which a one percentage point increase in the bonus affects the basic firm wage rate, assuming the industry wage is unaffected. I also allow for a nonlinear relationship between the bonus and the basic wage by adding the square of the bonus in some regressions, and I tested for differences in the responses in union and non-union firms (and found none). Finally, I include the relative wage at the time of IMPROSHARE's implementation to test for persistence effects. Because the last variable may be affected by the contemporaneous introduction of IMPROSHARE, I estimated these equations using both ordinary least squares and instrumental variables. In the latter regressions the relative wage one year prior to IMPROSHARE's implementation was used as the instrument for the relative wage in the month in which IMPROSHARE was introduced.

Initial estimations revealed no significant linear relationships but a significant nonlinear relationship in which small bonuses reduced subsequent wages and large bonuses increased them. Further investigation indicated that this nonlinear relationship resulted from one outlying observation in which the first year bonus was 32%, almost twice as large as the next largest bonus. Consequently, this

Table 2. Determinants of one-year and two-year changes in relative wage rates

Dependent variable: logarithm of the relative wage 1 year after IMPROSHARE's introduction

Average first-year IMPROSHARE bonus[a]	Average first-year IMPROSHARE bonus squared	Log of relative wage in the month IMPROSHARE was introduced	$\bar{R}^2$	Number of firms
		OLS estimates		
−0.040		1.00	0.977	53
(0.087)[a]		(0.022)		
		Instrumental variables estimates		
−0.503	0.033	1.02	0.977	52
(0.299)	(0.017)	(0.022)		
−0.041		1.01	0.976	52
(0.088)		(0.027)		

Dependent variable: logarithm of the relative wage 2 years after IMPROSHARE's introduction

Average first-year IMPROSHARE bonus[a]	Average second-year IMPROSHARE bonus	Log of relative wage in the month IMPROSHARE was introduced	$\bar{R}^2$	Number of firms
		OLS estimates		
−0.481		0.979	0.904	38
(0.235)		(0.053)		
		Instrumental variables estimates		
−0.487		0.964	0.899	37
(0.231)		(0.055)		
−0.631	0.138	0.975	0.886	35
(0.442)	(0.319)	(0.062)		

Note: [a]All coefficients and their standard errors, which are written below the coefficients in parentheses, have been multiplied by 100, *except* those for the logarithm of the relative wage in the month IMPROSHARE was introduced.

observation was dropped in the sample for the regressions reported in Table 2.

The regressions in the top panel of Table 2 indicate that the first-year bonus has no significant effect on the wage rate after one year although the coefficient is negative and borderline significant when the quadratic term is included. According to the three regressions in the bottom panel, however, a 1% bonus during the first year reduces the wage rate by about 0.5% after two years. This coefficient is significantly different from 0 at the 95, 95, and 80% levels of significance respectively. The net effect of bonuses on relative wages is also significantly different from -0.1. Other regressions indicate that this negative impact is larger among nonunion firms than among unionized firms, but the sample sizes are quite small. There is no evidence that relative wages will rise along with the bonus. Taken together, these results imply that wages fall but not by the full amont of the bonus.[12]

Conclusion

The empirical results presented in the preceding section indicate that one can usually reject both the perfectly competitive model in which effort is excluded (in which case the coefficient on the bonus in the wage rate regression would equal -1.0) and the "pure gravy" model (in which the coefficient would equal 0). There is no evidence that higher bonuses lead to higher relative wages. These results, however, are consistent with both the "no gravy" scenario, in which worker utility remains constant but workers must be compensated for providing greater work effort, and the partial gravy or imperfectly competitive model, in which worker utility rises. It should be noted, however, that this result is not very robust. Although the net effect of the bonuses is almost always negative, it is not always significant.

Notes

[1] When there is a significant change in technology or a purchase of capital equipment exceeding $15,000, firms are allowed to revise the "base period" coefficients to reap 90% of the labor-saving gains. See Fein (1981) or Kaufman (1992) for more details.

[2] At Point A workers would also be willing to accept a lower wage rate in return for expanding less effort. This, too, is assumed to be infeasible. This initial

inefficiency is required in order for there to be a Pareto-superior gain-sharing solution with strictly convex indifference curves.

[3] I implicitly assume that any free-rider effects are overcome via peer pressure or guilt [Lazear (1992)]. Weitzman and Kruse (1990) add that the implicit compensation-effort negotiations between workers and management may be viewed as a repeated game in which the cooperative solution may be one of the possible outcomes. If some free-rider problems remain, individual workers will not reap the full benefits of their extra effort, which would flatten the slope of the GS curve.

[4] This will be true unless product demand is extremely inelastic and firms are not allowed to reduce employment.

[5] Although Weitzman's model is usually applied to profit or revenue sharing, his basic model and results merely require that the marginal cost of labor curve lie below the average cost of labor curve. This will also arise in an IMPROSHARE plan because of the declining marginal physical product of labor.

[6] The remaining 15 firms were Canadian. Two US firms that reported wage data were excluded from the sample. One firm had negotiated a deferred profit-sharing plan prior to IMPROSHARE; the second had another regular bonus system before IMPROSHARE but did not report any data about the bonuses.

[7] The wage ratio may also be biased downwards because the numerator represents the firm wage rate while the denominator measures hourly earnings in the industry, which includes overtime premiums.

[8] There is a separate issue concerning the relationship between firm size and subsequent increases in productivity following the implementation of gain sharing. As stated in Footnote 3, the free-rider problem implies that workers in larger firms have less financial incentive to increase their individual effort. Kaufman (1992) found that gain sharing is more successful in increasing productivity among firms with fewer employees, especially among nonunion firms; a 10% increase in the number of employees reduced the productivity gain after one year by about 0.5 percentage points. In this larger, more inclusive study of profit and gain-sharing firms Kruse (1993) divided his sample into five size classes. Although firms in the smallest size class experienced the largest productivity gains, firms in the largest size class experienced the second largest gain.

[9] These data were requested in the original draft of my survey along with sales and price data, but a pre-screening sample indicated that many firms would refuse to provide them.

[10] The number of firms providing wage data two full years after IMPROSHARE's introduction is less than the number providing wage data one year out partially because there is a substantial number of firms that introduced IMPROSHARE between September 1986 and September 1987. At the time of the survey in September 1988, these firms had not yet had two full years of experience with IMPROSHARE.

[11] This is obviously a weak influence. The fact that the quit rate did not change does not rule out the possibility that there was a change in the type of workers who quit.

[12] Since the wage data refer to wages negotiated one and two years after the introduction of IMPROSHARE, there is no *a priori* reason to suspect that the error term is correlated with previous bonuses. Estimations in which these bonuses were treated as endogenous (and the number of employees and union status were included as instruments), however, did not materially affect the size of the

coefficients, but did render them insignificant. The R^2 for the reduced form of the bonus equation, however, never exceeded 0.05.

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