High-Skilled Labor Cyclicality and the Role of Pay Type

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Abstract

The cyclical volatility of hours per worker is lower among college graduates than those without a college degree. I show empirically that accounting for pay type reduces this volatility gap by 44%. Non-college graduates are more than twice as likely to be paid by the hour, and hourly workers have more cyclically volatile hours per worker than salaried workers. The cyclical volatility of employment, by contrast, is higher for salaried workers. Using a model with search and matching in which a matched worker and firm bargain over the intensive hours margin, I show how pay type itself can lead to hours per worker being more volatile among hourly workers. Pay stickiness hinders worker and firm from adjusting hours in response to productivity changes, and a sticky salary is a larger impediment than a sticky wage.

Keywords: Pay Type, Hours, Skill Level, Business Cycle, Salaried

JEL Classification: C78, E32, J24, M52

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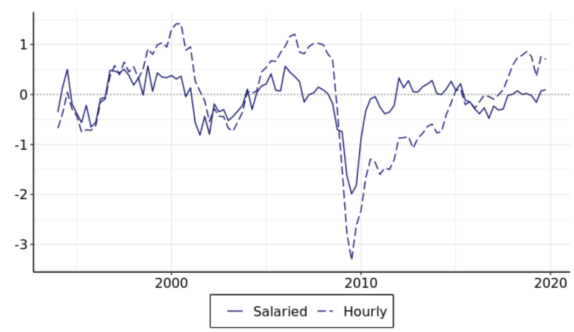
1 Introduction

High- and low-skilled workers differ in many ways, from their training, to the types of jobs they do, to how much they are paid. Another difference, seemingly superficial, lies in how they are paid. 70% of non-college graduates are paid by the hour. For college graduates, that share is 30%. Does it matter that non-college graduates are more than twice as likely as college graduates to have their compensation tied directly to hours worked? In this paper, I investigate empirically whether pay type can explain differences in the cyclical behavior of labor across skill levels, and I use a model with search and matching to study how pay type itself can affect aggregate labor variables. Furthermore, I argue that the recent increase in the share of jobs that are non-hourly, or "salaried," has the potential to influence business cycle dynamics in the future.

Figure 1: Cyclical Log Average Hours per Worker

(a) By education



(b) By pay type

Notes: Each panel plots 100 × the cyclical component of the HP-filtered log average hours per worker conditional on pay type or education, not adjusted for differences in composition across subsamples. Hours per worker are taken from the CPS outgoing rotation group, 1994-2019. The volatility gap in this figure is 0.4 percentage points between education levels and 0.5 percentage points between pay types.

Figure 1 plots the cyclical component of log average hours per worker of different subsamples, unadjusted for compositional differences across subsamples. The left panel splits the sample by education, and the right panel splits by pay type. As we can see, hours per worker are more volatile among non-college graduates than college graduates. Workers' mean hours are also more volatile among hourly than salaried workers, and the volatility gap is even larger in this case. The similarity of the two figures, possibly owing to the correlation between pay type and college graduation status, leads me to investigate how pay type contributes to the volatility gap between skill levels. In the empirical section of the paper, I control for compositional differences across skill levels other than pay type, reducing but not eliminating the volatility gap between skill levels. I then show that controlling for pay type differences reduces the remaining volatility gap between the two skill levels' hours per worker by 44%. Non-college graduates additionally have more volatile employment rates, but pay type's role in this case is more limited.

Although most models abstract from variation in pay type, whether a worker is paid a wage or salary could impact the employer's choice of hours. In a recession, firms tend to cut back on labor. Unemployment increases, and those who work work fewer hours. A sticky wage may alter the magnitude of labor fluctuations, but it does not qualitatively change the firm's problem of choosing labor inputs. If a worker is paid a sticky salary, however, the firm's problem of setting worker hours is turned upside down. To give a worker who is paid a sticky salary fewer hours would be to give her paid time off just as the firm would like to shift the burden of the recession onto the worker. If anything, the firm might even like the employee to pitch in by working more hours. Studying wage cyclicality among German workers, Anger (2011) presents evidence that unpaid hours are indeed countercyclical.

In addition to studying the effect of pay type on the cyclical volatilities of high- and low-skilled labor, I directly compare the cyclical differences between hourly and salaried labor, controlling for compositional differences including education. I find that hours per worker are 0.24 percentage points more volatile among hourly workers, while employment per capita is 0.39 percentage points more volatile among salaried workers. As a result of these offsetting differences, the cyclical volatility of aggregate labor hours per capita is essentially the same for both pay types. The hourly-salaried distinction therefore matters for the composition, rather than the magnitude, of aggregate labor hour fluctuations. A change in the share of jobs that are hourly could thus impact the distributional effects of the business cycle.

Since the COVID-19 pandemic, salaried employment has surged against hourly employment, lowering the share of workers paid by the hour. Because salaried workers' aggregate labor volatility relies more on employment fluctuations, this shift in labor composition could lead to larger increases in the unemployment rate and smaller increases in the part-time rate in future downturns. Fiscal policymakers may then be able to take a less active role in responding to recessions, as the automatic stabilizer of unemployment benefits will be more responsive to a fall in aggregate labor hours.

In addition to conducting an empirical analysis, I develop a model that distinguishes between hourly and salaried positions to analyze how pay type can affect the cyclical volatility of hours per worker. The model takes the standard search and matching model and augments it with partially sticky pay, a pay type difference between workers, and an intensive hours margin over which worker and firm bargain. In the model, there are two types of jobs, distinguished only by pay type: hourly and salaried. People are exogenously qualified to work only one of these two job types. Hence we can compare two separate but parallel labor markets, distinguished only by how workers are paid. This stylized model succeeds in obtaining higher volatility of hours per worker among hourly workers. When productivity increases and firms' match surplus rises, salaried workers try to capture some of the extra surplus by resisting large increases in their hours. Hourly workers are more willing to work longer hours because doing so directly increases their income. When productivity falls, salaried workers supplement firms' lost surplus by working longer hours than in the hourly pay case.

The model implies that hourly workers have higher employment volatility. Due to the sticky wage, an hourly worker's output rises much more than the cost of employing her when aggregate productivity increases, making vacancy-posting and subsequently employment more cyclical. A partially sticky salary, on the other hand, reduces hours elasticity with respect to productivity to such an extent that a productivity increase raises a salaried worker's output barely more than it raises her pay, leading to a milder cyclicality of vacancy posting in the salaried type labor market, compared to the hourly type. I discuss some possible reasons why the model's employment volatility result is counterfactual to the data, in which salaried employment is more volatile.

Researchers have studied differences in the cyclical behavior of high- and low-skilled labor along various dimensions. Keane and Prasad (1993) finds that both employment probabilities and weekly hours are more procyclical among college-educated workers. Buch and Pierdzioch (2014) finds that employment volatility is highest among high-skilled worker and lowest for medium-skilled workers but that aggregate labor hours volatility across 11 countries has increased more over time for low-skilled workers since the early 1980s. Castro and Coen-Pirani (2008) documents that aggregate high-skilled weekly hours per worker became relatively more cyclical after 1983 than during 1979-1983. Using firm-specific job experience instead of education as a measure of skill, Raisian (1983) finds that higher-skilled workers have more variable weekly hours but less variable weeks worked.

Economists have used a range of theoretical models to explain the cyclical differences in skill levels' aggregate labor. Chassamboulli (2011) uses a search-and-matching model with two skill levels to explain why low-skilled workers' unemployment rate is more volatile. In the model, high-skilled workers can take low-skill jobs, but low-skilled workers cannot take high-skill jobs, and so high-skilled workers have a safety net that low-skilled workers do not. Castro and Coen-Pirani (2008) explains the observed increase in the relative volatility of high-skilled aggregate labor hours using a model with capital-skill complementarity, a feature also present in Krusell et al. (2000). Keane and Prasad (1993) theorizes that the labor-hoarding motive may be stronger for employers of high-skilled labor. Pay type as a possible explanation of differences in skill levels' labor cyclicality has been alluded to, as in Keane and Prasad (1993), but not investigated.

This paper also contributes to the literature on pay type differences by empirically comparing hourly and salaried labor volatilities at the aggregate level and by presenting a model in which hourly and salaried labor outcomes differ because of pay type itself. Other research on hourly and salaried labor has so far focused on the question of what types of jobs and workers are hourly or salaried and how pay type is correlated with microeconomic outcomes. Fama (1991) and Goldfarb (1987) discuss theoretical reasons why a firm may choose to make a job salaried or hourly. Fama (1991) argues that a job is more likely to pay a salary instead of an hourly wage if the worker's effort per hour is not easily observed. If such a job were to pay an hourly wage, the worker would want to work many low effort hours to maximize income at minimal total effort. This theory succeeds in explaining why white-collar jobs are more often salaried than blue-collar jobs, as the effort exerted in white-collar, cognitive, non-routine jobs tends to be less observable —a mathematician staring out the window may be pondering a difficult math problem or thinking of what to order for lunch. Goldfarb (1987) argues that whether the employee or the manager sets the pace of work also affects the pay type decision. If the employee can set her own pace, low effort becomes a larger concern, and so the job will be less likely to pay by the hour than if the manager has control over pace. In the absence of concern over effort, paying an hourly wage could be preferable because it allows managers to more easily enforce schedules than when workers are salaried.

Other researchers have used data to study how pay type correlates with job and worker characteristics. Mellor and Haugen (1986) uses CPS data to look at cross-sectional differences of hourly and salaried workers and finds that hourly workers are more often young, non-white, lower paid, part time, and blue collar. MacLeod and Parent (1999) uses data from the Quality of Employment Survey to compare pay types by job characteristics. The paper finds, for example, that salaried workers are more likely to handle a "variety of things" than hourly workers. Hirsch et al. (2016) finds that the multiple jobholding rate is more procyclical for hourly than for salaried workers.

Some researchers have looked into the effect of pay type on workers' experience-income profiles. Cherry (2004) finds that although salaried workers are not explicitly paid for overtime, those who work overtime tend to have higher earnings and higher earnings growth. Haber and Goldfarb (1995) argues that salaried workers should have a greater incentive to accumulate human capital and estimates steeper age-earnings profiles among salaried workers.

Although the hourly-salaried distinction has received some attention, the literature is dwarfed by work on the other pay type distinction: piece rate versus wage or salary. More generally, the effect of performance pay on workers' incentives and output is one of the central questions in personnel economics (Lazear and Oyer 2007). Lazear (1986), for instance, models piece rate against (undistinguished) wage or salary pay to study the advantages and disadvantages of paying an employee according to output, in terms of both employee incentives and selection.

Some researchers have pointed out that wage stickiness could reduce the cyclicality of salaried workers' hours (Kim 2019; Anger 2011). Devereux (2001) finds that hourly workers' earnings are more procyclical than salaried workers who do not receive bonuses, commission, or overtime. Bils et al. (2014) uses a search and matching model with an intensive effort margin and sticky pay to show that the effort demanded of workers by their employers through bargaining would increase less in an expansion if pay is sticky than if it is flexible. The authors note that greater effort could be interpreted as longer hours for salaried workers or a faster pace for hourly workers, but the model does not distinguish between pay types.

The paper is structured as follows. Section 2 empirically analyzes cyclical differences in labor when split by skill level and pay type. I present the model in Section 3 and its calibration in Section 4. Section 5 discusses how pay type affects the elasticity of hours with respect to productivity in the model. Section 6 presents the model's simulation results. Section 7 concludes.

2 Empirical Analysis

Using CPS data I show that compositional differences in college and non-college graduates' pay type can explain almost half of the difference in the cyclical volatilities of high- and low-skilled hours per worker. I then compare the cyclical volatility of hourly and salaried workers' aggregate labor variables. Finally, I present evidence that hourly workers also have more flexible hours at the individual level.

2.1 Data

My observations come from the outgoing rotation group of the CPS, obtained through IPUMS (Flood et al. 2021). Households in the CPS are interviewed for four straight months, take an eight month break, and are interviewed for four more months. Households in the fourth and final months, also known as the outgoing rotation group, are asked additional questions about their work, known as the earner study[2] .

I limit my sample to observations from 1994 to 2019. Pay type was added to the outgoing rotation group's questions in 1982, and hours worked the previous week, previously limited to the Annual Social and Economic Supplement[3], were added to the outgoing rotation group in 1989. Therefore, employment series and hours series are available from 1982 and 1989, respectively. The 1994 redesign of the CPS, however, improved measurement of pay type as well as actual hours worked, better distinguishing them from usual hours worked. Furthermore, the redesign caused a significant discontinuity in the employment series of salaried college graduates. Hence I only use observations from after the redesign. Due to the novelty of the COVID-19 pandemic, I omit observations from 2020 onwards. College graduates and salaried workers may have had an easier time switching to remote work than non-college graduates or hourly workers, and such a mechanism was not operative in previous recessions. My sample consists of people between the ages of 25 and 60, and I restrict my definition of employed to those workers who report having been at work last week and work in the private sector. I drop those who merely report "hours vary" as well as outliers—those workers with hours outside the percentile range of 0.5 to 99.5.

Although I use "hourly" and "salaried" to refer to the two types of workers, households in the CPS are only asked whether or not they are paid by the hour. Therefore the workers are technically "hourly" or "non-hourly," but I assume the majority of workers who are non-hourly are paid mostly in the form of a salary. Multiple job holders report the pay type of

[2]The American Time Use Survey (ATUS) also contains similar information on labor hours, but ATUS surveys 2,190 households per month as of December 2003 and 3,375 households per month before then. The Current Population Survey contains about 60,000 households per month, which implies an outgoing rotation group of about 15,000 per month. I therefore use the latter to improve my estimates of cyclical volatilities and compositional differences between groups. Moreover, ATUS is not longitudinal, which would prevent me from checking the idiosyncratic volatility of hours, an exercise I perform in subsection 2.3.

[3]I use the outgoing rotation group rather than the ASEC because the former yields more observations and is not limited to a particular time of year.

whatever their primary job is.

2.2 Aggregate Differences

In this subsection I show that the difference in skill levels' pay type can partly explain why non-college graduates have a higher cyclicality of aggregate hours per worker. The two panels of Figure 1 in the introduction compare the cyclical hours per worker of college and non-college graduates, in the left panel, and of salaried and hourly workers, in the right panel. Clearly there are parallels between college graduates and salaried workers, which have less volatile hours per worker, and between non-college graduates and hourly workers, which experienced a deeper, more persistent drop in weekly hours around the Great Recession. Because omitted variables could theoretically be driving the patterns seen in figure 1, I adjust for compositional differences before replotting the hours per worker time series and calculating cyclical volatilities of each skill level's aggregate labor variables. Although my focus is on hours per worker, I also calculate the cyclical volatilities, after adjusting for composition, of each skill level's employment per capita, aggregate labor hours per capita, and employment rate. I calculate employment and aggregate hours in per capita terms so that fluctuations in the working age population have no direct impact on the volatility estimates.

2.2.1 Correcting for Composition

To study the ability of pay type to explain empirical differences between non-college and college graduates in the cyclical volatility of hours per worker and other labor variables, I calculate the cyclical volatilities of these time series before and after assuming that both skill levels have the same pay type composition. To make this exercise meaningful, I first control for compositional differences other than pay type. After all, both pay type and education correlate with other variables, personal and job-related, that could on their own impact labor volatility. For example, married people have less cyclical aggregate labor hours (Ellieroth 2019), and they could also be more likely to be college graduates and work a salaried job. Then if we do not control for compositional differences in marital status, adding the assumption that pay type composition is the same across skill level would also effectively reduce the difference in marital status composition, which on its own would shrink the volatility gap. We would then overestimate the role of pay type in explaining volatility differences.

To adjust the hours per worker time series for compositional differences across skill levels other than pay type, I first regress workers' hours on race, marital status, gender, age (as a quadratic polynomial), industry, and occupation[4]. I run this regression within each combination of education $e \in \{n, c\}$ (non-college or college) and pay type $p \in \{s, w\}$ (salaried or hourly (wage)), within each quarter t. Equation (1) shows this regression, where χ_i represents an individual i's vector of control variables plus intercept.

$$h_i = \beta_t^{e,p} \chi_i + \varepsilon_i \tag{1}$$

After estimating the regression coefficients $\hat{\beta}_t^{e,p}$ of each subsample, I fit each model to a new $\bar{\chi}$ that is common across all skill level-pay type subsamples to calculate $\hat{h}_t^{e,p}$, what the hours per worker series would be if each subsample had the same composition in age, gender, et cetera, shown in equation (2).

$$\hat{h}_t^{e,p} = \hat{\beta}_t^{e,p} \bar{\chi} \tag{2}$$

For my fixed sample mean $\bar{\chi}$ I use the mean of the entire employed sample. After acquiring the compositionally adjusted series $\{\hat{h}_t^{e,p}\}$ of each skill level-pay type subsample, I aggregate the pay type subsamples within each education category by taking a weighted average of the hourly and salaried series in equation (3), where ϕ_e is the share of workers in education category e who are hourly, on average.

$$\hat{h}_t^e = (1 - \phi_e)\hat{h}_t^{e,s} + \phi_e \hat{h}_t^{e,w} \tag{3}$$

For college graduates, $\phi_c = 0.3$, and for non-college graduates, $\phi_n = 0.7$. This weighting yields time series of each education level that are adjusted for compositional differences other than pay type across time and across education. I then adjust for pay type differences across skill level by aggregating the pay type series within each skill level using the sample average $\bar{\phi} = 0.57$ in equation (4).

$$\tilde{h}_t^e = (1 - \bar{\phi})\hat{h}_t^{e,s} + \bar{\phi}\hat{h}_t^{e,w} \tag{4}$$

Comparing the cyclical volatilities of $\{\hat{h}_t^n\}$ and $\{\hat{h}_t^c\}$ thus shows the difference in cyclical behavior of hours per worker across skill levels, adjusting for compositional differences other than pay type. To compare the cyclical volatilities of the two series when pay type composition is also accounted for, I use $\{\tilde{h}_t^n\}$ and $\{\tilde{h}_t^c\}$.

[4]The CPS includes hundreds of different industries and occupations. I aggregate industries into 16 categories and occupations into 26.

Compositional differences across skill levels could also impact employment volatility, so I again apply regression coefficients across subsamples to a common set of observations to adjust the employment series. However, regressing a dummy variable for employment on control variables within each pay type is not feasible because non-employed people are neither hourly nor salaried. Instead, I restrict the sample to employed people and regress a dummy variable for whether a worker is a college graduate on control variables within each pay type-quarter subsample in equation (5). Once again, χ_i contains race, marital status, gender, age, industry, occupation, and an intercept.

$$Coll_i = \beta_t^p \chi_i + \varepsilon_i \tag{5}$$

Applying the estimated regression coefficients of each sample to the mean $\bar{\chi}$ of all workers from 1994 to 2019 yields estimates of the share of workers who are college graduates within each subsample, controlling for cyclical changes in the composition of the labor force.

$$\widehat{Coll}_t^p = \hat{\beta}_t^p \bar{\chi} \tag{6}$$

Taking $1-\widehat{Coll}_t^p$ yields the equivalent time series for non-college graduates. The adjusted time series of college graduates' employment per capita within each pay type is then the adjusted college share times the full sample's employment per capita E_t^p of each pay type p each period, seen in equations (7) and (8).

$$\hat{E}_t^{c,p} = \widehat{Coll}_t^p E_t^p \tag{7}$$

$$\hat{E}_t^{n,p} = (1 - \widehat{Coll}_t^p) E_t^p \tag{8}$$

Adjusting the college share series for compositional changes over time effectively adjusts the employment per capita series for compositional differences across education. For example, if non-college graduates are more likely to work in a particular industry that tends to contract more in recessions, then in a downturn non-college employment would fall more than college graduates' employment as a result of this compositional difference, leading to an overestimate of non-college graduates' employment volatility. Adjusting for changes in industry size and other variables over time addresses this problem. As with the hours per worker series, once I get the compositionally adjusted series of the employment per capita $\{\hat{E}_t^{e,p}\}$ of each skill level-pay type combination, I weight the two pay type series within each skill level first by that skill level's own hourly and salaried shares to get a pair of time series $\{\hat{E}_t^n, \hat{E}_t^c\}$ that adjusts for compositional differences other than pay type. I then aggregate pay type series within each skill level by weighting them using the whole employed sample's hourly and salaried shares to adjust for skill levels' pay type differences as well and get $\{\tilde{E}_t^n, \tilde{E}_t^c\}$.

After calculating the adjusted and semi-adjusted series of the hours per worker and workers per capita of each skill level, it is simple to calculate the adjusted hours per capita, as well as the employment rate within each skill level. Multiplying hours per worker by workers per capita at each level of compositional adjustment, I get the adjusted hours per capita series. Employment rate differs from employment per capita in that the latter divides employment by total population, while the former divides employment by population within the subsample. I divide the adjusted employment per capita series of each education level by the share each period of people with a college degree to get the adjusted employment rate series.

2.2.2 Estimating the Cyclical Component

Once I have obtained the composition-adjusted time series for each aggregate labor variable for each subsample, I convert the time series to logs and detrend using a Hodrick-Prescott (HP) filter with a smoothing parameter of 10^5, the same value used in Shimer (2005), and adjust for seasonality. I then estimate the cyclical component of each detrended, compositionally-adjusted time series.

I am interested in comparing the different skill levels' labor fluctuations that are owing to the business cycle at large, as opposed to fluctuations (especially high frequency ones) that could be due to shocks uniquely impacting one of the subsamples. Therefore, I isolate the cyclical component of the filtered time series by first regressing the time series values on the current value, one-quarter lag, and one-year lag of several detrended business cycle variables: unemployment, GDP per capita, and nonfarm business sector labor productivity. The fitted values of each regression are then the cyclical component of the detrended time series of each subsample and for each labor variable. I interpret these fitted values as the percent deviation from the trend owing to the business cycle. The R-squareds of these regressions are presented in table 1. Jaimovich et al. (2013) uses a similar methodology, although the authors use current and lagged cyclical output and aggregate labor hours as business cycle indicators. Two other papers using this technique are Doepke and Tertilt (2016) and Ellieroth (2019).

Doepke and Tertilt (2016) uses current cyclical GDP per capita as a measure of the business cycle, and Ellieroth (2019) uses current cyclical unemployment.

Table 1: R-squared in Cyclical Component Regression

Variable	Hourly shares	Non-college	College
Hours per worker	(0.70, 0.30)	0.70	0.40
	(0.57, 0.57)	0.68	0.50
Workers per capita	(0.70, 0.30)	0.79	0.68
	(0.57, 0.57)	0.79	0.68
Hours per capita	(0.70, 0.30)	0.84	0.72
	(0.57, 0.57)	0.83	0.74
Employment rate	(0.70, 0.30)	0.84	0.52
(within skill level)	(0.57, 0.57)	0.84	0.61

Notes: This table displays the R-squared in the regressions of each filtered time series on current and lagged business cycle indicators: the unemployment rate, GDP per capita, and labor productivity. The employment rate differs from workers per capita in that the former divides employment by population within the skill level subset, while the former divides employment by total population. Values range from 0.40 to 0.84.

2.2.3 Cyclical Volatilities across Skill Levels

Calculating the standard deviations of each skill level's cyclical log hours per worker, I find that pay type can help explain the higher cyclical volatility of non-college graduates' hours per worker. Table 2 presents 100 $\times$ the cyclical volatilities of the log of each labor variable in each education category, both unadjusted and adjusted for differences in pay type composition. The standard deviation of hours per worker among non-college graduates is 0.18 percentage points higher than that of college graduates when we do not account for pay type differences. Setting each skill level's hourly worker share to the same level reduces the volatility gap between college and non-college graduates' hours per worker by 44%. In relative terms, non-college graduates' hours per worker are 32% higher than college graduates when hourly shares are same, while the former would only be 17% more volatile if the hourly shares were equal.

Table 2: Cyclical Log Volatilities

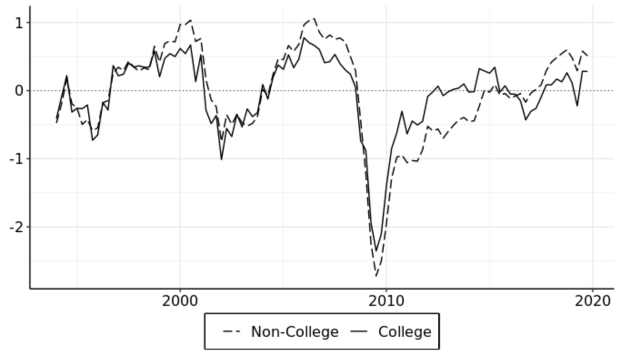
Variable	Hourly shares	Non-college	College	Volatility gap
Hours per worker	(0.70, 0.30)	0.74	0.56	0.18
	(0.57, 0.57)	0.70	0.60	0.10 (↓ **44%**)
Workers per capita	(0.70, 0.30)	1.78	1.98	-0.20
	(0.57, 0.57)	1.77	1.97	-0.20
Hours per capita	(0.70, 0.30)	2.43	2.42	0.01
	(0.57, 0.57)	2.38	2.50	-0.12
Employment rate	(0.70, 0.30)	2.29	1.25	1.04
	(0.57, 0.57)	2.28	1.35	0.93

Notes: This table displays the standard deviations of 100 × the cyclical component of log detrended labor variables, adjusted in all cases for compositional differences other than pay type. The first row in each section aggregates the hourly and salaried series using the average hourly share specific to each education subset, and the second row uses the population-average hourly share. Comparing the first and second rows' volatilities therefore shows the effect of correcting for differences in pay type composition between skill levels. The rightmost column takes the difference between the non-college and college volatilities.

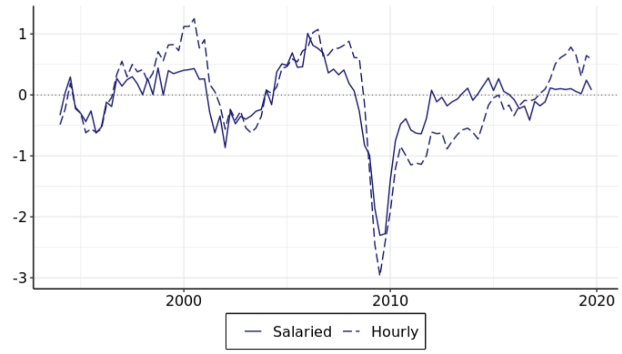
The results for hours per worker are also evident in figure 2, which plots hours per worker conditional on college graduation in the top left panel and pay type in the top right panel, both adjusted for composition differences (other than pay type in the top left panel). The bottom left panel plots hours per worker by education when the time series are also adjusted for differences in pay type composition. The difference between the two skill level series is smaller in the bottom left panel than in the top left panel. Figure 1 in the introduction plots the completely unadjusted versions of the top two panels. The volatility gap between skill levels is smaller even when I control for compositional differences other than pay type. The same is true when I control for compositional differences between hourly and salaried workers. Going from figure 1 to figure 2, the volatility gap between education levels falls by 55% and the volatility gap between pay type falls by 50%.

Table 2 also presents the cyclical volatilities of other labor variables besides hours per worker. Although hours per worker are more volatile among non-college graduates, it is college graduates who have the more volatile workers per capita. The employment rate of non-college graduates is 83% more volatile than that of college graduates, but college graduates have 10% more volatile workers per capita because the share of people with college degrees is procyclical. Conditioning on pay type has a negligible effect on the employment volatility gap between education levels. Without adjusting for pay type differences, hours per capita has practically the same cyclical volatility for both groups, and adjusting for pay type results in college workers' cyclical volatility being somewhat higher. Pay type accounts for a small fraction of the employment rate volatility gap.

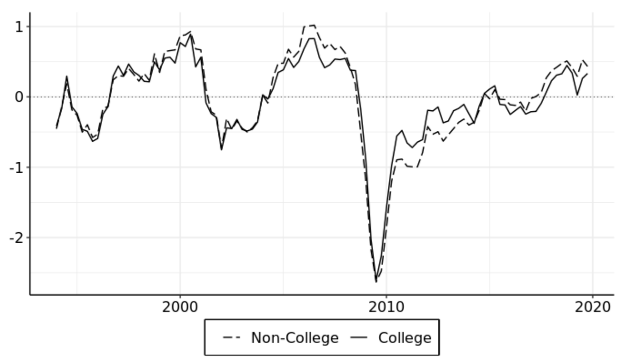
Figure 2: Cyclical Log Average Hours per Worker, Adjusted for Composition



(a) By education



(b) By pay type



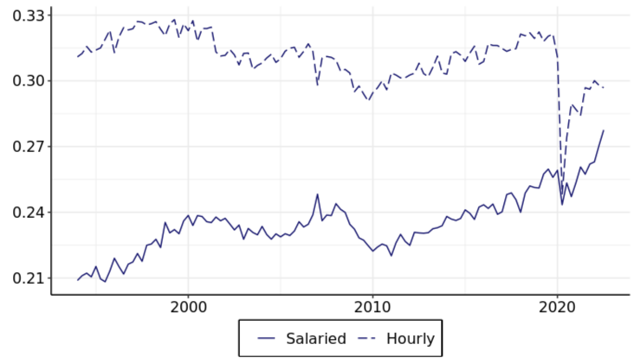
(c) By education, correcting for pay type composition

Notes: Each panel plots 100 $\times$ the cyclical component of the HP-filtered log average hours per worker conditional on pay type or education, adjusted for differences in composition across subsamples. The top left panel, however, does not adjust for differences in pay type composition across skill level, while the bottom left panel does. As a result, the volatility gap between skill levels shrinks by 44% from the top left to the bottom left panel.

2.2.4 Cyclical Volatilities across Pay Types

Pay type is useful in explaining some of the cyclical differences between different skill levels' labor outcomes, but pay type also matters in its own right. In figure 3, I plot the employment per capita of hourly and salaried workers, adjusted for seasonality but not detrended or adjusted for compositional differences. As we can see, hourly jobs have historically been more common. Hamermesh (2002) shows that despite compositional changes exerting downward pressure on the share of workers paid hourly, the share remained fairly steady from 1979 to 1999.

Figure 3: Employment per Capita



Notes: The figure plots the unfiltered levels of per capita private sector employment of salaried and hourly workers. Salaried employment has increased since 2019, while hourly employment is still below its pre-pandemic leve, lowering the share of jobs that pay by the hour.

In this more recent data, the difference in the pay types' per capita levels narrowed somewhat between 1994 and 2019. In 2020, the COVID-19 pandemic slashed this difference. The number of hourly workers per capita plunged at the onset of the pandemic and has not recovered since. For salaried workers, the drop was much smaller, followed nevertherless by a strong rebound which has closed the gap between the two pay types' employment levels by over half. The shift toward salaried work, combined with the differences in the cyclical behavior of each pay type, could therefore lead to changes in the aggregate economy relevant to policymakers and researchers.

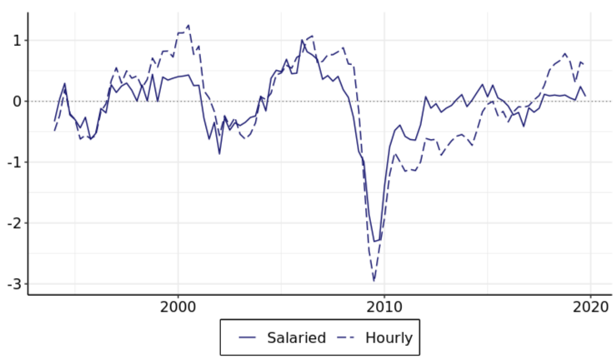
Table 3: Cyclical Log Volatilities

Pay Type	Hourly	Salaried	Gap
Hours per worker	0.78	0.54	0.24
Workers per capita	1.74	2.13	-0.39
Hours per capita	2.45	2.48	-0.03

Notes: This table displays the standard deviations of 100 $\times$ the cyclical component of the log of each detrended labor variable within either the hourly or salaried subset. The rightmost column takes the difference between the hourly and salaried values to get the volatility gap.

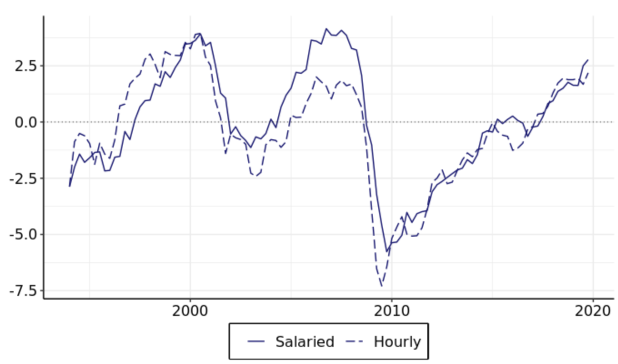
Table 3 presents the standard deviations of 100 $\times$ the cyclical components of the log of each pay type's hours per worker, workers per capita, and hours per capita series, and figure 4 plots these time series. I adjust for compositional differences in all of these time series using a methodology similar to that of the previous section in which I adjust for compositional differences between skill levels. Here I include education as a control variable when running regressions for each pay type in each quarter. As before, I also control for compositional differences in age, gender, marital status, race, occupation, and industry. Taking the log of the compositionally adjusted series, I then detrend and adjust for seasonality before estimating the cyclical component. Looking across the different labor variables in figure 4 or down the rows in table 3, we can see that pay type affects the composition, rather than the level, of aggregate labor hours' volatility. Hours per worker are more volatile, and employment less so, among hourly workers. Aggregate labor hours fluctuations therefore rely relatively more on intensive margin changes for hourly workers.

Figure 4: Cyclical Log Labor Variables by Pay Type



(a) Hours per worker

(b) Workers per capita



(c) Hours per capita

Notes: Each panel plots 100 × the cyclical component of the HP-filtered log of different labor variables conditional on pay type, adjusted for differences in composition across pay type. Observations are taken from the CPS outgoing rotation group, 1994-2019. Hours per worker are more volatile among hourly workers, while employment per capita is more volatile for salaried workers.

Because the rise of salaried jobs raises the volatility of employment relative to hours per worker, fiscal policymakers' response to recessions may change. Total unemployment benefits automatically increase in a recession as more people become unemployed. Supplementing the lost income from more dispersed labor shocks, such as full-time workers becoming part-time, requires a more active government response. If the government chooses to help workers whose hours fall in a recession but remain employed, it may do so by simply providing broad aid that covers many households, such as a universal stimulus check. Therefore, as aggregate labor fluctuations become more concentrated along the extensive margin, the government's response to recessions, by relying more on unemploymenet benefits, will become better targeted and more predictable.

Finally, an interesting difference between hourly and salaried workers lies not in the level of fluctuations, but in the timing. While movements in hours per worker occur at the same time for both pay types, hourly employment per capita appears in figure 4 to be leading employment of salaried workers. As salaried work becomes more popular, the response of aggregate labor to macroecomic shocks could become more delayed. One explanation for salaried workers' delayed changes in employment could be that hiring salaried workers may take longer, while their matches are more persistent. If a firm hires an hourly worker who turns out to be less productive than expected, the firm can perform damage control by reducing the worker's hours, especially if there are diminishing marginal returns to hours worked. If the unexpectedly unproductive worker is paid a salary, and the firm is not able to cut the previously agreed upon salary after learning the worker's true productivity, damage control is more difficult, as reducing the worker's hours would lower output without a corresponding decrease in costs. Therefore, because paying a salary instead of an hourly wage raises the cost of hiring a poor match, firms may be more cautious in hiring salaried workers, which could lengthen the hiring process and, by subsequently improving match quality, lengthen the duration of a match, ultimately making salaried employment lag hourly employment in the aggregate.

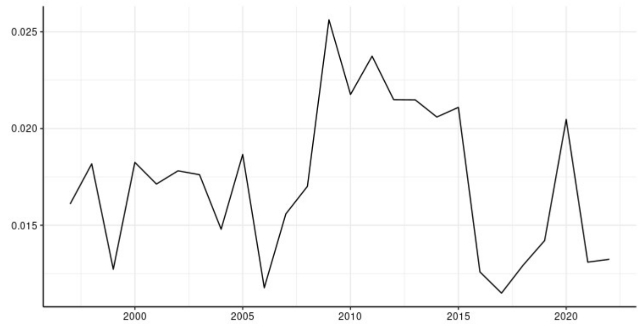
2.3 Idiosyncratic Hours Volatility

This subsection provides evidence at the individual level that hourly workers' labor hours are more volatile than those of salaried workers. The results from the aggregate time series above show that the hourly pay type's mean hours per worker are more volatile than the mean of the salaried pay type, but that does not guarantee the same will hold for individuals. Salaried workers could theoretically have more volatile idiosyncratic hours from month to month than hourly workers, yet still have less volatile mean hours per worker if hourly workers' hours are more cyclical. My model in section 3 achieves higher volatility of mean hours per worker among hourly workers through higher volatility at the individual level, and so I now check for micro evidence. As above, I use observations from the Current Population Survey, this time using observations from 1996 to 2022.

While directly estimating idiosyncratic hours variation from month to month would be preferable to looking at part-time to full-time transitions, the CPS only records hours worked for the survey's outgoing rotation group, which occurs in a household's fourth and eighth interview months. In other months, the survey merely records whether the worker works full time (at least 35 hours per week) or part time. Measuring the frequency with which workers switch between part time and full time without controlling for exact hours worked would not yield helpful comparisons between the two pay types, as salaried workers tend to work longer hours and, more generally, the distribution of weekly hours is not necessarily the same across pay type. Hence a change in hours of a given size would not have the same probability of crossing the 35 hour threshold for one pay type as for the other. Therefore I must control for hours worked in the current month when studying the transitions between part time and full time. Although it would be more natural to find the probability that a full-time worker this month becomes part-time next month, I am limited to households in the outgoing rotation group which, as the name suggests, is never directly followed by another month in the sample. After the fourth month of CPS, there is an eight-month hiatus, so I lack data for the subsequent month for households in either the fourth or the eighth (final) month of the survey. Therefore, due to the structure of the survey, I estimate the probability that a currently full-time worker was part time in the month preceding, not following, the outgoing rotation group month, during which I know the exact hours worked.

I find that among those who are working full time and who have the same employer as last month, hourly workers are 1.72 ($p < 0.001$) percentage points more likely than salaried workers to have worked part time the preceding month, controlling for current hours and other variables. I obtained this result by regressing a dummy variable for whether a currently full-time worker had part-time hours last month on pay type as well as on the control variables for year, month of the year, gender, marital status, number of children, age, race, education, industry, occupation, and a third-degree polynomial in hours worked last week, plus a dummy

Figure 5: Lagged Part-Time Probability Gap



Notes: The figure plots for each year the probability difference between hourly workers and salaried workers that a full-time worker this month was part-time last month. The regression controls for compositional differences and hours and restricts the sample to those who did not switch employers from the previous month. The probability difference was higher around the Great Recession, suggesting that employers make greater use of the higher flexibility of hourly workers' hours in a downturn.

variable for those who reported working exactly forty hours last week. The regression is shown in equation (9), where χ_i is a vector of control variables other than pay type.

$$lag(Part\ time) = \beta_0 + \beta_1 Hourly + \beta_2 \chi_i + \varepsilon_i \tag{9}$$

Repeating the regression with the subsample limited to full-time workers who reported working exactly 40 hours last week, full-time hourly workers' have a 1.46 percentage point higher probability of having been part-time last month than full-time salaried workers. These results suggest that hourly workers have more volatile hours.

By adding an interaction variable between pay type and year, I furthermore show that the difference in the two pay types' probability of a full-time working having been part-time varies over the business cycle. As shown in figure 5, full-time hourly workers' likelihood of having worked part time the preceding month was even higher relative to salaried workers around the Great Recession. This could result from employers making greater use of hourly workers' higher hours flexibility during a downturn.

3 Model

In this section I lay out the model I will use to demonstrate how the hourly-salaried distinction can affect the cyclical behavior of aggregate labor. The model features two separate but parallel labor markets for hourly workers and salaried workers. Each labor market has two-sided search and matching, and a matched worker and firm bargain over hours conditional on partially sticky pay. Although the distinction between the two pay types is purely cosmetic when pay is flexible, wage stickiness and salary stickiness affect the hours bargain differently.

3.1 Environment

Within a given pay type's labor market, unemployed workers are matched to firms that have posted vacancies. Pay and hours are determined through Nash bargaining with some degree of pay stickiness, and workers' pay type is completely exogenous.

3.1.1 Matching Process

Within each labor market $k \in \{w, S\}$, where w is the hourly (or wage) type labor market and S is the salaried type, unemployed workers and firms that have posted vacancies are matched to each other through a Cobb-Douglas matching function.

$$m(u_k, v_k) = \xi u_k^{\alpha} v_k^{1-\alpha} \tag{10}$$

Labor market tightness $\theta_k = \frac{v_k}{u_k}$ represents the number of vacancies per unemployed person in labor market k. As the matching function displays constant returns to scale, matching probabilities can be written as a function of θ_k. Unemployed people's job-finding probability and firms' vacancy-filling probability are given respectively by

$$f(\theta_k) = m(1, \theta_k) = \frac{m(u_k, v_k)}{u_k} \tag{11}$$

$$q(\theta_k) = m(\theta_k^{-1}, 1) = \frac{m(u_k, v_k)}{v_k} \tag{12}$$

Matches are terminated exogenously each period with probability δ. The laws of motion for the employment and unemployment stocks within each pay type k are therefore

$$E_{k,t+1} = (1 - \delta)E_{k,t} + f(\theta_k(y))U_{k,t} \tag{13}$$

$$U_{k,t+1} = \delta E_{k,t} + (1 - f(\theta_k(y)))U_{k,t} \tag{14}$$

3.1.2 Agents

Every agent is either an hourly type or a salaried type. An hourly type worker can only be hired in the labor market for hourly jobs, and a salaried type worker can only be hired in the labor market for salaried jobs. The model does not explain why some jobs are hourly and others are salaried, but we can assume that there is a characteristic, perhaps the observability of (unmodeled) effort as in Fama (1991), that varies across jobs and determines the ideal pay type. Salaried type workers only have the skills to work jobs that happen to pay a salary, while hourly type workers only have the skills to work jobs that happen to pay by the hour. In the data, of course, workers transition between hourly and salaried jobs. Roughly 20% of salaried workers who remain employed the following year will be working hourly jobs, and vice versa. By assuming that workers are stuck as one type, I prevent the two labor markets from interacting with each other and thus isolate the effect of pay type on labor outcomes.

The employment and unemployment value functions are nearly identical across pay type. Workers of either pay type receive linear utility from their income—wh for hourly types, S for salary types—and derive disutility $g(h) = \gamma h^2$ from hours worked h. Workers are separated from their jobs at rate δ. Unemployed agents receive unemployment benefits b and get zero disutility from working zero hours. Unemployed agents are matched to a new job at rate $f(\theta_k)$, which depends on labor market tightness θ_k in labor market k. Future periods are discounted at rate β, equal to $1/(1+r)$, with r being the per-period interest rate. Workers are identical in their preferences and productivities within and across type. Agents' value functions for employment are therefore

$$V_w^E(y) = w(y)h_w(y) - g(h_w(y)) + \beta[(1-\delta)\mathbf{E_y}[V_w^E(y')] + \delta\mathbf{E_y}[V_w^U(y')]] \tag{15}$$

$$V_s^E(y) = S(y) - g(h_s(y)) + \beta[(1-\delta)\mathbf{E_y}[V_s^E(y')] + \delta\mathbf{E_y}[V_s^U(y')]] \tag{16}$$

and the value to either pay type $k \in \{w, S\}$ of being unemployed is

$$V_k^U(y) = b + \beta[f(\theta_k(y))\mathbf{E_y}[V_k^E(y')] + (1 - f(\theta_k(y)))\mathbf{E_y}[V_k^U(y')]] \tag{17}$$

3.1.3 Firms

Firms in either labor market post vacancies to find matches, and matched workers produce output for the firm that is linear in hours worked. Firms differ across labor markets only in whether they pay workers a salary or an hourly wage. A firm that is matched to a worker produces output yh and pays the worker either wh or S, depending on pay type. Hourly productivity y follows the process

$$log(y_t) = \rho log(y_{t-1}) + \varepsilon_t \tag{18}$$

where $\varepsilon \sim N(0, \sigma^2)$. Again, matches are destroyed at rate δ, and the firms discount future periods by rate $\beta = 1/(1+r)$.

Firms post vacancies in a given pay type's labor market at cost ψ per period. A firm that has posted a vacancy is matched with an unemployed agent at rate $q(\theta_k)$. Both labor markets have free entry to firms, and so a firm's value V_k^V of posting a vacancy in labor market k must equal zero in equilibrium. Firms' values of finding a match in the hourly and salaried labor markets respectively are given by

$$V_w^F(y) = yh_w(y) - w(y)h_w(y) + \beta[(1-\delta)\mathbf{E_y}V_w^F(y') + \delta\mathbf{E_y}V_w^V(y')] \tag{19}$$

$$V_s^F(y) = yh_s(y) - S(y) + \beta[(1-\delta)\mathbf{E_y}V_s^F(y') + \delta\mathbf{E_y}V_s^V(y')] \tag{20}$$

and the value of posting a vacancy in the labor market of pay type $k \in \{w, S\}$ is given by

$$V_k^V(y) = -\psi + \beta[q(\theta_k(y))\mathbf{E_y}V_k^F(y') + (1 - q(\theta_k(y)))\mathbf{E_y}V_k^V(y')] \tag{21}$$

with $V_k^V(y) = 0$ under free entry. While agents are unable to switch between pay types in my model, I am agnostic about whether a given firm has a choice of pay type. Whether a given firm has a choice of which labor market in which to post a vacancy or whether its technology restricts it to a particular pay type has zero implications for the model's outcomes.

3.1.4 Bargaining

A matched firm-worker pair determine hours worked each period through Nash bargaining conditional on sticky pay. The sticky wage or salary at a given state y is a weighted average of the flexible wage or salary at y and that at the median state $\bar{y}$. This "partial smoothing" method of making pay sticky is suggested in Hall (2005). An alternative method is to make the sticky pay an average of flexible pay and lagged, rather than median, pay. This "adaptive wage" method, also mentioned in Hall (2005), has the drawback of adding a state variable, last period's wage or salary, to the worker and firm value functions. I use the former method to avoid the additional state variable, not only to simplify the math, but to allow for hours and other variables to be plotted against the current productivity state without needing to hold some other state variable constant.

To allow for sticky pay but flexible hours, the bargaining process of either pay type proceeds in three stages. First, the perfectly flexible wages and salaries in each aggregate state y are determined through Nash bargaining, conditional on efficient hours $h^*(y)$, as seen in equations (22) and (23).

$$S^*(y) = \underset{S}{\text{argmax}}(V_s^E(S, h^*(y), y) - V_s^U(y))^\eta (V_s^F(S, h^*(y), y) - V_s^V(y))^{1-\eta} \tag{22}$$

$$w^*(y) = \underset{w}{\text{argmax}}(V_w^E(w, h^*(y), y) - V_w^U(y))^\eta (V_w^F(w, h^*(y), y) - V_w^V(y))^{1-\eta} \tag{23}$$

If hours and pay were determined jointly, this bargaining problem would yield the same result, as flexible pay always leads to the efficient number of hours, where marginal benefit equals marginal cost, or $y = g'(h^*(y))$. In the second stage, I find the actual, sticky pay in each state by taking a weighted average between flexible pay in the current state and in the median state.

$$S(y) = \lambda S^*(y) + (1 - \lambda)S^*(\bar{y}) \tag{24}$$

$$w(y) = \lambda w^*(y) + (1 - \lambda)w^*(\bar{y}) \tag{25}$$

Finally, actual hours worked are determined through Nash bargaining, conditional on sticky pay. Workers and firms in the hourly type labor market bargain over hours conditional on the sticky wage, while bargaining in the salaried type labor market is conditional on the sticky salary.

$$h_s(y) = \underset{h}{\text{argmax}}(V_s^E(S(y), h, y) - V_s^U(y))^\eta (V_s^F(S(y), h, y) - V_s^V(y))^{1-\eta} \tag{26}$$

$$h_w(y) = \underset{h}{\text{argmax}}(V_w^E(w(y), h, y) - V_w^U(y))^\eta (V_w^F(w(y), h, y) - V_w^V(y))^{1-\eta} \tag{27}$$

Note that actual hours $h_k(y)$ are not calculated in the same way as actual wage or salary. If hours, like pay, were simply the weighted average of the flexible values at the current state y and the median state $\bar{y}$, then there would be no difference in the two pay types' hours. This is because hours, regardless of pay type, will be set to the efficient level when pay is flexible.

4 Calibration

In this section I detail my calibration process for the model.

4.1 Externally Set Parameters

Table 4 features the parameters that I set using external sources rather than through targeting internal moments. I borrow the values for the separation rate δ, the persistence of productivity shocks ρ_z, and the standard deviation of productivity shocks σ_z from Bernstein et al. (2021). I set α, the matching elasticity with respect to unemployment, equal to 0.5, within the range of empirical estimates (Petrongolo and Pissarides 2001). I set bargaining power η equal to the matching elasticity α to satisfy the Hosios condition. The monthly interest rate r is 0.0017 to achieve a 2% annual interest rate.

The pay stickiness parameter λ is informed by, but not equal to, the Barattieri et al. (2014) estimate of the quarterly hazard rate of wage updating for hourly workers, 0.178, which implies a monthly probability of wage change of 0.063. Under the adaptive pay rule in equation (28), which averages the flexible wage and lagged wage to get the actual wage in the current period, $\tilde{\lambda}$ could plausibly be set to this hazard rate.

$$w_t(y_t) = \tilde{\lambda} w_t^*(y_t) + (1 - \tilde{\lambda}) w_{t-1} \tag{28}$$

In the actual model's partial smoothing wage rule (equations 24 and 25), however, λ cannot be interpreted as the hazard rate of wage changes. Instead I choose λ by minimizing the distance between the partially smoothed wage and the hypothetical adaptive wage in a simulation of the model that assumes efficient hours. I set the flexibility of a hypothetical adaptive wage rule at $\tilde{\lambda} = 0.063$. I then simulate the partially smoothed wage, starting it from a steady state and hitting the simulation with a one standard deviation productivity shock. I then choose $\lambda = 0.64$ to minimize the average difference between the simulated wage series under the adaptive wage rule in equation (28) and the series under the partial smoothing wage rule in equation (25) over 36 months. Although Barattieri et al. (2014) finds an even lower hazard rate for non-hourly workers than for hourly workers, I use the same value of λ for both pay types so we can observe the effect of pay type alone on aggregate outcomes.

Parameter	Value	Source
r, interest rate	0.0017	Annual rate of 2%
α, matching elasticity	0.5000	Petrongolo and Pissarides (2001)
η, bargaining power	0.5000	Hosios (1990) condition
δ, separation rate	0.0327	Bernstein et al. (2021)
σ_z, productivity shock sd	0.0083	Bernstein et al. (2021)
ρ_z, productivity autocorr.	0.9537	Bernstein et al. (2021)
λ, pay flexibility	0.6390	Barattieri et al. (2014) and simulation

Table 4: Externally Set Parameters

4.2 Internally Calibrated Parameters

Table 5 feature the parameters that I choose in order to hit certain moments. I set γ to 0.5 to normalize median hours to one, for both pay types. Changing γ has no effect on model moments if certain other parameters, such as b, are scaled accordingly. Similar to Shimer (2005), I jointly calibrate the vacancy-posting cost ψ and matching efficiency μ to achieve a mean job-finding rate of 0.49 and a mean labor market tightness normalized to 1. Bils et al. (2014) sets b to attain a utility replacement rate of 70%for unemployed agents in the steady state. Here, I target a replacement rate of 40%.

Parameter	Value	Target means
γ, hours disutility	0.5	Hours per worker (1)
ψ, vacancy cost	2.15	Job-finding rate (0.45) and
μ, matching efficiency	0.45	Labor market tightness (1), jointly
b, unemployment benefits	0.19	Util replacement rate of 40%

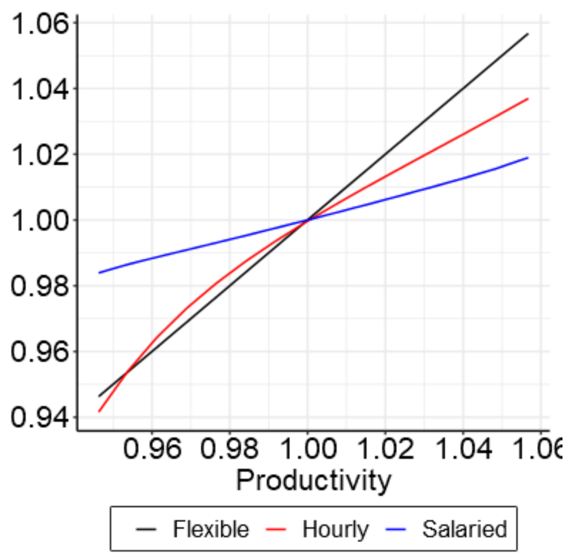
Table 5: Targeted Parameters

5 Pay Type and Hours

This section examines the effect of pay type on the relationship between productivity and a worker's hours h. Figure 6 plots hours as a function of productivity for both hourly and salaried workers in comparison to the hours curve if pay were perfectly flexible. We see that hours in the flexible pay case exhibit the greatest elasticity with respect to productivity y.

Hourly workers who are paid a sticky wage have more elastic hours than the workers who are paid a sticky salary.

Figure 6: Hours per worker



Notes: Each curve plots the hours worked per period h by an hourly type, salaried type, or hypothetical type worker with perfectly flexible pay in each aggregate productivity state y.

At the efficient number of hours, marginal product y equals the worker's marginal disutility $g'(h)$. As productivity y increases, the efficient level of hours increases to the point where $g'(h)$ once again equals y. If pay were perfectly flexible ($\lambda = 1$), the Nash bargaining problem in equations (26) and (27) would yield the efficient number of hours. Efficient hours $h^*(y)$ would be achieved through corresponding changes in the wage or salary that allow the firm and worker to work out a win-win that gets hours to the efficient level. If $h < h^*(y)$, then the marginal product y of hours worked exceeds the worker's marginal disutility $g'(h)$. If the worker were to increase hours to the efficient level, the gain to the firm would be larger than the disutility cost to the worker, and so the firm could induce the worker to increase hours by increasing her pay by more than her extra disutility but by less than the firm's increase in revenue.

A sticky wage impedes this sort of deal-making, however. Suppose productivity increases. If paid a sticky wage, the worker and firm cannot quite reach the efficient number of hours because the wage does not increase enough to sufficiently compensate the worker for the added pain of working more. Therefore hours increase by less than in the case of flexible pay. A sticky salary adds another wrinkle to the bargaining problem. If productivity rises and a firm's profit increases, a worker paid a perfectly flexible salary will capture a share of that increase by bargaining for a higher salary. If the salary is sticky, there is something else the worker can bargain for instead: a smaller increase in hours. This mechanism is not operative for hourly workers because for them fewer hours means lower income, which is bittersweet. Therefore, salaried workers' hours react less to productivity changes than hourly workers' hours. The lower hours elasticity of workers paid a sticky salary than a flexible salary is similar to the result in Bils et al. (2014), in which workers exert more effort in a downturn if their pay is sticky than if it is flexible.

Curiously, hourly workers' hours curve is nonlinear, unlike the other two, and even intersects the hours curve for flexible pay at a low productivity level. When productivity is only somewhat below average, hourly workers paid a sticky wage work longer hours than they would if their wage were flexible because the sticky wage is higher than the flexible wage, and so the hourly workers will bargain for longer hours than they would otherwise. In this productivity range, the employers are earning a profit on the margin and would not mind if the workers worked every waking hour, and so they oblige the hourly workers. At the lowest level of productivity, by contrast, the sticky wage leads to lower hours than the flexible wage because at the low end of productivity, employers pay a sticky wage that is higher than workers' hourly output. The employers would prefer in this case that the hourly workers would work zero hours, but there is no opportunity for temporary layoffs here, and workers bargain for some hours because they would like to be paid. Firms at a sufficiently low productivity level therefore push for lower hours than they would if the wage were flexible. As productivity falls, employers' per-period profit per worker declines, and so hourly workers' hours bend toward this lower point below the flexible case, leading to the nonlinearity of the hours curve in the hourly case.

6 Model Results

In this section I compare the means and volatilities of each pay type's moments. Averages are nearly identical across pay types, but volatilities differ. While hours per worker is most directly impacted by pay type, other variables are affected as well.

6.1 Means

Table 6 shows the means of several variables for each worker type, illustrating that pay type has little impact on averages. Because both pay types have the same equilibrium in the steady state, it is unsurprising that their variable means are essentially the same in the stochastic model. Unemployment is rather high at 6.5%, and the job-finding rate f equals 0.49, as targeted. Mean hours are normalized to one because I set $\gamma = 2$. Both the mean salary and wage are 0.98, a bit higher than Hall (2005)'s sticky wage of 0.966.

Table 6: Simulation Means

Variable	Hourly	Salaried
Hours per worker	1.00	1.00
Unemployment	0.065	0.064
Job-finding rate	0.49	0.48
Effective Wage	0.98	0.98
Effective Salary	0.98	0.98

Notes: I simulate the model and calculate the means of each variable within each pay type's labor market. The effect of pay type on these moments is negligible.

6.2 Volatilities

Table 7 presents the volatilities of hours per worker, employment, and other variables in each pay type. The model succeeds in generating a higher volatility of hours per worker among hourly workers than salaried workers, as we see in the data. This volatility difference results directly from the hourly pay type's hours curve $h(y)$ being more elastic with respect to productivity than the salaried pay type's hours curve, as seen above in figure 6. Because of the disconnect between a salaried worker's pay and hours, an employer can share the bounty with a salaried worker when productivity is high by giving the worker fewer hours than in the hourly case. When productivity is low, the salaried worker must share in the firm's pain by working longer hours than in the hourly case. Because the hourly and salaried labor markets are subject to the same aggregate shocks, this difference in the elasticity of bargained hours translates to a lower volatility of hours among salaried workers. Hourly workers' hours per worker are more than double salaried workers' in the model but in the data only 44% higher than in the salaried case. The volatility gap may be relatively larger in the model because I assume a sharp contrast in how hourly and salaried workers are compensated, and this difference may be more subdued in the real world. After all, employers can pay a hard working employee a larger bonus in addition to their salary, but there are no bonuses in the model.

Table 7: Simulation Log Standard Deviations

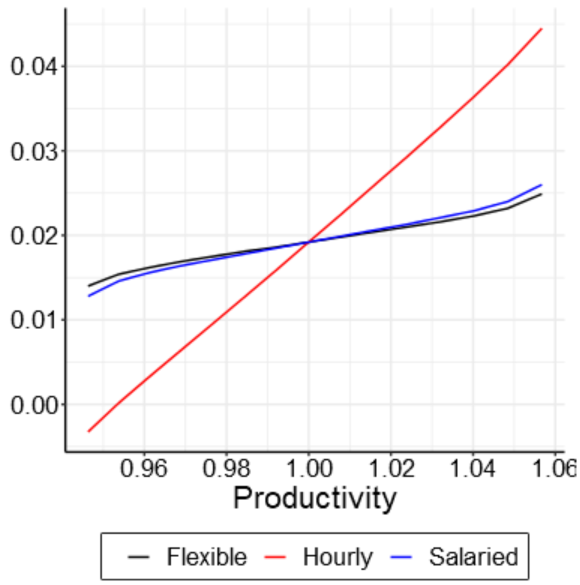
Variable	Hourly	Salaried
Hours per worker	2.08	0.80
Unemployment	19.31	4.42
Employment	1.38	0.30
Aggregate Labor Hours	3.40	1.09
Aggregate Labor Income	4.94	3.50
Effective Wage	1.57	2.41
Effective Salary	3.64	3.21

Notes: I simulate the model and calculate 100 $\times$ the standard deviation of log variables within each pay type's labor market. Hourly workers experience more volatile hours per worker, employment, and aggregate labor hours. The effective wage of salaried workers equals S/h, and the effective salary of hourly workers is wh.

In addition to hourly workers having more volatile hours per worker, they also have more volatile employment than salaried workers. The employment volatility gap relates to the fact that a firm's per-period returns to employing a worker are more volatile in the hourly type labor market. Figure 7 plots output (yh) minus cost (wh or S) per worker[5] for hourly workers, salaried workers, and hypothetical workers whose pay is perfectly flexible. Although hourly workers' hours curve is closer to the flexible case in figure 6, here the pay types' relation to flexible pay is flipped. Salaried workers' output less cost is quite similar to the flexible case, whereas employers of hourly workers face significantly more elastic per-period returns. Hence when productivity increases, firms increase their vacancies siginificantly in the hourly labor market and only somewhat in the salaried market. The higher cyclicality of vacancy posting results in a higher volatility of employment in the hourly labor market.

[5] An employer's per-period profit, especially when pay is sticky, is closely related to the concept of fundamental surplus, which Ljungqvist and Sargent (2017) argues is a key determinant of employment volatility. Though the latter is indeed more fundamental, I use the former for purposes of explaining the intuition behind the results.

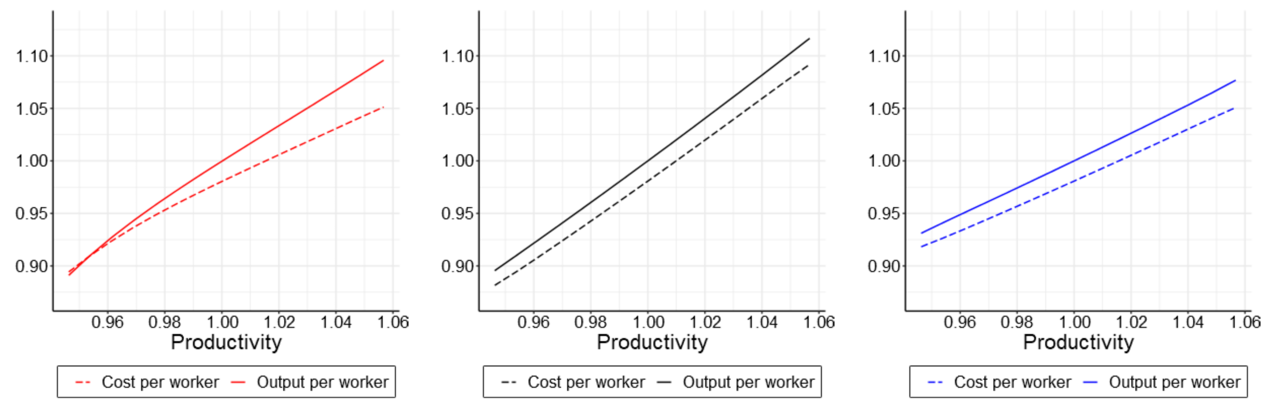
Figure 7: Output Less Cost per Worker



Notes: Each curve plots the per-period output less costs per worker in each aggregate productivity state y for different pay types. Output less costs equals $yh - wh$ or $yh - S$. The black curve represents a hypothetical worker whose pay is perfectly flexible (i.e., $\lambda = 1$). In the flexible case, pay type is irrelevant.

The reason for hourly workers' more elastic output less costs can be seen in figure 8, which plots the output (yh) and labor costs (wh or S) per worker curves separately as a function of the aggregate productivity state y. First comparing the second and third panels, we can see why output less cost per worker is so similar in the salaried case as in the flexible case. Although a sticky salary flattens the output and cost curves, these two curves are flattened by nearly the same amount, changing the difference between them only somewhat. Hourly workers differ from the other two cases because, as seen in panel (a), the sticky wage flattens labor costs more than output. Consider the number of distortions that each curve is subject to when pay becomes sticky. In the salaried case, pay stickiness makes $S(y)$ less elastic, and this reduces the elasticity of $h(y)$. We can say that output $yh(y)$ and cost $S(y)$ are each distorted (flattened) once. In the case of hourly workers, a sticky wage distorts the cost curve $w(y)h(y)$ twice—once by flattening $w(y)$, once by flattening $h(y)$. The output curve $yh(y)$, on the other hand, is flattened by a sticky wage just once, through $h(y)$. This asymmetry of distortion results in a larger flattening of the cost curve and therefore a more elastic output less cost curve in figure 7.

Figure 8: Output and Cost per Worker



(a) Hourly (b) Flexible Pay (c) Salaried

Notes: Each panel plots the per-period cost per worker wh or S and output per worker yh against productivity y within the hourly and salaried labor markets, as well as in a hypothetical labor market with perfectly flexible pay. Each of the hourly type's curves are closer to the flexible case than the salaried curves are, but output minus cost is most similar between the flexible and salaried types.

Although hourly workers have higher volatility of both hours per worker and employment than salaried workers, these two volatility gaps exist for opposite reasons. Hours per worker are more volatile when pay is flexible, and hourly workers hours are closer to the flexible case than salaried workers' hours are. Meanwhile, employment is less volatile when pay is flexible, and hourly workers have more volatile employment because they are further away from the flexible case than salaried workers are. Hours, output, and costs are all less distorted by a sticky wage than a sticky salary, but the sticky wage flattens costs more than output, leading to higher employment volatility.

Table 8 presents the volatilities in the hypothetical case of perfectly flexible pay, plus the percent deviation of the volatilities in the hourly and salaried sticky pay cases away from the flexible case. The effective wage S/h of salaried workers is almost as flexible as in the perfectly flexible pay case, while hourly workers have more flexible effective salaries wh than salaried workers. With hourly workers having hours volatility closer to the flexible case, and salaried workers having employment volatility that is closer to the flexible case, one takeaway is that a sticky salary mostly distorts hours per worker, while a sticky wage mostly distorts employment.

Table 8: Log Standard Deviations: Flexible Versus Sticky Pay

Variable	Flexible pay	Hourly	Salaried
Hours per worker	2.61	-20%	-69%
Unemployment	3.65	429%	21%
Employment	0.25	452%	20%
Aggregate Labor Hours	2.84	20%	-62%
Aggregate Labor Income	5.33	-7%	-34%
Effective Wage	2.54	-38%	-5%
Effective Salary	5.10	-29%	-37%

Notes: I simulate the model when pay is perfectly flexible ($\lambda = 1$) and calculate 100 $\times$ the standard deviation of log variables within each pay type's labor market, shown in the flexible pay column. The hourly and salaried columns present the percentage deviation of the volatilities in the hourly and salaried type labor markets (in which $\lambda < 1$) from the flexible case.

In most search models, there is only an extensive margin for labor and no choice of hours worked, and so a sticky wage unambiguously increases the volatility of labor because it increases the volatility of unemployment. Here, a comparison of the flexible-pay workers with the hourly and salaried workers reveals that with the addition of the hours margin, the effect of sticky pay on total labor hours volatility becomes theoretically ambiguous. Pay stickiness increases employment volatility because it prevents workers' pay from fully absorbing the added surplus from a productivity increase. As firms do not need to raise their workers' incomes as much in response to a productivity change, the firms get to keep a larger share of the extra revenue for themselves. Therefore, as explained in Ljungqvist and Sargent (2017), the volatility of the fundamental surplus is raised, leading to a higher cyclicality of vacancy posting. Meanwhile, sticky pay, whether wage or salary, gums up the hours bargaining process and dampens fluctuations in hours. The ultimate effect of sticky pay on total labor hours thus depends on calibration and, evidently, pay type. Table 8 shows that total labor hours are 20% more volatile among hourly workers who are paid a sticky wage than their flexible counterparts. For workers paid a sticky salary, however, total labor hours are 62% less volatile than in the flexible case. Total labor income is still highest for flexible pay workers.

Counterfactual to the data, hourly workers' employment is more volatile than salaried workers' employment in the model simulations. Hourly workers' employment volatility is 1.08 percentage points higher in the model but 0.39 percentage points lower than that of salaried workers in the data. As a result of the simulations' compounding volatility gaps of both hours per worker and employment, total labor hours are twice as volatile for hourly than salaried workers. In the data, the volatility of total labor hours per capita is essentially the same for both types due to the offsetting volatility differences in hours per worker and employment.

There are several changes to the model that could reverse the higher volatility of hourly type employment. Firstly, I could break the assumption that each type's pay flexibility λ is the same and instead make hourly workers' wages substantially more flexible than salaried workers' salaries. Salaried workers' hours per worker are less volatile than in the perfectly flexible case, while their employment volatility is larger. As the hourly wage becomes more flexible, the hourly workers' simulation results converge to the perfectly flexible case, and hence the hourly employment volatility would fall below that of salaried workers at some sufficiently high λ, while volatility of hours per worker would only increase further.

No doubt there are plenty of other parameter asymmetries that could make employment volatility lower for hourly workers than salaried workers, and there are also model extensions that could achieve this result. Currently, production is linear, both at the individual level with respect to a worker's hours and at the aggregate level with respect to aggregate labor hours within each labor market, just as in the standard model with search and matching. If the aggregate production function in each labor market were subject to diminishing returns, this modification could impose a tradeoff between adjustments in hours per worker and in employment. As hours per worker increase, aggregate labor hours increase and would lower the marginal product of a new hire. The hourly pay type, with its higher volatility of hours per worker, could have less volatile employment, as the fluctuations in one crowd out fluctuations in the other. Alternatively, a model allowing for skill upgrading or switching between labor markets, if it were to generate procyclical participation in the salaried type labor market, could yield a higher volatility of employment of salaried workers.

7 Conclusion

In this paper I empirically document that differences in pay type contribute to the higher volatility of hours per worker among non-college graduates, even after controlling for other compositional differences between skill levels. Non-college graduates are much more likely to be paid by the hour, and holding pay type constant across skill levels reduces the volatility gap in the two skill levels' hours per worker by 44%. Pay type has limited or no effect, however, on the skill levels' relative volatilities of other aggregate labor variables, such as employment per capita. I also show that, while hours per worker are more volatile among hourly workers, employment is more volatile among salaried workers. The share of jobs that are salaried as opposed to hourly has been increasing, especially since the onset of the COVID-19 pandemic, and so the composition of aggregate labor hours may shift toward larger fluctuations in employment and smaller fluctuations in hours per worker.

Turning to the theoretical section of the paper, I present a model in which pay type itself, and not a calibration difference that varies by pay type, is able to generate a higher volatility of hours per worker among hourly type workers. Each agent in the model is either an hourly type or a salaried type. A worker matched to a firm bargains over hours worked conditional on a sticky wage or sticky salary. When pay is sticky, salaried workers resist large increases in hours when productivity rises. Hourly workers are more willing to increase their hours during a boom because their income is tied to the number of hours worked. When productivity falls, employers of salaried workers push them to shoulder some of the burden by working longer hours than in the hourly pay case. Not only hours per worker, but also employment in the model is more volatile among hourly workers. As productivity increases, hourly workers' output rises faster than their pay, due to their sticky wage. A sticky salary, meanwhile, flattens hours to such an extent that salaried workers' output increases almost as slowly as their pay when productivity increases. As a result, vacancies fluctuate more in the hourly type market, leading to more volatile employment of hourly workers.

Future research into the hourly-salaried distinction could look at the part-time rate, which is a key determinant of hours per worker. A firm wanting to lower hours per worker by a given amount may do so by lowering all employees hours somewhat or by shifting a fraction of full-time workers to a part-time schedule. It is possible that pay type affects firms' choice of whether to rely on the part-time rate or more dispersed hours changes to achieve hours reductions. My model abstracts from the part-time rate and assumes that all workers of a given pay type work the same hours. The model results could be made more robust to increases in pay flexibility if the intensive hours margin were discretized into a choice between part-time and full-time work. Additionally, further research could be done on the difference in timing between hourly and salaried employment fluctuations. In the data, salaried employment appears to lag hourly employment. A model in which firms are uncertain about applicants' productivity could generate a longer, more careful hiring process for salaried workers.

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