The incentive effect of bonuses on firm performance

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ABSTRACT
I investigate the relationship between bonus payments and firm performance using Hungarian linked employer-employee data. A raw comparison shows that firms paying bonuses to 10 percentage points more of their employees are 3-5 percent more productive. Then, I construct an instrument to estimate the incentive effect of bonus payments. The IV estimates show that the incentive effect of a 10 percentage point increase in the share of employees with bonus payments increases firm productivity by 7-14 percent. Based on these results, I conclude that the raw comparison of firms with and without bonuses underestimates the incentive effects of bonus payments. Furthermore, some firms may have motivations for paying bonuses other than incentivizing employees.

JEL codes: G32, M5, J31, J23
Keywords: Risk Management, Wage Structure, Personnel Economics

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A bónuszok ösztönzési hatása a cégek termelékenységére

Reizer Balázs

ÖSSZEFOGLALÓ

Magyarországi munkadói-munkavállalói kapcsolt adatbázis felhasználásával vizsgálom a bónuszfizetések és a vállalati teljesítmény közötti kapcsolatot. A nyers összehasonlítás azt mutatja, hogy azok a vállalatok, amelyek 10 százalékponttal több alkalmazottjuknak fizetnek bónuszt, 3-5 százalékkal termelékenyebbek. Ezután instrumentálist becslést használok a bónuszok ösztönző hatásának becsléséhez. Az IV becslések azt mutatják, hogy a bónuszban részesülő alkalmazottak arányának 10 százalékpontos növekedése 7-14 százalékkal növeli a vállalat termelékenységét. Ezen eredmények alapján arra a következtetésre jutok, hogy a bónuszokat fizető és nem fizető vállalatok egyszerű összehasonlítása alábecsüli a bónuszok ösztönző hatását. Továbbá, egyes vállalatoknál a bónuszokat nem csak a munkavállalók ösztönzésére, hanem egyéb célokra is használhatják.

JEL kódok: G32, M5, J31, J23

Kulcsszavak: kockázatkezelés, személyzeti közgazdaságtan, bér struktúra

The incentive effect of bonuses on firm performance

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Abstract

I investigate the relationship between bonus payments and firm performance using Hungarian linked employer-employee data. A raw comparison shows that firms paying bonuses to 10 percentage points more of their employees are 3-5 percent more productive. Then, I construct an instrument to estimate the incentive effect of bonus payments. The IV estimates show that the incentive effect of a 10 percentage point increase in the share of employees with bonus payments increases firm productivity by 7-14 percent. Based on these results, I conclude that the raw comparison of firms with and without bonuses underestimates the incentive effects of bonus payments. Furthermore, some firms may have motivations for paying bonuses other than incentivizing employees.

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1 Introduction

Firms that do not only pay a monthly fixed wage to their workers but measure and reward their effort with additional side payments (Joseph and Kalwani, 1998; Bloom and Van Reenen, 2007; Gielen et al., 2009) perform better as they are larger and more productive on average. A large body of literature investigates to what extent this correlation is driven by the incentive effects of bonuses and by other unobserved factors. For example, field experiments show that well-designed incentive contracts indeed increase worker productivity. These papers found that the introduction of piece rate pay for blue-collar workers (Lazear, 2000; Shearer, 2004; Bandiera et al., 2005), commissions for salespeople (Chung et al., 2014), or publication bonuses for researchers (Mallon and Korn, 2004; Andersen and Pallesen, 2008) effectively boost the productivity of workers. Although these field experiments provide evidence of high internal validity, their external validity is limited. The problem is that many bonus contracts contain long-term goals or depend on outcomes that are difficult to measure or not even observable to the researcher. In these cases, field experiments are not feasible.

Using observational data in the empirical investigation of the incentive effects of bonus payments on firm performance is also challenging. First, a simple OLS comparison of firms with and without bonus payments may underestimate the incentive effects of bonuses. This is mainly because firms may want to pay bonuses to workers even if bonuses do not incentivize them. For example, firms with low productivity and wages may use bonus payments to decrease downward wage rigidity (Ehrlich and Montes, 2018; Kurman and McEntarfer, 2019) or to improve their attractiveness and decrease worker turnover (Oyer, 2004; Levitt and Syverson, 2008; Cuñat and Guadalupe, 2009). In addition, if bonus schemes are not efficiently constructed, some workers may try to maximize their own bonus payments instead of the firm's profit (Levitt and Syverson, 2008; Bénabou and Tirole, 2016). In this case, bonus payments do not incentivize workers and even hurt firm performance. Second, an OLS regression may overestimate the incentive effects of bonuses if firms using bonus payments are more efficient in other dimensions as well. This mechanism creates a positive correlation between bonuses and firm productivity even if bonuses do not increase firm productivity.

In this paper, I propose an instrumental variable approach to estimate the incentive effects of bonuses on firm productivity. Based on the insights of contract theory (Holmstrm 1979; 1982; Grossman and Hart, 1981; Lazear, 2018) I use the volatility of the firm growth as the instrument of bonuses[1]. The underlying assumptions are that workers are risk-averse and firms do not observe the effort of their workers. In this case, firms can use the output of the worker as a proxy of effort and pay output-dependent bonuses (Lazear, 2018). If the firm has a lower volatility in revenue, the output of the firm is more informative about the effort of its workers, and firms are more likely to want to incentivize workers' efforts with bonuses. When the volatility of firm revenue is very high, risk-averse workers strongly dislike output-dependent wages. In this case, firms offer fixed wages and do not use bonuses to incentivize workers. This argument implies a strong negative relationship between revenue volatility and bonus payments in the first stage regression.

I use the Hungarian Structure of Earnings Survey (HSES) and administrative balance sheet data for the estimation. The strength of the database is that it includes information on the share of workers receiving bonus payments and balance sheet data at the same time. The OLS estimation shows that a 10 percentage point higher share of workers with bonus payments is associated with a 3-5 percent larger total factor productivity (TFP) and value added per worker. Furthermore, the IV estimates show that a 10 percentage point larger share of workers with bonus payments increases firm productivity by 7-14 percent.

These estimates provide two contributions to the literature. First, I use large-scale, firm-reported data to observe the extent to which firms use bonus payments. This is important because previous literature used firm-level surveys, which did not allow for the estimation of TFP or the observation of bonuses at the worker level. This causes attenuation bias if the share of workers with bonuses drives productivity gains rather than whether firms pay bonuses. In line with this, even the OLS estimates are larger compared to the findings (Oyer,

[1]Note: I add firm fixed effects to the regression that calculates the volatility of firm growth to control for unobserved, time-invariant differences in firm growth and managerial ability.

2004). Second, I present an empirical framework that can be used when field experiments are not feasible and that distinguishes the incentive effects of bonuses from other effects. Since instrumental variables (IV) estimates of the incentive effects are larger than raw differences, I conclude that bonus payments have significant incentive effects. However, some firms use bonus payments inefficiently or for purposes other than incentivizing workers.

2 Data

The HSES is conducted every year and it contains information on the share of workers with bonus payments. On the firm level, it includes every firm with more than 50 employees and a random sample of firms with less than 50 employees. On the worker level, the HSES has a repeated cross-sectional structure and reports the detailed wage structure and the number of paid working hours in May. It covers every worker at firms with less than 50 employees and a 15 percent quasi-random sample of workers at larger firms. Randomization of workers is based on date of birth within the month. Altogether, the HSES has information on approximately 11 thousand firms and 120 thousand workers every year. The database has a unique firm identifier which allows merging the data with the administrative balance sheet data containing information on the universe of double-bookkeeping firms. Reizer (2022) provides more information on the database.

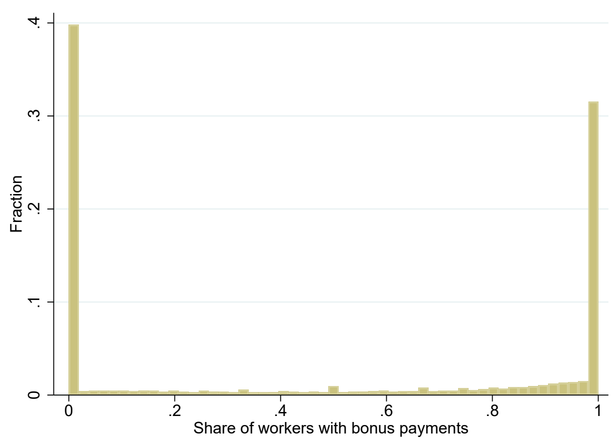
I use the years between 2003 and 2018 for the estimation. Furthermore, I restrict attention to firms which are part of the HSES in two consecutive years and have a positive value added in both years. These restrictions are needed for the estimation of TFP and for the empirical analysis (see the next section). The final sample consists of 54,257 firms-year observations. Table 1 shows the descriptive statistics of the database. As in most European countries, the ratio of bonus payments to the total wage bill is around 10 percent (Druant et al., 2012) and has decreased somewhat after the Great Recession (see Figure A-1). Finally, Figure 1 shows that one third of firms pay bonuses to every worker, one third of firms do not pay bonuses at all, while the remaining firms are evenly distributed on the [0 1] interval.

Table 1: Descriptive statistics

	whole sample			
Firm characteristics	Mean	p(25)	median	p(75)
Share of workers with bonus payments	0.486	0.000	0.500	1.000
Employment	32.037	11	35	52
TFP	6.712	6.102	6.693	7.317
Log(Value added / worker)[a]	8.252	7.664	7.821	8.818
Log(Kapital/worker)[a]	7.653	6.704	7.823	8.801
Share of females	0.401	0.116	0.333	0.665
Average tenure (month)	108.7	64.6	97.9	139.5
Monthly working hours[b]	169.4	164.5	172.1	183.4

Note: Table 1 shows the mean, and the 25th, 50th and 75th percentile of the observations. [a] Real values on 2003 price level [b] The number of paid hours worked in May.

Figure 1: The distribution of firms by the share of workers receiving bonuses



Note: The figure is a histogram showing the distribution of firms by the share of workers receiving bonuses.

3 Methodology

I start the analysis by running the following regression:

$$prod_{jt} = \alpha_1 bonus_{jt-1} + \alpha X_{jt} + \mu_t + \nu_{jt} \qquad (1)$$

where the dependent variable is the productivity of firm j at year t. I use the value added per worker and the TFP proposed by Ackerberg et al. (2015) as the measures of productivity. The main variable of interest is $bonus_{jt-1}$, the share of workers receiving bonuses in year $t-1$. I lag the share of bonus payments to avoid reverse causality, namely, the possibility that firms reward workers with bonuses if their revenue temporarily increases. Control variables include the log-size of the firm and capital per worker, which filter out differences in the quantity of available firm inputs. Furthermore, I control for worker quality as much as possible using the available data, such as average years of education, the percentage of female workers, and average hours per worker. Finally, I add industry-year fixed effects (μ_t) to filter out industry composition. It is well known that firms which are larger and have more capital are also more productive. Moreover, large firms are more likely to pay bonuses (Reizer, 2022), and therefore, omission of these variables may bias the results. At the same time, bonus payments may improve firm quality and thereby help firms acquire more workers and capital. Similarly, it is possible that better quality firms can hire higher ability workers. In this case, firm size and capital endowment and worker quality are bad controls, and filter out the effect of bonus payments. To circumvent this problem, I show that the results are similar with and without control variables.

As the next step, I use the volatility of firm revenue to instrument bonus payments. As I do not observe volatility directly, I have to estimate it as well. For this purpose, I run the following regression:

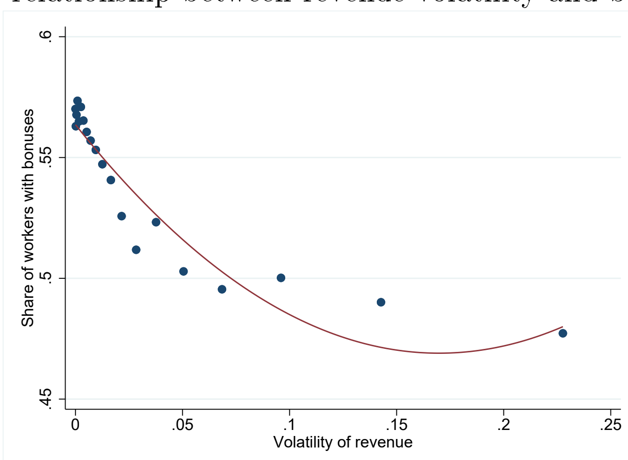
$$\Delta log(sales_{jst}) = \mu_j + \mu_{st} + \varepsilon_{jst} \tag{2}$$

where the dependent variable is the growth of revenue of firm j in sector s between year $t-1$ and t. The firm fixed effect (μ_j) controls for the unobserved general ability of the management. The sector-year fixed effects μ_{st} control for aggregate demand changes which firms may foresee or form expectations about. Then, I use the square or the predicted error term of ($\widehat{\varepsilon}^2_{jst}$), which is by definition the proxy of the volatility of the revenue. Since I run the

IV estimation in two steps, the baseline standard errors are biased. Therefore, I bootstrap the estimation procedure with 1000 replications to get the correct standard errors.

The volatility of the revenue is a valid instrument only if it is correlated with the share of workers receiving bonus payments. To show this, I order the firms by the volatility of their revenue and put the firm-year observations in twenty equally sized bins. In line with the insights of contract theory, Figure 2 shows a strictly negative relationship between bonus payments and revenue volatility. The share of workers with bonus payments is 55 percent if the volatility of the revenue is very small, while it is only 40 percent if the volatility is larger than 20 percent. The figure also shows that this relationship is non-linear, therefore, I use the predicted volatility and its square as instruments.

Figure 2: The relationship between revenue volatility and bonus payments



Note: The figure is a binscatter plot showing the relationship between the proxy of revenue volatility ($\widehat{\varepsilon}_{jst}^2$) and the share of workers receiving bonus payments.

The second crucial assumption is that the volatility of the revenue is not correlated with the general quality or the ability of the management. To cope with this problem, I add firm fixed effects in Equation 2 to control for unobserved, time-invariant differences in firm growth and managerial ability. One possible concern is that high volatility in revenue may negatively effect firm. If this were the case, the IV estimates would over estimate the true effect of bonus payments. For this reason, I winsorized the revenue changes in Equation 2 at 50 percent. Furthermore, Jiang (2017) suggests investigating specific subsamples to infer the potential direction and size of the biases in OLS and IV estimates. That is why, I re-estimated the model using a sub-sample of firms where revenue volatility is below five percent. The revenue volatility is very small here, so it may not harm the firm much. Reassuringly, the OLS and IV estimates are similar to the main results (See: Table A-1). Finally, the instrument estimates the local average treatment effect from the subsample of firms that want to incentivize workers only when the revenue volatility is low (compliers). The effect of bonuses on this subgroup may be larger than on firms that pay bonuses in all circumstances (always takers) or never pay bonuses (never takers), for whatever reason (Card, 2001). Nevertheless, this argument reinforces my previous assertion that the OLS comparison underestimates the incentive effects of bonus payments.

4 Results

The results are summarized in Table 2. The upper panel shows the OLS estimates, while the lower panel shows the IV estimates. The first column shows that firms where the share of workers with bonus payments is 10 percentage points higher also have a 4.38 percent higher value added per worker. This difference is 3.02 percent if we control for differences in size, capital endowment and worker composition. Columns (3) and (4) reveal that firms which pay bonuses to a 10 percentage point higher share of workers have a 2.85 percent higher TFP. The point estimates are basically the same regardless of whether we control for firm composition or not.

The bottom panel shows that a 10 percentage point increase in the share of employees with bonuses increases value added per employee by 13 percent when I do not control for firm characteristics, and by 12 percent when I add control variables. Column (3) shows that this increase is 5.8 percent in the case of TFP. The point estimate is somewhat higher (9.8 percent), but statistically not different in Column (4) where I add control variables to the IV estimates. Finally, the first-stage F-statistic is greater than 25 in each specification, confirming that the IV is strong.

Table 2: The effect of bonus payments on firm productivity

	(1)	(2)	(3)	(4)
	Panel A: OLS estimates			
	Value added per worker		TFP	
Share of workers	0.464***	0.388***	0.298***	0.288***
with bonus payments	(0.017)	(0.015)	(0.015)	(0.014)
Controls	No	Yes	No	Yes
Observations	54,257	45,042	53,589	45,571
R-squared	0.313	0.468	0.530	0.590
	Panel B: IV estimates			
	Value added per worker		TFP	
Share of workers	0.672***	1.114***	1.061***	1.380***
with bonus payments	(0.185)	(0.240)	(0.221)	(0.263)
Controls	No	Yes	No	Yes
Observations	48,688	45,372	49,304	44,829
F-statistics	53.24	35.88	51.12	36.13

Note: The table shows the effect of bonus payments on firm productivity. Panel A shows the OLS estimates and Panel B shows IV estimates. Controls are the year log-size of the firm, capital per worker, average years of education, the share of females, average hours per worker and industry-year fixed effects. TFP denotes Ackerberg et al. (2015) productivity and F-statistics denotes the first stage F statistics. The standard errors of the OLS estimates are clustered at the firm level, while the standard errors of the IV estimates are bootstrapped. See Section3 for the details.

5 Conclusion

I investigated the effect of bonus payments on firm productivity. The OLS estimates show that bonus paying firms are on average more productive than firms which are not using bonus payments. At the same time, the IV estimates – which pinpoint the incentive effects of bonus payments – show a larger productivity gain from using bonus payments than the raw difference. The point estimates are high in economic terms, as a 10 percentage pointhigher share of workers with bonus payments corresponds to 8-12 percent higher productivity. This result is surprising because bonus paying firms are more likely to use other high quality management practices as well (Bloom and Van Reenen, 2007). The most likely explanation is that some firms have other motivations for paying bonuses other than incentivizing worker effort, such as decreasing downward wage flexibility or worker turnover.

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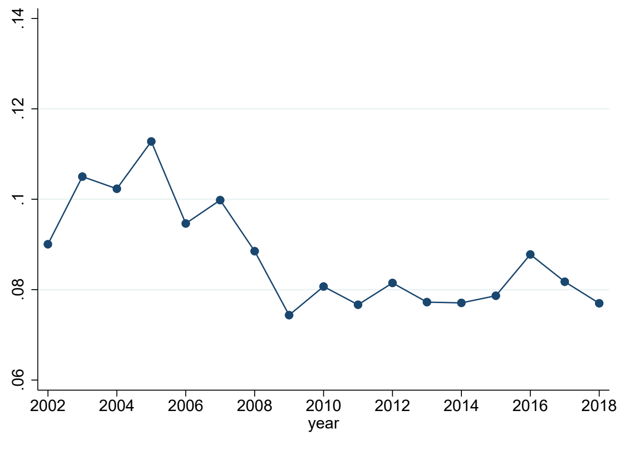
Figure A-1: The ratio of bonus payments and total wage bill over time



The figure shows the percentage of bonuses in total wages over time.

Table A-1: The effect of bonus payments on firm productivity - if the volatility of revenue is below 5%

	(1)	(2)	(3)	(4)
	Panel A: OLS estimates			
	Value added per worker		TFP	
Share of workers	0.458***	0.353***	0.297***	0.269***
with bonus payments	(0.021)	(0.017)	(0.018)	(0.017)
Controls	No	Yes	No	Yes
Observations	31,248	28,557	30,740	28,760
R-squared	0.336	0.515	0.572	0.634
	Panel B: IV estimates			
	Value added per worker		TFP	
Share of workers	1.259***	1.439***	0.927***	1.257***
with bonus payments	(0.308)	(0.374)	(0.260)	(0.350)
Controls	No	Yes	No	Yes
Observations	31,248	28,557	30,740	28,760
F-statistics	27.45	16.70	28.12	16.95

Note: The table shows the effect of bonus payments on firm productivity. Panel A shows the OLS estimates and Panel B shows IV estimates. Controls are the year log-size of the firm, capital per worker, average years of education, the share of females, average hours per worker and industry-year fixed effects. TFP denotes Ackerberg et al. (2015) productivity and F-statistics denotes the first stage F statistics. The standard errors of the OLS estimates are clustered at the firm level, while the standard errors of the IV estimates are bootstrapped. See Section3 for the details.