# Replication study of Massenkoff & Wilmers, 2023

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## 1 Introduction

The stagnation of US blue-collar workers wage, starting in the 1970s, has been at the core of a wide strand of literature. Indeed, these workers experienced flat or declining real wages from the 1970s to the mid-1990s, which contributed to increased wage inequality and socio-economic as well as political consequences that are still observable today in previously heavily industrialized US states, notably in the Midwest. To explain this phenomenon, a large variety of reasons have been explored, ranging from the impact of economic globalization and technological advances to the weakening of a variety of labor institutions. It must particularly be noted that these years were a context of declining labor union power (Stansbury and Summers 2020b), coinciding with transformation of various aspects of the labor market and workplace organization and practices.

In *Wage Stagnation and the Decline of Standardized Pay Rates, 1974–1991*, Maxim Massenkof and Nathan Wilmers turn to one particular feature of changing pay practices. Indeed, after decades of widespread standardized pay rates, called for and encouraged by labor unions, the 1970s saw a bounce of pay flexibility through the rise of merit-based pay practices, subject to managerial discretion. The reason of such a change in pay practices are diverse, but it has been argued that the declining influence of labor unions in those years, as well as technological and regulatory changes have greatly facilitated this evolution.

The literature that tried to address and assess the impact on wages of these policies has offered argument going in different directions, some of them suggesting that these policies are consistently associated with higher mean wage, but more unequal pay scales. But these works mainly focused on piece rate pay or bonuses and equity incentives, rather than overall wage trends. On the other hand, only one earlier study precisely tried to assess the effect of flexible pay practices on wage levels and found evidence of a negative effect (Brown 1992).

**Data**

This is why the authors address the question using a new dataset, the Wage Fixing Authority Survey (WFAS) coming from the US Department of Defense Wage Fixing Authority, and gathering data from 1974 to 1991. This survey, used to set wage levels for blue-collar federal government employees, asked establishments about pay rates and a bunch of other employment and job-related information. Its main interest, for the authors' study, is to offer large details on pay structures and their drivers. More precisely, one of the survey's question asks about the reason for wage differences within each job category considered. The surveyed employer could then choose between : "none" (no within-job variation) (39 % of the sample), longevity (tenure) (25%), merit (13%), a combination of merit and longevity (16%), or other (6%). This offers a clear

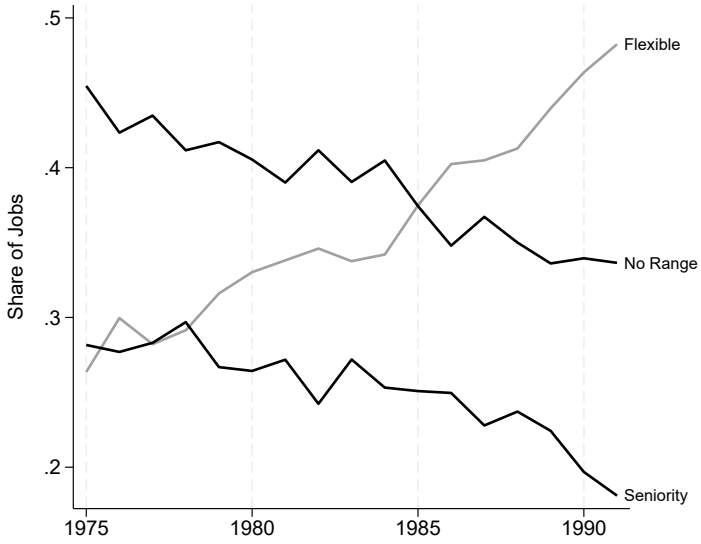


Figure 1: The Decline of Standardized Pay Rates

insight on the pay structure and the way wages are determined in the surveyed firms. Using this new data the authors can then study the effect of different pay structures on wages.

We will therefore present and replicate their key findings and results, and underline their importance, before to check their robustness and look at potential blind spot of their study or additional insight we can get from their work and data.

## 2 Summary of Massenkoff & Wilmers 2023

Using the Wage Fixing Authority Survey (WFAS), the authors have a dataset providing them with precise and detailed information on the wage scale, type of contract, pay practices and a lot of other details of firm-workers relation on a large, although not well defined, sample of US firms. More particularly they rely on the question asking the base for wage differences within job categories that we presented above. They, then, classify each job occupation along those lines, defining non-standardized pay as based on merit, a combination of merit and longevity, or other. Once this is done, they can start exploring the dynamics of, and associated with, non-standardized pay rate expansion.

First, they present some descriptive statistics, of different elements of their dataset. They do it, to compare the WFAS data with other data sources (CPS earnings data, Employer Cost Index from the BLS, Distributional National Accounts from Piketty et al.) to show that it can be taken as representative of US firms although the sampling strategy for the WFAS is not well documented. In all data sources, the pay stagnation trend starting in the 1970s is confirmed. This also allows them to offer some primary evidence on the decline of standardized pay rates and insight on associated trends. As has been showed by previous research (Heneman and Werner 2004), the rise of non-standardized pay rate, associated to the decline of standardized pay, is apparent since the first year of the sample (1974) and accelerates in the mid-1980s (Figure 1).

Finally, they turn to the wage distribution under standardized versus non-standardized pay. They highlight that wage distributions were wider and lower for jobs under flexible pay setting compared to standardized pay, indicating higher wage inequality under the former than the latter, a result coinciding with findings from Lemieux et al. (2009).

To try to understand the drivers of these changes in pay settings, they investigate in the direction of unionization, starting with the observation that nonunion workplaces were more likely to have non-standardized pay rate at the beginning of the surveyed period, and to adopt flexible pay setting during the time of the survey (in fact these non-union firms can explain almost all the shift to flexible pay). This finding coroborates previous studies suggesting that unions were likely to resist standardized pay rate abandonment. This is all the more important as unionization in the sample decreased from 45 to 32 percent between 1974 and 1991, in line with multiple evidence of declining labor union power in this period (Jacoby 2004, Balkin 1989). When the authors precisely look at how flexible pay rate evolved in response to declining labor power, they find that a 20 percentage point decrease in the share of unionized workers was associated with a 4 percentage point increase in the share of workers under non standardized pay scheme.

For the same occupation, the wage differences between workers under flexible and standardized pay is higher in unionized than in non-unionized firms (where it is near zero for most occupations).

Finally, a striking finding is that even in firms that switched to flexible pay, unions protected workers from wage falls. Indeed the authors show that when they estimate the impact of merit-based pay on wages, the effect is non-significant, or if anything slightly positive for firms that always had unions, while they find a negative effect in general, as we will now see.

## 2.1 Main results of the Job Fixed Effects Regression

Indeed, in the following section, they estimate the impact of the decline of standardized pay rate on workers' wages. To do so, they use the following wage equation:

$$\log w_{itc} = \beta NonStand_{itc} + \alpha_i + X'_{itc}\gamma + \epsilon_{itc}$$

to explain real hourly wage $w_{itc}$ in job-by-establishment $i$, year $t$ and at common pay rate $c$, based on an indicator for the use of non-standardized pay rates, and a vector of fixed effects $\alpha_i$, and where they include a vector of controls, to account for potential external sources of wage changes. Indeed, earlier studies have focused on different kind of explanations for the wage trends observed during the period.

First, the role of labor market institutions, primarily labor unions and minimum wage, in raising wages have been demonstrated. Even in non-unionized firms, a high density of unions in the same industry, has been shown to play a similar role as that of union inside the firm; a phenomenon known as the "union threat" (Jacoby 1984). Therefore, the authors control for the presence of unions, as well as union density in the industry-region, and local real minimum wage.

Then, they also use proxies for technological change, through worker's skills composition, as well as controls for other types of organizational change (controlling for average coworkers' occupational level). Finally they control for other forms of unobserved heterogeneity between establishments. The results of the regression are presented in Table 1.

Under all specifications, non-standardized pay is associated with lower wages. In the baseline, we observe that non-standardized pay accounts for a 14.5% wage

Table 1: Wage effects of Nonstandardized Pay Rates

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Non-standardized Pay | -0.145 | -0.108 | -0.077 | -0.008 | -0.010 |
| | (0.003) | (0.003) | (0.002) | (0.001) | (0.004) |
| log(Workers at Pay Level) | 0.044 | 0.040 | 0.034 | 0.013 | 0.012 |
| | (0.002) | (0.001) | (0.001) | (0.000) | (0.001) |
| log(Workers in Est.) | 0.050 | 0.048 | 0.040 | 0.014 | 0.012 |
| | (0.001) | (0.001) | (0.001) | (0.002) | (0.004) |
| log(Workers in Job) | -0.016 | -0.023 | -0.012 | -0.016 | -0.013 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| log(Minimum Wage) | 0.085 | 0.075 | 0.001 | 0.010 | -0.001 |
| | (0.011) | (0.010) | (0.010) | (0.004) | (0.005) |
| Collective Bargaining | | 0.034 | 0.021 | 0.002 | -0.003 |
| | | (0.004) | (0.003) | (0.002) | (0.003) |
| Share Managerial, Clerical in Est. | | 0.018 | -0.008 | -0.002 | -0.018 |
| | | (0.006) | (0.005) | (0.004) | (0.011) |
| Co-Workers' Occupational Level | | 0.556 | 0.262 | 0.006 | 0.002 |
| | | (0.008) | (0.006) | (0.004) | (0.008) |
| Union Density in Industry-Wage Area | | 0.049 | 0.030 | -0.002 | 0.008 |
| | | (0.005) | (0.004) | (0.002) | (0.006) |
| Constant | 2.206 | 0.742 | 1.760 | 2.608 | 2.643 |
| | (0.021) | (0.029) | (0.023) | (0.018) | (0.033) |
| Fixed effects: | | | | | |
| Year | × | × | | | |
| Year X City X Ind. X Occup. | | | × | × | × |
| Occup. X Establishment | | | | × | × |
| Year X Occup. X Firm | | | | | × |
| Observations | 900359 | 852024 | 829626 | 769166 | 535106 |

difference. Even when the set of controls increases, to a its maximum, controlling labor markets, establishment-by-occupation and firm-name-by-year fixed effects, the effect is still significant even though it is much lower. This nevertheless suggests that some unobserved features of establishments may be correlated with standardized pay and with wages. Furthermore, we cannot completely rule out that still unobserved factors account for the remaining effect found out in the most controlled estimations.

A complementary feature that should be highlighted, is the impact of unions on wages which still appears under wide range of controls and fixed effects. For (almost) all specifications, the coefficient of Collective Bargaining and Union Density is positive, and significant in columns (1)-(3). Interestingly, we can note that the "union threat" effect (accounted for by the union density variable) appears to be often significant, and higher than the mere effect of union presence inside the firm. This indicates that if the union desnity were to raise from 0% to 100% in the local labor market of the firm, the impact on workers' wages would be stronger than if the firm were to adopt collective bargaining and unionization internally.

This adds up to the fact that, as noted by the authors, the adoption of non-standardized pay can be seen as a proxy or consequence of declining labor union power. This is an important finding and we will come back to this later.

## 2.2 Event study

In order to have even more robust results on the effect of a switch to flexible pay, the authors perform an event study looking at establishments' first move away from

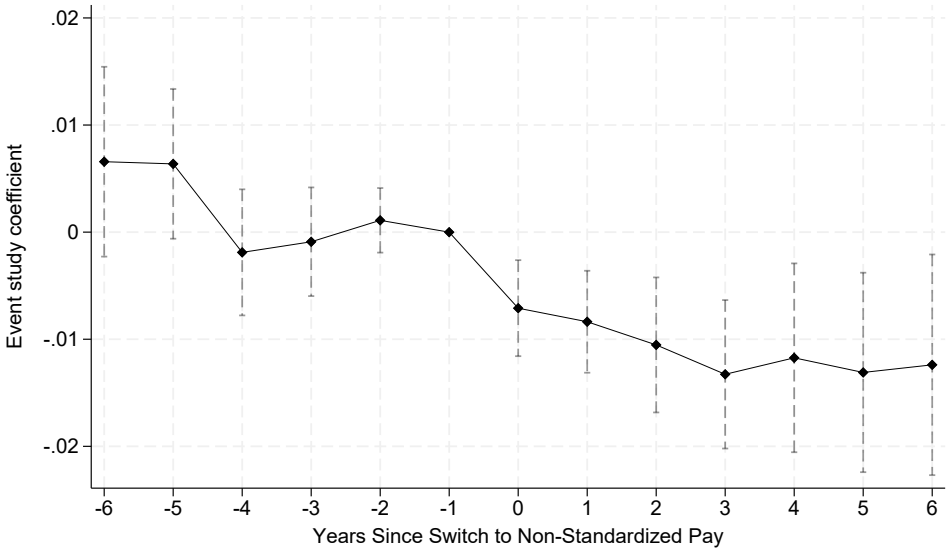


Figure 2: Wage Trajectory Following Switch to Nonstandardized Pay Rates

standardized pay. They find that while wages are quite stable in the years before the switch, there is a sudden wage drop as soon as an establishment switches to non-standardized pay rates. The magnitude of the drop being significant and persistent over time. The results of the baseline event study are shown in Figure 2 (and Table 3). This finding corroborates the first estimates of a negative relation between non-standardized pay and wages, as they suggest that wages were cut as soon as non-standardized pay was adopted. This seems to indicate that the adoption of these new pay settings was a way to reduce wages, in times of economic troubles and declining worker power. Therefore, standardized pay seems to have a causal but only proximate role in the decline of workers' wages, as they were used to cut them in a context where it was facilitated by external conditions.

## 2.3 Additional results and analysis of wage decline

Using their estimates, the authors can next evaluate the share of wage stagnation that is attributable to the decline of standardized pay rates. Using their estimated effect of the switch away from standardized-pay on wages, they scale it by the share of workers who effectively experienced such switches to non-standardized pay. Depending on the specifications used, they find estimates of this contribution ranging from 20 to 1 % of the overall real wage decline experienced by nontrade workers [1], and between 16 and 4% of the real wage decline experienced by trades workers.

They evaluate how these changes were spread among workers, finding that lowest-paid workers suffered from significant wage drops (around 4%), while highest-paid workers benefited from slight wage increases. More broadly, they find an effect that had already been studied and displayed in previous studies : non-standardized pay rate leads to a widening of the pay scale. They indeed find out that the top of the pay scale slightly increased after the switch to non-standardized pay, while the bottom

[1] The wage of nontrades workers decreased by around 30% between its 1978 hike and the end of the surveying period in 1991, against an approximately 10% decrease for trades workers

decreased a lot (around -9%). Interestingly, they also note that the employers with the previously highest-than-average pays are those that are using the switch away from standardized pay to decrease wages the most, which sustains their idea that standardized pay was constraining employers to pay high wages, in a time of economic downturns and decreasing workers' bargaining power. This is also the reason why they observe that unionized firms experienced almost no wage decline following the switch, while non-unionized firms experienced severe wage drops.

Finally they find that firms displaying large employment growth were more prone to switch away from standardized pay. This, in line with the previous result, is a further indication that these wage drops were most likely to be borne by new hires (and not by, better-paid, incumbent workers, which probably facilitated the adoption of these new pay settings).

They eventually evaluate a wage size premium conditional on pay setting structure, trying to correlate firms' wage dynamics with their performance. In the tightest-controlled estimation, there is an establishment size effect 30 to 75 % larger for jobs using nonstandardized pay rate. This would imply that wages are more closely linked to the economic performance of the firm, and therefore its size dynamics, under non-standardized pay, probably due to the more flexible nature of such pay settings.

# 3 Robustness checks and extension of the main results

## 3.1 Data representativeness

As mentioned earlier, the WFAS surveying strategy is not explicit and well defined, as a result one might fear that it leads to biased results. The authors provide comparison of summary statistics to different sources (as detailed in section 2) to ensure that the surveyed sample is representative. Furthermore, several trends that are observed in the sample had already been described in other studies, such as wage stagnation, the decline of standardized pay rate, or of cost-of-living adjustment (COLA) clauses. In addition to these checks, it may be interesting to look at similar data and perform similar types of estimations on other data sources. Unfortunately, to our knowledge, no such rich dataset exists under free access. If it was the case, or that such information were to be released it would surely be of great interest to investigate and compare the new findings to those of this study.

## 3.2 Job Fixed Effects Regression

Let us now turn to the main results, especially the main regression estimating the impact of non-standardized pay rate on workers' wage, to check their robustness, and eventually extend them.

In the main regression, as we have seen, the authors estimated the wage difference in a firm under non-standardized versus standardized pay rate, controlling for a set of potential omitted variables and hidden explanation of wage differences. Such variables include establishment size, number of workers at the same pay level, the presence of collective bargaining agreements, etc. When replicating their study, with similar controls and weights, we got to the same output as presented in the original paper. In the latter, they propose to test the robustness of their results by using alternative weighting schemes for their observation. Indeed, in the baseline each job is weighted

as one equal unit, but as the WFAS also includes information on the number of employees in each job, it is possible to weight each job accordingly. Doing so has the direct consequence of upweighting a lot jobs with many employees (in fact 54 % of the weight concentrates on only the 5% jobs with most employees). It is also possible to reweight the data using the Current Population Survey (in proportion to the industry and occupation cells). Once this is done, the results are coherent with Table 1, except for the job-by-establishment fixed effect model weighted by number of employees, which is driven by the largest jobs. Once these are excluded, results are coherent and significative, in the same magnitude as with other weighting schemes.

**Standardized pay effect estimation**

Another way to check the robustness of the results of this main regression, and to look into more details at the revealed phenomenon, is to use different classifications / definitions of pay methods. Indeed, let us recall that the authors define non-standardized pay rate as pay based on merit, a combination of merit and longevity or other reasons. To evaluate if the results are sensitive to this specification, one can estimate the same model, with different specifications of non-standardized pay as just merit or a combination of merit and flexibility, or pure merit (as suggested by the authors). Doing so, one finds that the main results are not affected by these different specifications.

It would then be possible to conclude that standardized pay rate is always associated with higher wages, but such a conclusion needs to be checked and refined. Indeed, until then jobs under standardized pay rate are defined as jobs with no wage variation within-job, or variation only based on longevity (tenure). If these categories can convincingly be labeled as standardized pay, as is usually done in other studies, they are not homogeneous nor identical. It would then be interesting to see where the difference comes from, and whether seniority alone is a driver of higher wages relative to flexible wages. To do it we therefore refine the categories and estimate the same equation as in Table 1, but with now a dummy for standardized instead of non-standardized pay. If letting the broad standardized pay category logically yields similar estimated magnitude, with opposite sign, of the impact on wage, we can now do it under longevity only and under the "no change" specification. The results are presented in Table 4 and 5.

We can observe that the coefficient on the "no within-job variation" is much higher than that on the longevity based pay. Further, the coefficient of longevity-based pay is close to zero, and sometimes even negative. This suggests that the effect that was found mainly comes from these jobs without wage variation, rather than those where pay is based on tenure. This may be an indication that only "pure" standardized pay, where there is no within-job pay variation, was the best way to ensure high wages to workers. This may also indicate that even longevity-based pay scales, already allowed the employers to smooth wage increases rather than synonymous of systematic higher wages than under flexible settings. This result is especially important as the share of jobs with no within job variation has decreased from 37% of surveyed jobs in 1974 to around 23% in 1991. Therefore, refining the pay settings categories is useful to get a better understanding of the dynamics at play here.

**Bootstrap :** Next, back to the baseline, we observe that some estimates are barely significant (in column 5 in particular). This suggests that bootstrapping the standard errors may be a good way to check the robustness of the results, and ensure they are significant enough. Because of the weighting scheme that has been adopted, it is not possible to exactly bootstrap the main fixed effects regression in its original

specification, but we can at least bootstrap the uniformly weighted alternative which yields extremely close estimated coefficients. Because the estimates displayed in column 5 are the least significant we found, we focus on them, for a matter of time and feasibility. We proceed to 100 bootstrap repetitions. The resulting estimates with bootstrapped standard errors are displayed in Table 6, and are similar to the robust ones from baseline, reinforcing confidence in the original estimates.

## 3.3 Event study

In the Event study, that has been detailed above, the authors propose two checks : (1) changing the event time indicators to count the number of surveys since the switch away from standardized pay rather than the number of years, (2) strengthening the balance requirements to make sure that a firm appears at least three times before and after the switch. In both cases, the sudden and significant wage decrease is still observed. Another way to check this would be by looking at the way this changes when we modify the type of pay methods under study, by focusing on pure merit in particular. In this case we get the estimates presented in Figure 3 (in Appendix). We observe the very similar trend and same significant wage drop following the switch to flexible pay settings, as in baseline. This finding goes in the same direction as the original one, pointing toward a significant negative impact on wages following the adoption of flexible or non-standardized pay methods.

**Wage trajectory following switch away from standardized pay**

Then, to go beyond this finding and look at how standardized pay affects wages relative to non-standardized pay, one can focus on an alternative, though close, event study : focus on the first switch away from tenure-based pay instead of the broader category we had, which nests both firms with no within-range pay variation and those with longevity based variation. One can then do the same exercise with "pure" standardized pay (not based on longevity).

First, let us look at the "no-change" category (no within-job wage difference). Following a similar methodology as in the baseline, we now focus on jobs switching from a pay setting without any wage difference to a non-standardized pay setting (as defined originally). Before considering the results, note that the sample keeps a significant size (more than 4000 switchers observations). The resulting estimates, presented in Figure 4 (and Table 7) show a similar pattern as the original event study, but with more significant values and higher absolute values of coefficients (more negative).

On the other hand, when focusing on jobs that precisely switched from longevity to non-standardized pay (in its broader sense, Figure 5, Table 8), the estimated effect is no longer significant (the coefficients are close to zero and standard errors higher). This result definitely goes in the same direction as the job fixed effects regression. Indeed, both indicate that the difference between standardized and non-standardized pay settings is largely, if not fully, originated by switch away from "pure" standardized pay rate jobs, where there is no within-job wage variation (as opposed to longevity-based variation). This is an interesting finding as it sheds light on the type of pay setting that is associated with higher wages. Furthermore, in the sample, the presence of unions is more correlated with longevity pay settings than purely uniform pay setting. This survey alone does not provide enough evidence on the type of pay setting that was favored by unions, but if we were to find out that unions were indeed more prone to encourage longevity based pay settings, our finding would take an even greater importance.

**Placebo test :** Finally, we can run a kind of placebo test, by looking at what happened to these jobs several years before the switch. By computing the wages for instance two years before the switch to non-standardized pay rather than at the impact, we can capture if there is an additional relation between wages and the fact of switching to non-standardized pay. Doing so, and estimating this effect, yields an estimate very close to zero, suggesting that we are indeed studying a causal effect.

### 3.4 Other components of flexible pay

If the authors already made an exhaustive effort and important contribution to existing literature, using their brand new dataset to provide insights about the role of standardized pay abandonment on workers' wages, the WFAS can still be investigated to contribute to similar questions raised in the literature. Indeed, the focus is here put on base pay, but bonuses and incentive pay are also an important part of these new pay settings, emerging particularly starkly in the 1970s. As we had mentioned, earlier literature on flexible and merit-based pay settings was divided on its effect, and a wide range of previous work went in the direction of a positive effect on workers' earnings. Luckily, the WFAS includes information not only on the broad pay structure, but also on other forms of pay, including jobs paid according to piece rates or receiving production bonuses. In the sample, between 13 % and 15 % of jobs receive bonus each year, and this increases in the mid-1980s to reach 22% in 1990.

This allows us to estimate the impact of such bonuses on workers' pay. This is all the more important that there had already been studies on this topic, with Lemieux et al. (2009) finding a positive relationship for instance. To do it, let us regress the log hourly wage on an indicator variable for whether a job receives production bonuses or not, and a set of controls. From the argument that was made before, we know that a set of external elements can influence workers' pay, in addition to bonuses too. This is why we control for the number of workers at pay level, in establishment and in job. We also control for minimum wage level. In a second time, we add controls for non-standardized pay as we now know that it is associated with lower wages, and for the presence of unions and union density in the local labor market.

To get a better understanding of the phenomenon and the way bonuses affect workers' wages, we can try to subdivide this impact by type of workers. To do so, one can use as a proxy the share of managerial or clerical workers in establishment. First, we can check that the share of workers receiving production bonuses do not vary too much with the share of white-collar workers. One finds that this share is around 16-17 % for most firms, except for those with more than 75% of white-collar workers, where it falls to around 10%. Then, let us study the differentiated impact of production bonuses on workers' wages, for different shares of office workers. To do it, let us split the firms into four bins, by share of white-collar workers. Those with less than 25%, between 25% and 50%, between 50% and 75% and more than 75%. The results of these estimations are shown in Table 2. We observe that the positive effect is very concentrated in the firms with a high share of white-collar workers relative to blue-collars, with an effect comprised between 10% and 20% for firms with more than 75% of managerial and clerical workers. This therefore complements previous studies on the impact of this kind of bonuses, as it allows us to refine our understanding of their impact, and the way it is spread across workers and jobs types. It is in fact going in similar direction as previous studies already highlighting that bonuses disproportionately benefit white-collar workers, managers and executives.

One could then be willing to do a similar study for piece rate pay. Using the WFAS, such estimates would be comprised between 6% and 22% depending on the

Table 2: Estimated effect of bonus on wages

| Share of white-collar | (1) | (2) |
|---|---|---|
| Overall | 0.059 | 0.047 |
| | (0.004) | (0.004) |
| Less than 25% | 0.035 | 0.045 |
| | (0.006) | (0.005) |
| Between 25% and 50% | 0.036 | 0.035 |
| | (0.007) | (0.006) |
| Between 50% and 75% | 0.074 | 0.057 |
| | (0.008) | (0.007) |
| More than 75% | 0.203 | 0.107 |
| | (0.016) | (0.012) |
| Regressors: | | |
| Baseline | × | × |
| Additional Controls | | × |

controls and fixed effects used. Nevertheless, due to the very tiny portion of the sample using piece rate pay, we will not detail it here (in some years, less than 100 firms are using piece rate pay). This is actually a more important aspect of piece rate, even though literature already stressed the positive effect it has on workers' income, it is a restricted and limited tool that can only be used when output is precisely measurable.

# 4 Final comments and concluding remarks

Following the steps of Maxim Massenkoff and Nathan Wilmers, we have seen that the decline of standardized pay rates in the late 1970s and the 1980s have been one of the drivers of wage stagnation over this period. We have been able to confirm their main findings and implications, through different robustness checks in particular.

Furthermore, we refined their analysis of standardized versus non-standardized pay rate, and found that most, if not all, of the difference comes from switching away from completely standardized pay rate, with no within-job pay variation. On the other hand, switching away from tenure based pay settings does not seem to be associated with lower wages. As a result, once we focus on jobs switching away from completely standardized pay, we observe a sharper real wage decline than under the baseline. This is a key finding, which both allows us to get a more precise understanding of the mechanisms at play here, but which also has direct policy implications and should lead further studies to focus specifically on this type of pay. Indeed, we observe that the firms under "pure" standardized pay are also the most prone to switch to flexible pay in the WFAS sample.

To go further and complete our study of flexible pay settings, we also studied in-depth the effects of other dimensions of pay flexibility, namely bonuses (and piece rate pay). In line with previous literature on the topic, we estimated that most of the positive effect of bonuses on worker's income is captured by firms with high shares of white-collar workers. This goes along with earlier findings of a similar concentration of this beneficial effect on white-collar workers, whose wages include a higher share of bonuses. The effect of piece rate pay also looks significant and high, but it is

unfortunately hard to estimate and generalize because of the small number of firms using it in the WFAS, and more generally in the economy.

Finally, it is also possible to test the true impact of the switch to non-standardized pay by running a random inference test. This method usually exploited to assess average treatment effects in randomized controlled experiments, tests the null hypothesis that the treatment has no effect. When we ran a simple random inference test on the sample, we observed that the estimated effect was likely significant and the null hypothesis of no effect of non-standardized pay rate on wages could be rejected. To go further, one could then use propensity score matching to get more robust results and exploit the set of co-explanatory variables that is at our disposal. Unfortunately, one of such technique exceeded our computing power, and otherwise the test was not significant enough due to unbalanced matched and unmatched observations. More precise analysis on this point is left to further study.

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# Appendix

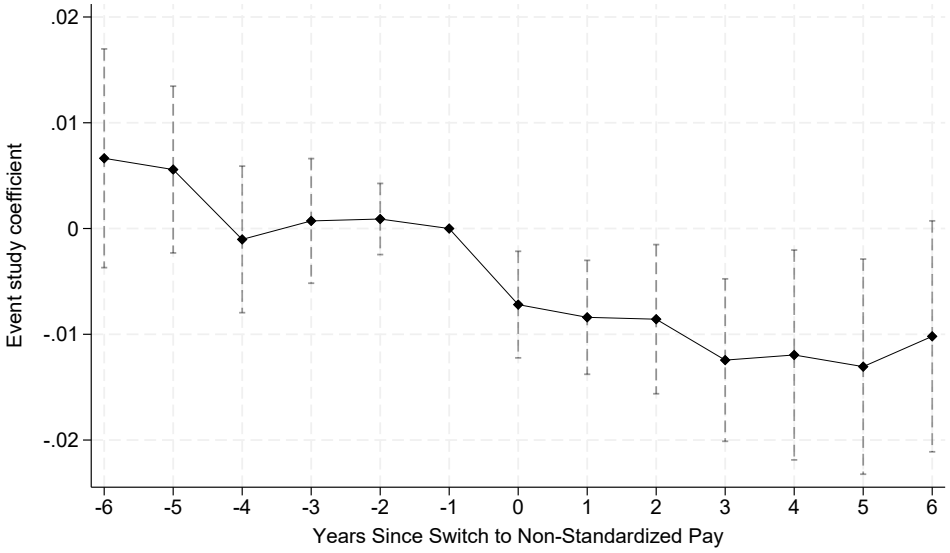


Figure 3: Event study, switch to pure merit pay

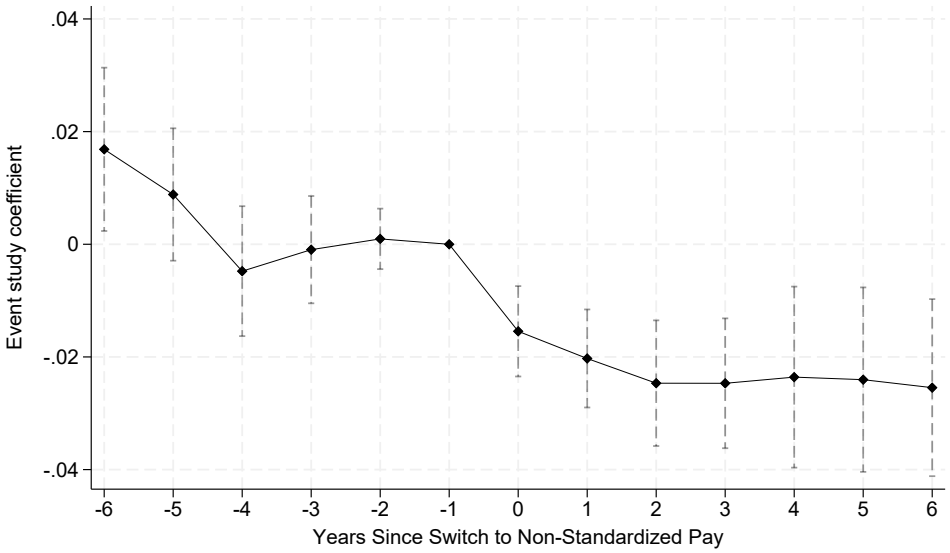


Figure 4: Event study, switch from pure standardized to non-standardized pay

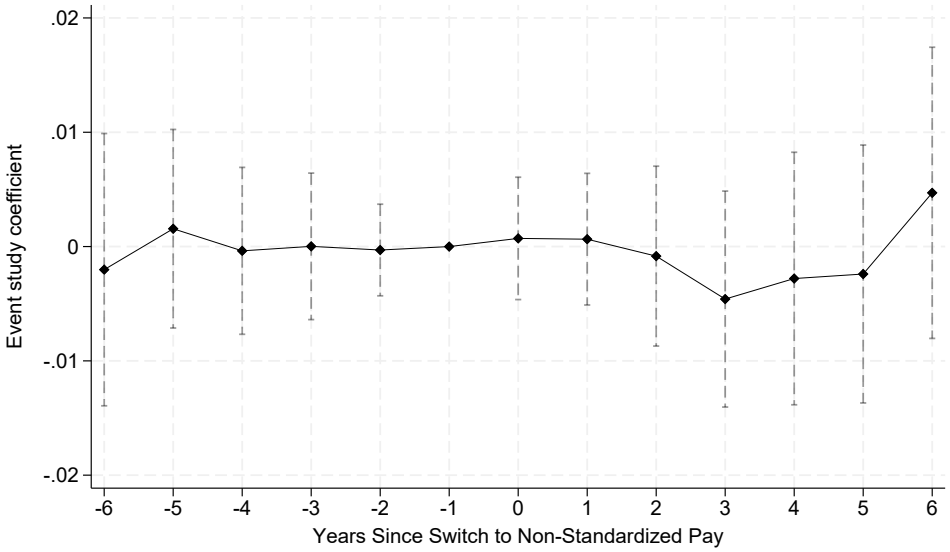


Figure 5: Event study, switch from longevity-based to non-standardized pay

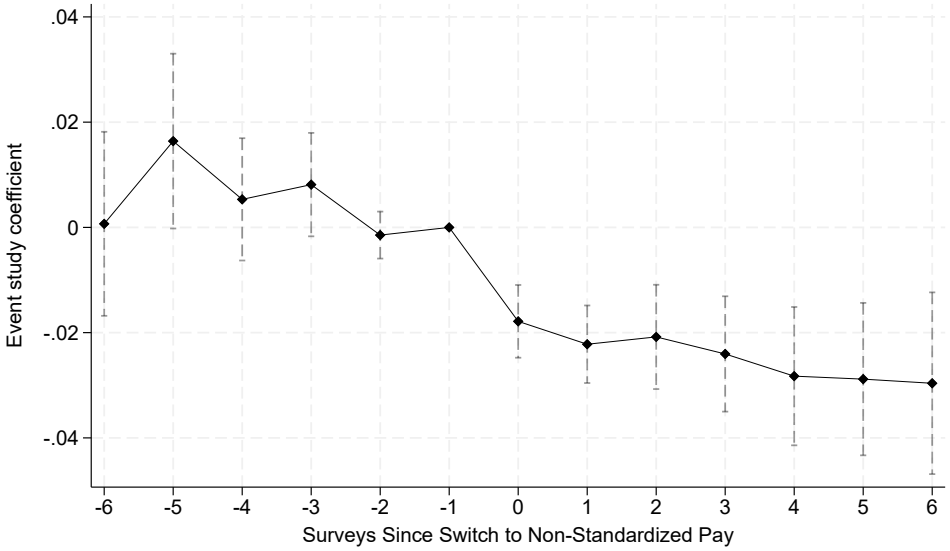


Figure 6: Event study, switch from pure standardized to non-standardized pay, alternative specification

Table 3: Event study coefficients, baseline

| | (1) | (2) | (3) |
|---|---|---|---|
| -6 yrs | 0.007 | -0.004 | |
| | (0.005) | (0.006) | |
| -5 yrs | 0.006 | 0.006 | |
| | (0.004) | (0.006) | |
| -4 yrs | -0.002 | -0.000 | 0.003 |
| | (0.003) | (0.003) | (0.005) |
| -3 yrs | -0.001 | 0.003 | -0.003 |
| | (0.003) | (0.003) | (0.004) |
| -2 yrs | 0.001 | -0.001 | -0.002 |
| | (0.002) | (0.001) | (0.002) |
| 0 yrs | -0.007 | -0.009 | -0.009 |
| | (0.002) | (0.002) | (0.004) |
| 1 yrs | -0.008 | -0.010 | -0.010 |
| | (0.002) | (0.002) | (0.005) |
| 2 yrs | -0.011 | -0.009 | -0.016 |
| | (0.003) | (0.003) | (0.005) |
| 3 yrs | -0.013 | -0.011 | -0.016 |
| | (0.004) | (0.003) | (0.005) |
| 4 yrs | -0.012 | -0.017 | -0.012 |
| | (0.004) | (0.004) | (0.006) |
| 5 yrs | -0.013 | -0.013 | |
| | (0.005) | (0.005) | |
| 6 yrs | -0.012 | -0.009 | |
| | (0.005) | (0.006) | |
| R-squared | 0.966 | 0.966 | 0.968 |
| N | 722,502 | 726,755 | 670,119 |
| N switchers | 12,677 | 13,054 | 2,787 |

Standard errors in parentheses

Table 4: Wage effects of completely standardized pay rates

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| No within-job variation | 0.141 | 0.114 | 0.071 | 0.010 | 0.024 |
| | (0.003) | (0.003) | (0.002) | (0.001) | (0.004) |
| log(Workers at Pay Level) | 0.043 | 0.037 | 0.034 | 0.013 | 0.012 |
| | (0.002) | (0.001) | (0.001) | (0.000) | (0.001) |
| log(Workers in Est.) | 0.056 | 0.052 | 0.043 | 0.014 | 0.012 |
| | (0.001) | (0.001) | (0.001) | (0.002) | (0.004) |
| log(Workers in Job) | -0.013 | -0.019 | -0.012 | -0.016 | -0.013 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| log(Minimum Wage) | 0.090 | 0.080 | -0.001 | 0.010 | -0.001 |
| | (0.011) | (0.010) | (0.010) | (0.004) | (0.005) |
| Collective Bargaining | | 0.046 | 0.030 | 0.002 | -0.003 |
| | | (0.004) | (0.003) | (0.002) | (0.003) |
| Share Managerial, Clerical in Est. | | 0.030 | 0.001 | -0.001 | -0.018 |
| | | (0.006) | (0.005) | (0.004) | (0.011) |
| Co-Workers' Occupational Level | | 0.551 | 0.259 | 0.005 | -0.000 |
| | | (0.008) | (0.006) | (0.004) | (0.008) |
| Union Density in Industry-Wage Area | | 0.048 | 0.029 | -0.002 | 0.007 |
| | | (0.005) | (0.004) | (0.002) | (0.006) |
| Constant | 2.045 | 0.624 | 1.694 | 2.602 | 2.637 |
| | (0.021) | (0.029) | (0.024) | (0.018) | (0.033) |
| Fixed effects: | | | | | |
| Year | × | × | | | |
| Year X City X Ind. X Occup. | | | × | × | × |
| Occup. X Establishment | | | | × | × |
| Year X Occup. X Firm | | | | | × |
| Observations | 900359 | 852024 | 829626 | 769166 | 535106 |

Table 5: Wage effects of Longevity-based pay rates

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Longevity | -0.001 | -0.015 | 0.002 | -0.001 | -0.015 |
| | (0.003) | (0.003) | (0.002) | (0.001) | (0.003) |
| log(Workers at Pay Level) | 0.072 | 0.058 | 0.045 | 0.013 | 0.012 |
| | (0.002) | (0.001) | (0.001) | (0.000) | (0.001) |
| log(Workers in Est.) | 0.050 | 0.049 | 0.041 | 0.014 | 0.012 |
| | (0.001) | (0.001) | (0.001) | (0.002) | (0.004) |
| log(Workers in Job) | -0.038 | -0.037 | -0.021 | -0.017 | -0.013 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| log(Minimum Wage) | 0.075 | 0.069 | -0.004 | 0.010 | -0.001 |
| | (0.011) | (0.010) | (0.010) | (0.004) | (0.005) |
| Collective Bargaining | | 0.052 | 0.032 | 0.002 | -0.003 |
| | | (0.004) | (0.003) | (0.002) | (0.003) |
| Share Managerial, Clerical in Est. | | -0.002 | -0.018 | -0.002 | -0.019 |
| | | (0.006) | (0.005) | (0.004) | (0.011) |
| Co-Workers' Occupational Level | | 0.569 | 0.262 | 0.006 | 0.001 |
| | | (0.008) | (0.006) | (0.004) | (0.008) |
| Union Density in Industry-Wage Area | | 0.057 | 0.034 | -0.002 | 0.007 |
| | | (0.005) | (0.004) | (0.002) | (0.006) |
| Constant | 2.181 | 0.684 | 1.736 | 2.606 | 2.648 |
| | (0.021) | (0.029) | (0.024) | (0.018) | (0.033) |
| Fixed effects: | | | | | |
| Year | × | × | | | |
| Year X City X Ind. X Occup. | | | × | × | × |
| Occup. X Establishment | | | | × | × |
| Year X Occup. X Firm | | | | | × |
| Observations | 900359 | 852024 | 829626 | 769166 | 535106 |

Table 6: Bootstrapped coefficients of baseline column (5)

| | (1) |
|---|---|
| Non-Standardized Pay | -0.0106** |
| | (0.004) |
| log(Workers at Pay Level) | 0.0089*** |
| | (0.001) |
| log(Workers in Est.) | -0.0128*** |
| | (0.003) |
| log(Workers in Job) | 0.0156*** |
| | (0.004) |
| log(Minimum Wage) | -0.0046 |
| | (0.005) |
| Collective Bargaining | -0.0051 |
| | (0.004) |
| Share Managerial, Clerical in Est. | -0.0226 |
| | (0.012) |
| Co-Workers' Occupational Level | 0.0002 |
| | (0.020) |
| Union Density in Industry-Wage Area | 0.0132 |
| | (0.013) |
| Constant | 2.594*** |
| | (0.055) |
| $N$ | 535,106 |

bootstrapped standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Event study coefficients, switch away from no-within job variation

| | (1) | (2) | (3) |
|---|---|---|---|
| -6 yrs | 0.017 | 0.001 | |
| | (0.007) | (0.009) | |
| -5 yrs | 0.009 | 0.016 | |
| | (0.006) | (0.008) | |
| -4 yrs | -0.005 | 0.005 | 0.002 |
| | (0.006) | (0.006) | (0.008) |
| -3 yrs | -0.001 | 0.008 | -0.007 |
| | (0.005) | (0.005) | (0.008) |
| -2 yrs | 0.001 | -0.001 | -0.003 |
| | (0.003) | (0.002) | (0.005) |
| 0 yrs | -0.015 | -0.018 | -0.018 |
| | (0.004) | (0.004) | (0.007) |
| 1 yrs | -0.020 | -0.022 | -0.026 |
| | (0.004) | (0.004) | (0.008) |
| 2 yrs | -0.025 | -0.021 | -0.034 |
| | (0.006) | (0.005) | (0.009) |
| 3 yrs | -0.025 | -0.024 | -0.034 |
| | (0.006) | (0.006) | (0.009) |
| 4 yrs | -0.024 | -0.028 | -0.026 |
| | (0.008) | (0.007) | (0.010) |
| 5 yrs | -0.024 | -0.029 | |
| | (0.008) | (0.007) | |
| 6 yrs | -0.025 | -0.030 | |
| | (0.008) | (0.009) | |
| R-squared | 0.966 | 0.966 | 0.967 |
| N | 747,968 | 749,575 | 732,686 |
| N switchers | 4,218 | 4,402 | 1,167 |

Standard errors in parentheses

Table 8: Event study coefficients, switch away from longevity

| | (1) | (2) | (3) |
|---|---|---|---|
| -6 yrs | -0.002 | -0.007 | |
| | (0.006) | (0.008) | |
| -5 yrs | 0.002 | -0.000 | |
| | (0.004) | (0.006) | |
| -4 yrs | -0.000 | -0.002 | 0.006 |
| | (0.004) | (0.004) | (0.008) |
| -3 yrs | 0.000 | 0.000 | -0.000 |
| | (0.003) | (0.003) | (0.006) |
| -2 yrs | -0.000 | -0.003 | -0.003 |
| | (0.002) | (0.001) | (0.003) |
| 0 yrs | 0.001 | -0.001 | 0.002 |
| | (0.003) | (0.002) | (0.005) |
| 1 yrs | 0.001 | -0.001 | 0.003 |
| | (0.003) | (0.002) | (0.005) |
| 2 yrs | -0.001 | 0.000 | 0.004 |
| | (0.004) | (0.004) | (0.006) |
| 3 yrs | -0.005 | -0.000 | 0.005 |
| | (0.005) | (0.004) | (0.008) |
| 4 yrs | -0.003 | -0.005 | 0.007 |
| | (0.006) | (0.005) | (0.008) |
| 5 yrs | -0.002 | 0.003 | |
| | (0.006) | (0.006) | |
| 6 yrs | 0.005 | 0.013 | |
| | (0.006) | (0.007) | |
| R-squared | 0.966 | 0.966 | 0.966 |
| N | 737,232 | 739,686 | 705,358 |
| N switchers | 7,211 | 7,280 | 1,891 |

Standard errors in parentheses