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When Monetary Policy Bites: State-Level Evidence on Wages*

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Abstract

We study how labor market tightness shapes the transmission of monetary policy to wages. Using U.S. state-level data and high-frequency-identified monetary policy shocks, we estimate state-dependent wage responses using local projections that allow effects to vary with both the sign of the shock and local labor market tightness. We find pronounced nonlinearities in wage adjustment. Expansionary monetary policy raises wages strongly, with pass-through up to four times larger in tight labor markets than in slack ones. In contrast, contractionary shocks generate little wage decline at any tightness level, consistent with downward nominal wage rigidity. These results imply that nonlinear monetary transmission arises partly at the wage-setting stage: tight labor markets amplify wage responses during expansions, while wage rigidity limits adjustment during contractions. Because wages account for a large share of marginal costs, these nonlinear wage responses provide a microeconomic foundation for state-dependent inflation dynamics and help explain the strong wage growth and persistent inflation observed during the recent period of exceptional labor market tightness.

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1 Introduction

How do wages respond to monetary policy? The answer is central to how interest-rate changes pass through to labor costs, price inflation, and ultimately aggregate demand. Standard theory predicts that contractionary monetary policy reduces labor demand and exerts downward pressure on wages, while expansionary policy stimulates hiring and raises wage growth (see Christiano et al. (2005); Ramey (2016)). These effects are widely understood and embedded in virtually all frameworks for monetary policy analysis. However, recent work highlights that the strength of these wage effects depends critically on labor market tightness. In particular, Gitti (2025) provides empirical evidence that tighter labor markets steepen the Phillips curve, while Benigno and Eggertsson (2023) develop theoretical foundations for why tightness amplifies the pass-through from demand shocks to marginal costs and inflation. Similarly, Schmitt-Grohé and Uribe (2022) show that heterogeneous downward wage rigidity interacts with tightness to generate a nonlinear wage Phillips curve. Together, these studies imply that the response of wages and inflation to demand disturbances should be highly state dependent, particularly when labor markets are tight and downward nominal rigidity binds.

A closely related debate concerns whether the recent surge in inflation reflects a genuinely nonlinear Phillips curve. While studies such as Gitti (2025) and Benigno and Eggertsson (2023) interpret recent evidence as consistent with strong nonlinearities in the relationship between tightness and inflation, Beaudry et al. (2026) argue that much of the apparent nonlinearity may instead reflect movements in inflation expectations rather than causal effects of tightness itself. A common feature of this literature is its focus on inflation outcomes. It estimates nonlinear Phillips curve relationships, but does not directly identify how exogenous monetary policy shocks propagate through wages across different labor market states.

This paper shifts attention to the wage-setting stage of monetary transmission. We combine high-frequency-identified monetary policy shocks with cross-state variation in labor market tightness to identify how identical national policy impulses translate into wage adjustments across heterogeneous local labor markets. Using a panel of U.S. states and measuring tightness by the vacancy–unemployment ratio, we exploit that monetary shocks are common across states while labor market conditions differ. We show that the transmission of monetary policy to wages is strongly state-dependent: wage responses are highly nonlinear in labor market tightness, and asymmetric across contractionary and expansionary policy impulses. While the existing literature documents nonlinear inflation responses, our results show that the underlying nonlinearity arises already at the wage-setting stage of monetary transmission. In doing so, we provide causal evidence on the labor-cost channel that underlies nonlinear inflation dynamics and the state-dependent effectiveness of monetary policy. These findings imply that aggregate inflation responses to monetary policy depend critically on prevailing labor market tightness, even if firms' price-setting behavior is itself linear.

More broadly, our findings suggest a reinterpretation of nonlinear monetary transmission. Rather than arising solely from state-dependent price-setting behavior or shifts in inflation expectations, an important source of these nonlinearities operates upstream in wage-setting itself. Because monetary policy affects firms' labor demand and workers' outside options, tight labor markets amplify wage increases following expansionary shocks, while downward nominal rigidity limits wage declines after contractionary shocks. Monetary policy therefore does not propagate symmetrically through labor markets: wages respond strongly when labor is scarce but adjust little downward when demand weakens. By documenting this nonlinear wage channel, we provide a microeconomic foundation for state-dependent and asymmetric inflation responses to monetary policy. Because wages account for a substantial share of firms' marginal costs, nonlinear wage responses naturally translate into nonlinear inflation dynamics, even in the absence of intrinsically nonlinear price-setting behavior.

We estimate dynamic causal effects using local projections with an external instrument (LP–IV), allowing wage responses to vary flexibly with both the sign of the monetary shock and the degree of local tightness. This framework enables us to address three core questions: (i) Does the transmission of monetary policy to wages depend on labor market tightness? (ii) Are wage responses symmetric for expansionary and contractionary shocks? (iii) How do tightness and sign asymmetries interact? The central identification advantage of our approach is that cross-state variation in tightness provides predetermined differences in economic conditions through which a common monetary shock propagates, allowing us to identify state-dependent wage transmission without imposing structural restrictions.

In contrast to existing nonlinear Phillips curve evidence, which infers state dependence from inflation outcomes, our approach directly identifies the wage channel of monetary transmission itself. These nonlinearities are of direct policy relevance: the strength of wage pass-through determines how strongly monetary policy affects inflation when labor markets become exceptionally tight. Our empirical design therefore isolates how monetary policy operates conditional on labor market conditions, rather than estimating an average transmission mechanism that abstracts from state dependence.

Our results reveal pronounced nonlinearities in wage adjustment to monetary policy shocks. First, monetary policy has a substantially stronger effect on wages in tighter labor markets, where hiring is more costly and workers' outside options are stronger. Second, wage responses display a clear sign asymmetry: expansionary shocks raise wages significantly, whereas contractionary shocks produce little or no decline, consistent with downward nominal wage rigidity. This inability of contractionary policy to lower wages, even in slack labor markets, goes beyond what is implied by the symmetric wage adjustment mechanisms embedded in standard New Keynesian models. Third, these two dimensions interact sharply: expansionary shocks generate up to four times larger wage increases in tight markets than in slack ones, while contractionary shocks do not reduce wages at any tightness level. Together, these findings indicate that when labor markets are tight, monetary stimulus translates more directly into wage growth, whereas the influence of contractionary policy is constrained by wage rigidity even in relatively slack environments. These patterns imply that expansionary monetary policy is substantially more inflationary in tight labor markets: when labor is scarce, wage responses amplify the effect of monetary expansions on marginal costs and, therefore, on inflation. These nonlinear wage responses also illuminate the experience of 2021–2022: when tightness reached historic highs, wage growth accelerated sharply, and subsequent monetary tightening generated little wage disinflation, exactly the pattern implied by our estimates.

Our paper makes three contributions to the literature on monetary transmission and labor markets. First, we provide new evidence that the effects of monetary policy on wages are strongly state dependent, with tightness playing a central role in determining the strength of pass-through. Second, we document a pronounced sign asymmetry: expansionary shocks raise wages while contractionary shocks do not reduce them, consistent with downward nominal wage rigidity. Third, we show that these two nonlinearities interact sharply: expansionary shocks generate much stronger wage growth in tight labor markets, whereas contractionary shocks have little effect at any tightness level. Together, these findings reveal a previously unidentified nonlinear wage transmission channel of monetary policy, arising from the interaction of labor market tightness and downward wage rigidity.

Our findings relate to a growing literature emphasizing the role of labor market tightness in wage-setting and worker mobility. In search-and-matching models, higher tightness raises recruiting costs and strengthens workers' outside options, amplifying wage responses to demand shocks. Empirical evidence in Sahin et al. (2014), Mukoyama et al. (2018), and Barnichon and Shapiro (2024) highlights persistent dispersion in tightness and its importance for inflation dynamics, while Haefke et al. (2013) show that wage cyclicality varies with labor market conditions. We extend this literature by demonstrating that tightness shapes not only wage cyclicality but also the causal response of wages to monetary policy shocks and the degree of asymmetry in those responses. Consistent with mechanisms emphasized by Moscarini and Postel-Vinay (2023), tight labor markets amplify wage increases through improved worker outside options, while downward rigidity limits wage declines during contractions.

A complementary strand of research studies nonlinear inflation dynamics and asymmetric transmission. Gitti (2025), Benigno and Eggertsson (2023), and Michaillat and Saez (2013) argue that tight labor markets steepen the Phillips curve and amplify inflation responses to demand shocks, while Dupraz et al. (2025) develop models generating nonlinear transmission of aggregate demand disturbances. At the same time, Beaudry et al. (2025) show that part of the apparent nonlinearity in inflation may reflect movements in inflation expectations rather than structural Phillips curve effects, and Bunn et al. (2024) document asymmetric price adjustments at the firm level. Relatedly, Graves et al. (2023) show that monetary policy also affects labor supply flows asymmetrically. Our contribution complements this literature by identifying the wage-setting channel through which such nonlinear inflation dynamics can emerge.

A related literature documents asymmetric monetary transmission. Tenreyro and Thwaites (2016) show that contractionary monetary policy has stronger real effects than expansionary policy, while Aastveit and Anundsen (2022) document substantial regional asymmetries in responses to monetary shocks. Ramey and Zubairy (2018) show how state-dependent multipliers can be estimated via nonlinear local projections, a methodological approach similar to ours. Our contribution is to apply this framework to wages and labor market tightness, revealing nonlinearities arising from the interaction of tightness and downward wage rigidity.

Finally, our paper contributes to work on downward wage rigidity and the microfoundations of wage-setting. Micro evidence from administrative and household data documents substantial limits to wage reductions (e.g., Grigsby et al. (2021); Elsby et al. (2013); Hazell et al. (2022)). On the macro side, Schmitt-Grohé and Uribe (2016) show that downward rigid wages have large implications for business cycle dynamics and policy transmission.

Schmitt-Grohé and Uribe (2022) propose a model where heterogeneous downward wage rigidity across labor types generates a nonlinear wage Phillips curve and estimate such a relationship in regional U.S. data. Our estimates complement this evidence, as we identify the conditional responses to monetary policy shocks across U.S. states rather than tracing out a relation between wage growth and unemployment. Our findings are remarkably consistent with theirs, as we find that expansionary monetary policy shocks generate substantial wage growth in tight markets, while contractionary shocks do not reduce wages whatever the degree of labor market tightness. This interaction between tightness and wage rigidity might help reconcile why wage growth surged in the recent period of extreme labor market tightness without turning negative during the subsequent monetary contraction.

Taken together, our findings suggest that nonlinear inflation dynamics documented in recent work partly reflect state-dependent wage adjustment to monetary policy shocks, highlighting a nonlinear wage transmission channel as a central mechanism underlying state-dependent monetary policy effects.

The remainder of the paper is organized as follows. Section 2 presents a simple exposition of why the transmission of monetary policy is likely to be nonlinear. Section 3 describes the state-level data and the construction of the monetary policy shocks. Section 4 presents the LP–IV methodology and our main empirical findings. Section 5 reports robustness exercises. Section 6 concludes.

2 Economic Mechanisms and Empirical Predictions

This section outlines the economic mechanisms motivating our empirical analysis. The goal is to summarize well-established insights from search-and-matching theory and the literature on wage rigidity that clarify why the transmission of monetary policy to wages may be nonlinear.

2.1 Labor Market Tightness and Wage Responsiveness

In search-and-matching models of the labor market (Mortensen and Pissarides (1994); Pissarides (2000)), the ratio of vacancies to unemployed workers, summarizes the balance between labor demand and labor supply and thus labor market tightness. When tightness is high, vacancies fill more slowly and recruiting becomes costly for firms, while workers enjoy improved outside options. Both forces increase the marginal cost of labor and strengthen the worker side of the wage bargaining process.

These mechanisms imply that aggregate demand shocks, including monetary policy shocks, should transmit more strongly to wages when labor markets are tight. Recent contributions formalize and document this idea. Gitti (2025) shows that tighter labor markets steepen the Phillips curve by amplifying the sensitivity of marginal costs to demand conditions, while Benigno and Eggertsson (2023) and Michaillat and Saez (2013) highlight the role of tightness as a state variable governing inflation dynamics. Empirical evidence on recruiting frictions (Mukoyama et al. (2018)) and the interaction of the Phillips and Beveridge curves (Barnichon and Shapiro (2024)) similarly emphasizes that tightness governs how aggregate shocks propagate through labor markets.

Applied to monetary policy, these insights suggest a simple prediction: expansionary monetary shocks should generate larger wage increases when labor markets are tight than when they are slack.[1]

2.2 Downward Wage Rigidity and Asymmetric Adjustment

A large empirical literature documents substantial downward nominal wage rigidity. Institutional constraints, implicit contracts, morale considerations, and adjustment costs all limit

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[1] Other theories of the labor market give the same prediction. With a perfectly competitive labor market where the maximum supply of labor is given, wages will respond more to demand when the economy is close to or at the upper constraint. In efficiency wage theory, wages grow faster with labor demand when employment is high, since then the firm struggles to discipline the worker from shirking.

firms' ability to reduce nominal wages (Elsby et al. (2013); Grigsby et al. (2021); Hazell et al. (2022)). As a result, negative demand shocks typically induce adjustment along margins such as vacancies, hiring, or employment rather than through wage cuts.

In the presence of downward rigidity, wage responses to monetary policy are therefore expected to be asymmetric. Expansionary shocks can raise wages as firms compete for scarce labor, whereas contractionary shocks need not produce corresponding wage declines even when labor markets weaken. This asymmetry implies that tightness should matter primarily for positive shocks, while wage responses to contractionary policy may remain muted across labor market states.

2.3 Empirical Predictions

Taken together, tightness-dependent wage setting and downward nominal wage rigidity yield three empirical predictions that guide our analysis.

First, the transmission of monetary policy to wages should be stronger in tighter labor markets, reflecting higher marginal hiring costs and stronger worker bargaining positions.

Second, wage responses should display sign asymmetry: expansionary monetary policy should raise wages more strongly than contractionary policy lowers them.

Third, these mechanisms should interact, generating nonlinear wage dynamics in which expansionary shocks produce particularly strong wage growth in tight labor markets, while contractionary shocks have limited wage effects regardless of tightness.

Figure 1 summarizes these mechanisms graphically. The steeper response under tight labor market conditions reflects stronger wage pass-through following expansionary shocks, while the flat response for contractionary shocks illustrates the constraints imposed by downward nominal wage rigidity.

We next turn to directly estimating how identical national monetary policy shocks translate into differential wage dynamics across states with different initial labor market conditions.

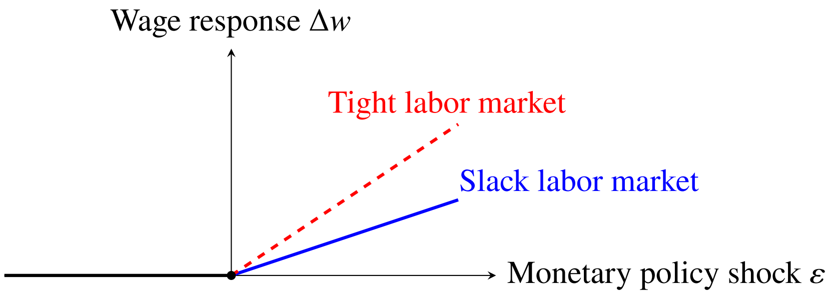

Figure 1: Conceptual illustration of the wage response to monetary policy. For contractionary shocks ($\varepsilon < 0$), downward wage rigidity implies negligible wage responses in all labor market states. For expansionary shocks ($\varepsilon > 0$), wage responses are stronger when labor markets are tight (steeper dashed line) than when they are slack (flatter solid line), reflecting tightness-dependent wage-setting.

3 Data and Descriptive Statistics

To analyze the effects of monetary policy shocks on wages, we use two primary data sources. The first is quarterly data on average hourly earnings growth, labor market tightness, and additional economic controls across all 50 U.S. states and the District of Columbia from 2007Q1 to 2023Q1, constrained by the availability of our wage measure. This dataset allows us to exploit variation across regions and over time in labor market dynamics. The second source is a monetary policy shock instrument constructed from high-frequency changes in Eurodollar futures, capturing exogenous variations in monetary policy decisions. This instrument enables us to isolate and analyze the causal effects of monetary policy shocks.

3.1 State-level data

We obtain state-level data on average hourly earnings from the U.S. Bureau of Labor Statistics (BLS) Current Employment Statistics (CES) establishment survey, which provides large-sample employer-based payroll data at the state level.[2] To account for regional wage and

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[2] We use the CES rather than the Current Population Survey (CPS) because it is based on employer payroll records and draws on a substantially larger establishment sample. In addition, CES employment estimates are benchmarked to administrative unemployment-insurance records covering roughly 97 percent of U.S. nonfarm employment, providing broad coverage and more precise measures of aggregate wage dynamics.

labor market disparities, we include control variables reflecting broader economic conditions in each state. These controls include per capita disposable income (adjusted for inflation using the U.S. Consumer Price Index), state-level employment, working-age population, and net migration rates. All data are sourced from Moody's Analytics' Economy.com website. A comprehensive description of each series, along with its original source, is provided in Appendix A .

To explore regional heterogeneities in the response to monetary policy shocks, we use state-level labor market tightness as a key measure of labor market conditions. We measure tightness as the vacancy-to-unemployment ratio (V/U), which reflects the balance between labor demand and supply in each state. State-level vacancy data (V) are drawn from the BLS Job Openings and Labor Turnover Survey (JOLTS), while state-level unemployment (U) is obtained from the BLS Local Area Unemployment Statistics (LAUS). A higher ratio indicates a tighter labor market, where firms face greater difficulty filling vacancies and the economy is closer to full employment. This indicator provides a comprehensive measure of local labor market conditions, capturing both the availability of job openings and the pool of workers actively seeking employment. Our choice follows Barnichon and Shapiro (2024), who show that V/U is a theoretically grounded and empirically powerful measure of labor-market scarcity and that it outperforms more traditional slack indicators, such as the unemployment rate or the output gap, in predicting wage and price pressures. Their evidence underscores that V/U closely tracks firms' recruiting difficulties and marginal hiring costs, making it a natural measure of tightness in our setting. While no single metric captures all dimensions of labor-market conditions, the V/U ratio offers a transparent and economically meaningful proxy for the state-level variation in labor-market tightness that is central to our analysis.

Table 1 summarizes key statistics on average labor market tightness and average wage growth across U.S. states for the sample period 2007:1 to 2023:1. The top five states with the highest labor market tightness also exhibit relatively strong wage growth, with North Dakota leading in both measures. Conversely, the bottom five states, including Mississippi and California, display substantially lower tightness and wage growth. The percentile values in the lower panel further illustrate this relationship. Moving from the 10th percentile of labor market tightness (0.52) to the 90th percentile (0.94), average wage growth rises from 1.84 percent to 2.86 percent. The same upward trend is visible at intermediate points: the 25th percentile of tightness (0.56) is associated with wage growth of 1.96 percent, while the median (0.64) is associated with 2.20 percent, and the 75th percentile (0.82) with 2.38 percent wage growth. Thus, wage growth appears to increase systematically with tighter labor markets. Overall, the summary statistics point to sizable cross-state variation in both measures: labor market tightness ranges from about 0.5 to above 1 in the tails of the distribution on average over the time sample considered, while wage growth spans from below 2 percent to nearly 3.5 percent. The positive association between tightness and wage growth in the percentiles, alongside the patterns observed for the top and bottom states, underscores the link between labor demand conditions and wage dynamics across the United States.

While the table is informative, we complement it with two map plots that visualize the full distribution of average labor market tightness and wage growth across U.S. states, see Figure 2.[3] These graphical representations reinforce the observed pattern: states experiencing higher labor market tightness tend to exhibit, on average, stronger wage growth over the sample period. This spatial perspective further highlights the regional disparities in labor market conditions and wage dynamics. Additionally, in Appendix B, we provide a map of state-level unemployment rates, see Figure B.2, which further supports these findings: states with higher labor market tightness and stronger wage growth also tend to have lower unemployment rates.

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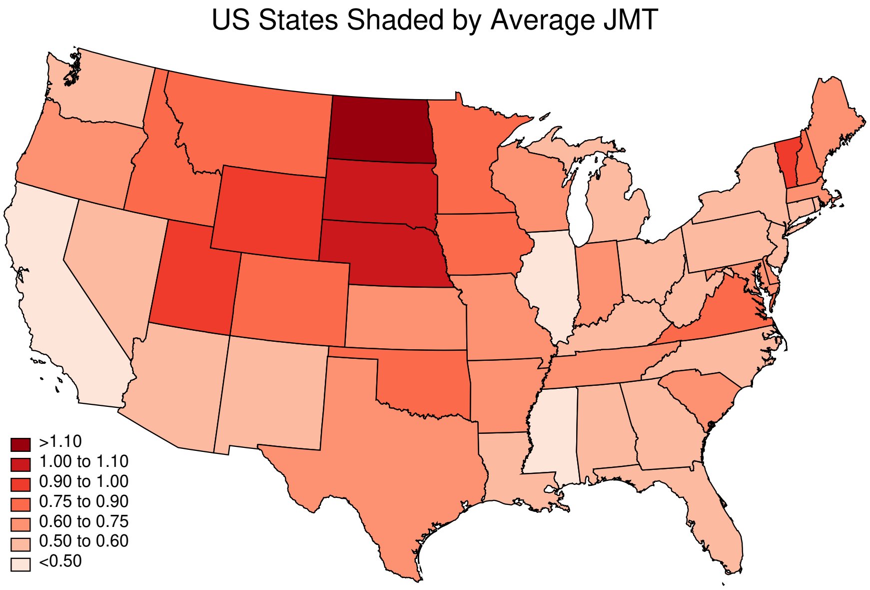
[3] In Appendix B, we further report state-level time series of labor market tightness (V/U) for a set of representative states spanning different regions and average tightness levels (see Figure B.1). These plots illustrate the magnitude and persistence of within-state fluctuations in tightness over the sample period.

Table 1: Average Labor Market Tightness and Average Wage Growth for All US States

State	**Labor Market Tightness**	**Wage Growth**
Top 5 States:		
North Dakota	1.43	3.38
South Dakota	1.02	2.98
Nebraska	1.00	2.22
Vermont	0.99	2.06
Utah	0.98	2.12
Bottom 5 States:		
Mississippi	0.44	2.39
California	0.46	2.35
Illinois	0.49	1.96
Connecticut	0.50	1.84
Michigan	0.50	1.80
Summary Stats:		
Tenth percentile	0.52	1.84
Twenty-fifth percentile	0.56	1.96
Median	0.64	2.20
Seventy-fifth percentile	0.82	2.38
Ninetieth percentile	0.94	2.86
Mean	0.70	2.26
Standard deviation	0.19	0.39

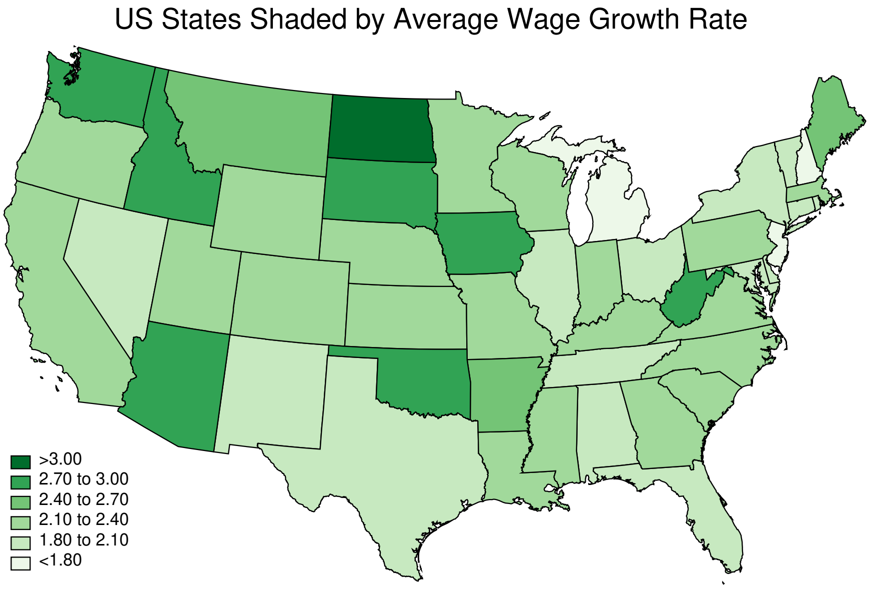
Notes: The table reports average labor market tightness and average annual nominal wage growth for all U.S. states in our sample period. The upper panel lists the five states with the highest and lowest average tightness. The lower panel provides summary statistics for the distribution of both variables across all states. Labor market tightness is defined as the ratio of job openings to unemployed workers. Wage growth is measured as the average annual change in nominal hourly wages. All statistics are computed over the full sample period.

To summarize the joint relationship between labor market tightness and wage growth across all state-quarter observations, Figure 3 presents a binscatter of four-quarter nominal wage growth against log labor market tightness. Observations are grouped into 100 equal-frequency bins to smooth idiosyncratic noise while providing a nonparametric visualization of the relationship. The binscatter shows a clear positive association between four-quarter nominal wage growth and log labor market tightness, with the slope steepening around log tightness equal to zero (corresponding to a vacancy-to-unemployment ratio of one). States and



US States Shaded by Average JMT

(a) Average Job Market Tightness (JMT) Across U.S. States.



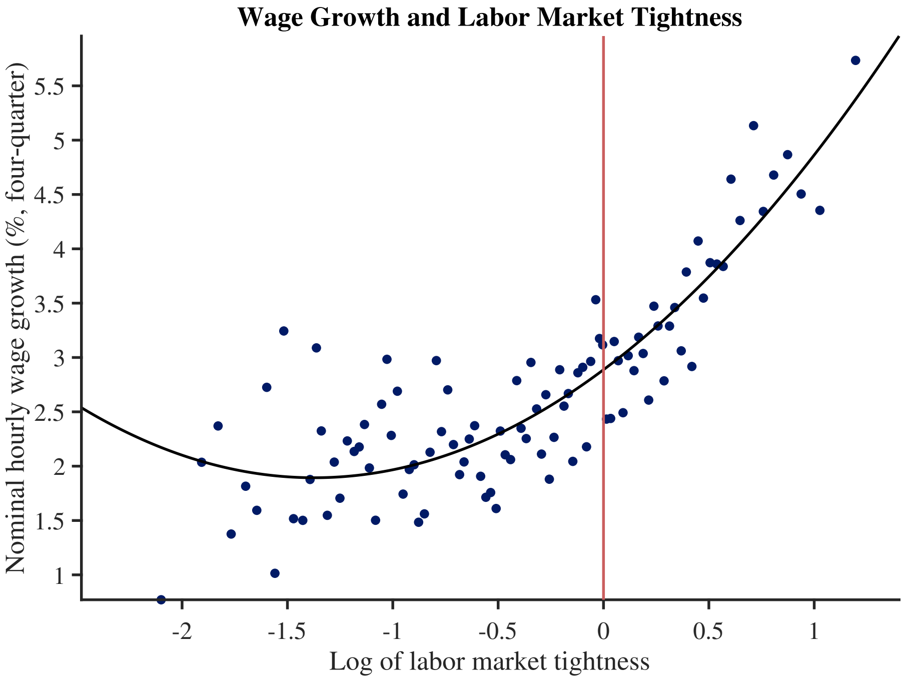
US States Shaded by Average Wage Growth Rate

(b) Average Wage Growth Across U.S. States.

Figure 2: Geographic Variation in Labor Market Tightness and Wage Growth Across U.S. States

Notes: This figure illustrates the average labor market conditions across U.S. states over the sample period. Panel (a) shows the average value of job market tightness (JMT), calculated as the ratio of job openings to unemployed persons, and averaged over time. Higher values reflect tighter labor markets. Panel (b) displays the average annual growth rate of nominal hourly wages by state. All state-level values are computed from quarterly data and averaged over the full sample period.

Figure 3: State-Level Wage Growth and Labor Market Tightness



Notes: The figure plots a binscatter of four-quarter nominal wage growth against log labor market tightness. Observations are grouped into 100 equal-frequency bins based on the distribution of log tightness, and the figure plots the mean wage growth against the mean log tightness within each bin. The solid curve corresponds to a quadratic regression in which four-quarter nominal wage growth is regressed on log labor market tightness and its square. The quadratic term in log tightness is positive and highly statistically significant ($p < 0.001$), indicating a convex relationship between wage growth and labor market tightness.

periods characterized by tighter labor markets tend to exhibit higher wage growth, consistent with the patterns documented in Table 1 and the maps in Figure 2. The fitted quadratic curve closely tracks the binned means and indicates a nonlinear (convex) relationship: wage growth increases gradually at lower levels of tightness and more strongly as labor markets become tighter, in line with the evidence on inflation in Benigno and Eggertsson (2023) and Gitti (2025). The smooth progression across bins indicates that the pattern is not driven by a small number of extreme observations but reflects broad-based variation in labor market conditions across states and over time. This dispersion in tightness – both across states at a given date and within states over time – provides the variation we exploit in the next section to estimate the differential effects of monetary policy shocks across labor market conditions.

3.2 Monetary policy shocks

The monetary policy instrument we use is the series constructed by Bauer and Swanson (2023). Their series covers FOMC announcements from 1988 to 2023 and is based on high-frequency changes in the first four quarterly Eurodollar futures contracts (ED1–ED4) within a narrow 30-minute event window around each FOMC announcement (from 10 minutes before to 20 minutes after the press release). The first principal component of the ED1–ED4 changes is extracted and rescaled so that a one-unit change corresponds to a one percentage point change in the ED4 rate. The series is then orthogonalized with respect to a set of macroeconomic and financial variables, including nonfarm payroll surprises, employment growth, the S&P500 index, the slope of the yield curve, commodity prices, and Treasury skewness, ensuring that it captures the unexpected component of monetary policy decisions.

In our empirical analysis, we use this orthogonalized instrument at the monthly frequency and aggregate it to the quarterly level by a simple time-series sum. No further adjustments or modifications are made, so our quarterly instrument is directly derived from their monthly series. Nonetheless, as a robustness check, we also use in Section 5 the monetary policy shock measure of Jarociński and Karadi (2020), which is based on high-frequency changes in 3-month Federal Funds futures (FF4) rather than Eurodollar futures as in our baseline measure.

4 Wage responses to monetary policy shocks

In this section, we use the granularity of state-level data to estimate how monetary policy shocks affect wage dynamics. We employ a panel local projection instrumental variable (LP–IV) approach to trace the dynamic response of wages to high-frequency-identified monetary shocks. We begin by estimating the average wage response across states, providing a benchmark for our subsequent analysis. We then allow the response to vary with lagged labor market tightness and with the sign of the monetary shock, enabling us to assess both state dependence and asymmetry in transmission. This strategy exploits the fact that the same *national* monetary policy shock is transmitted through *heterogeneous* state-level labor market conditions, allowing us to identify how tightness shapes the wage response. Our design therefore resembles a difference-in-transmission approach: identical aggregate shocks allow us to identify differences in how monetary policy propagates across local labor markets with different initial conditions.

This interpretation relies on two standard assumptions in regional identification frameworks. First, because the monetary policy shock is constructed from high-frequency financial market data around FOMC announcements, it is plausibly exogenous to contemporaneous state-level wage dynamics. Second, cross-state differences in lagged labor market tightness are predetermined with respect to the national shock at the quarterly frequency, so that tightness can be treated as a conditioning state variable rather than an outcome of the shock itself.[4] In Section 5, we verify this assumption by re-estimating all nonlinear specifications using tighter timing restrictions, measuring tightness two to three quarters prior to the shock; the results remain unchanged. Under these assumptions, heterogeneity in tightness allows us to trace how identical national monetary shocks propagate through local labor markets with different initial conditions.[5] The remainder of this section proceeds accordingly.

4.1 Average Wage Responses to Monetary Policy

We begin our analysis by examining the *average* wage response to a monetary policy shock across U.S. states. This specification provides a benchmark against which the nonlinear,

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[4] As a robustness check, we re-estimate all nonlinear specifications using tighter timing restrictions – specifically, using tightness lagged by two to three quarters. The results are nearly identical, confirming that our state-dependence findings are not sensitive to alternative timing assumptions.

[5] As an additional robustness exercise, we also examine whether our results depend on the assumed size of the monetary policy shock by implementing the δ-modified local projection approach of Gonçalves et al. (2021), which allows impulse responses to be evaluated for different shock magnitudes.

state-dependent patterns documented later in Section 4.2 can be evaluated. At this stage, the response is restricted to be the same across states and independent of both local labor market tightness and the sign of the shock, allowing us to quantify the unconditional pass-through of monetary policy to wages before introducing heterogeneity.

Following Jordà (2005), we regress the cumulative change in log nominal hourly wages in state i over h quarters on the interest rate measure instrumented with the monetary policy shock:

$$\Delta_h w_{i,t+h} = \alpha_{i,h} + \beta_h \Delta\widehat{i_t} + \sum_{p=1}^{n} \Gamma_{i,h} \mathbf{X}_{i,t-p} + \eta_{i,t+h}, \tag{1}$$

where $j = 0, \ldots, H$, $\Delta_h w_{i,t+h} = w_{i,t+h} - w_{i,t-1}$ is the cumulative change in log nominal hourly wages (in percent) from quarter $t-1$ to $t+h$ in state i. The term $\alpha_{i,h}$ captures time-invariant unobserved differences at the state level, and $\Delta\widehat{i_t}$ represents the fitted value of the interest rate change from the first-stage regression, namely the component explained by the monetary policy instrument. The vector $\mathbf{X}_{i,t}$ is a set of controls which consists of lagged values of the dependent variable, the monetary policy shock, and a set of state-level controls (Employment Rate, Labor Market Tightness, Real Disposable Income, Working Population, and Net Migration Rates). The inclusion of these state-level controls is important for identification. Employment rates, disposable income, demographic composition, and migration are all likely to matter for wage growth. By conditioning on these variables, our subsequent main analysis isolates how exogenous national monetary shocks propagate through local labor markets with different degrees of tightness, rather than capturing differential exposure to underlying regional demand or supply trends. We set the benchmark horizon to $H = 8$ quarters and include four lags for each lagged variable, covering one year of data. β_h is our object of interest: the cumulative impulse response of wage growth to a monetary policy shock.

Table 2 reports the results from both stages of the estimation. Panel (a) presents the first-stage relationship between the monetary policy instrument and the change in the nominal interest rate, both without and with controls. The instrument is positively and statistically significantly related to changes in the short-term rate in both specifications. The associated first-stage F-statistics are 13.84 and 13.99, both above the conventional threshold of 10, indicating that the instrument is sufficiently strong. These results confirm that high-frequency monetary policy surprises provide meaningful variation in interest rates suitable for identification. Importantly, this first-stage specification is maintained throughout the subsequent analysis, including the sign- and state-dependent extensions, ensuring that all estimated effects are identified using the same source of exogenous monetary policy variation.

Panel (b) of Table 2 presents the estimated coefficients from the linear local projection in Equation (1). Consistent with the literature, our results show that a contractionary monetary policy shock – corresponding to a 100 basis point increase in the interest rate – leads to a statistically significant decrease in nominal wages across all horizons considered. Specifically, at $h = 0$, wages fall by 0.28 percent, and the response increases to 0.78 and 0.87 percent at horizons $h = 4$ and $h = 8$, respectively. That the magnitude of the estimate increases with time, indicates that monetary policy shocks have persistent impacts on nominal wage dynamics.

4.2 State-Dependent Wage Responses: Tightness, Sign, and Their Interaction

We now examine whether the transmission of monetary policy to wages varies with labor market conditions or with the sign of the shock. Motivated by the mechanisms discussed earlier, we allow the wage response to depend on lagged labor market tightness, on whether the shock is expansionary or contractionary, and on the interaction of these two forces. To do so, we estimate three panel LP–IV specifications. First, we interact the instrumented interest

Table 2: Average Wage Responses to Monetary Policy Shocks

Panel (a): First-stage relationship between change in short rates and the instrument

Δi_t	No controls	With controls
	(1)	(2)
z_t (instrument)	**0.016*****	**0.017*****
	(0.004)	(0.004)
F-statistic	13.84	13.99

Panel (b): Effects of Monetary Policy Shock on Nominal Wages

	$h = 0$	$h = 4$	$h = 8$
$\widehat{\Delta i_t}$	**-0.28****	**-0.78*****	**-0.87*****
	(0.12)	(0.24)	(0.30)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: Panel (a) reports the first-stage relationship between changes in short-term interest rates and the monetary policy instrument. Panel (b) reports the estimated cumulative effects of a standard monetary policy shock on nominal hourly wages at horizons $h = 0, 4$, and 8, based on local projection regressions. The dependent variable is the cumulative change in nominal hourly wages over the respective horizon. Monetary policy shocks are identified using high-frequency surprises around policy announcements, following Bauer and Swanson (2023). Estimates are based on local projection regressions as specified in Equation 1, and all specifications include standard macroeconomic and labor market controls. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

rate with our measure of state-level labor market tightness measured at $t - 1$. Second, we estimate separate responses for contractionary and expansionary monetary policy shocks. Third, we interact lagged tightness with the sign of the shock, allowing both dimensions of nonlinearity to operate simultaneously. These specifications allow us to test whether wage responses vary systematically across labor market states, across shock types, and through their interaction.

4.2.1 Labor Market Tightness and Wage Response to Monetary Policy Shocks

The first specification explores how labor market tightness (LMT) influences the wage response to monetary policy shocks. This is motivated by the hypothesis that labor scarcity amplifies the impact of demand shocks, such as monetary policy, leading to disproportionate effects when LMT is high. To test this hypothesis, we extend Equation (1) by introducing an interaction term between the instrumented interest rate at time t and the state-level, time-varying measure of labor market tightness at time $t-1$:

$$\Delta_h w_{i,t+h} = \alpha_{i,h} + \beta_{1,h} \Delta\widehat{i_t} + \beta_{2,h} \left(\Delta\widehat{i_t} \times LMT_{i,t-1}\right) + \sum_{p=1}^{n} \Gamma_{i,h} \mathbf{X}_{i,t-p} + \sum_{p=1}^{n} \Lambda_{i,h} \mathbf{X}_{i,t-p} \times LMT_{i,t-1} + \eta_{i,t+h}, \tag{2}$$

where $LMT_{i,t-1}$ denotes the logarithm of the vacancy-to-unemployment ratio in state i at time $t-1$. The coefficient $\beta_{2,h}$ captures how labor market tightness modifies the effect of monetary policy shocks on wages. The vector $\mathbf{X}_{i,t}$ corresponds to the same set of controls used in Equation (1). We also include the controls interacted with labor market tightness, $\mathbf{X}_{i,t-p} \times LMT_{i,t-1}$, allowing their effects to vary with tightness. Since $\mathbf{X}_{i,t-p}$ includes lags of labor market tightness itself, this specification controls for the persistence of labor market conditions and their direct effects on wage dynamics. This ensures that $\beta_{2,h}$ reflects the differential impact of monetary policy rather than variation in the controls across labor market conditions. In the robustness section, we replace $LMT_{i,t-1}$ with $LMT_{i,t-2}$ and $LMT_{i,t-3}$ in the interaction terms to address potential concerns that monetary policy shocks may themselves influence contemporaneous labor market tightness.

Table 3 presents the estimated effects of a standard monetary policy shock and its interaction with labor market tightness on nominal hourly wages. The direct effect of the shock (MP shock) is small, reaching statistical significance only at $h = 4$ (-0.68), while it is essentially zero at $h = 0$ (0.03) and not significant at $h = 8$ (-0.47). In contrast, the interaction between the shock and LMT exhibits a strong, statistically significant effect at longer horizons: -1.15 percent at $h = 4$ and -2.07 percent at $h = 8$. This indicates that wage responses are amplified in tighter labor markets. For example, at $h = 8$, the interaction coefficient implies that a one-unit increase in log labor market tightness amplifies the wage decline by an additional

Table 3: Standard Monetary policy shock interacted with LMT

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t}$	0.03	**-0.68****	-0.47
	(0.15)	(0.29)	(0.35)
$\Delta\widehat{i_t} \times LMT_{i,t-1}$	0.30	**-1.15*****	**-2.07*****
	(0.20)	(0.39)	(0.48)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table presents the estimated effects of a standard monetary policy shock and its interaction with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0, 4,$ and 8. The dependent variable is the cumulative change in nominal hourly wages over the respective horizon. The shock is identified using high-frequency monetary policy surprises, as in Bauer and Swanson (2023). The interaction term captures state dependence in the transmission of monetary policy across local labor market conditions. All regressions are estimated using the local projection method specified in Equation 2 and include standard control variables. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

2.07 percentage points. Thus, in relatively tight labor markets (e.g., $LMT = 0.5$ based on Figure 3), the implied wage response is approximately -1.5 percent, substantially larger than the baseline effect of -0.47 percent observed when $LMT = 0$. These results highlight the critical role of labor scarcity in shaping wage responses to monetary policy.

4.2.2 Asymmetries in Wage Responses to Monetary Policy Shocks

The second specification focuses on potential asymmetries in the wage response to contractionary versus expansionary monetary policy shocks. This addresses the conjecture that downward nominal wage rigidity may result in differential effects of monetary policy depending on the sign of the shock. To this end, we estimate the following regression:

$$\Delta_h w_{i,t+h} = \alpha_{i,h} + \beta_h^+ \Delta\widehat{i_t^+} + \beta_h^- \Delta\widehat{i_t^-} + \sum_{p=1}^{n} \Gamma_{i,h} \mathbf{X}_{i,t-p} + \eta_{i,t+h}, \tag{3}$$

Table 4: Monetary policy shock by type

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i}_t^{+}$	-0.38	-0.18	0.89
	(0.25)	(0.56)	(0.73)
$\Delta\widehat{i}_t^{-}$	0.18	**1.04*****	**1.90*****
	(0.18)	(0.34)	(0.40)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table reports the estimated effects of contractionary and expansionary monetary policy shocks on nominal hourly wages at horizons $h = 0, 4$, and 8, using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following the approach in Bauer and Swanson (2023). All specifications include standard macroeconomic and labor market controls and are based on Equation 3. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

where $I(\Delta\widehat{i}_t > 0)$ is an indicator variable equal to one for contractionary shocks and zero otherwise, $\Delta\widehat{i}_t^{+} = \Delta\widehat{i}_t \times I(\Delta\widehat{i}_t > 0)$ and $\Delta\widehat{i}_t^{-} = \Delta\widehat{i}_t \times I(\Delta\widehat{i}_t < 0)$. Again, the vector $\mathbf{X}_{i,t}$ corresponds to the same set of controls used in Equation (1), and we include the controls interacted with the indicator variables $I(\Delta\widehat{i}_t > 0)$ and $I(\Delta\widehat{i}_t < 0)$, allowing their effects to vary with the sign of the shock. Using these definitions, β_h^{+} and β_h^{-} measure the cumulative effects of contractionary and expansionary monetary policy shocks on wages, respectively.

We observe significant sign-asymmetries in wage responses to expansionary versus contractionary shocks. Table 4 demonstrates that expansionary shocks lead to a significant increase in wages, particularly noticeable at $h = 8$ (with a coefficient of 1.90, significant at the 1% level). On the other hand, contractionary shocks show no significant effect on wages at any horizon. This result suggests that monetary policy's effect on wages is not symmetric and that wage responses are more pronounced during expansionary phases, supporting the hypothesis of downward nominal wage rigidity.

4.2.3 Interaction of Sign Effects and Labor Market Tightness

The third specification integrates the first two approaches to examine whether labor market tightness amplifies the asymmetry in wage responses to monetary policy shocks. To do so, we extend Equation (3) by including interaction terms between labor market tightness and the sign-specific components of monetary policy shocks:

$$\begin{aligned}\Delta_h w_{i,t+h} = \alpha_{i,h} &+ \beta^{+}_{1,h}\Delta\widehat{i_t^{+}} + \beta^{+}_{2,h}\big(\Delta\widehat{i_t^{+}} \times LMT_{i,t-1}\big)\\ &+ \beta^{-}_{1,h}\Delta\widehat{i_t^{-}} + \beta^{-}_{2,h}\big(\Delta\widehat{i_t^{-}} \times LMT_{i,t-1}\big)\\ &+ \sum_{p=1}^{n}\Gamma_{i,h}, \mathbf{X}_{i,t-p} + \sum_{p=1}^{n}\Lambda_{i,h}\mathbf{X}_{i,t-p} \times LMT_{i,t-1} + \eta_{i,t+h}.\end{aligned} \tag{4}$$

This formulation allows us to test whether labor scarcity magnifies the asymmetries in wage responses to positive and negative monetary policy shocks.

Table 5 shows that labor market tightness significantly enhances the transmission of expansionary monetary policy shocks. The interaction between expansionary shocks and labor market tightness is positive and statistically significant. At $h = 8$, the interaction coefficient equals 2.81, implying that the wage response to an expansionary monetary policy shock becomes substantially larger as labor markets tighten. The interaction is economically meaningful and indicates that the effects of expansionary monetary policy increase systematically with labor market tightness. This interaction is particularly pronounced at medium and longer horizons ($h = 4$ and $h = 8$), reinforcing the notion that a tight labor market amplifies the impact of monetary policy on wage growth.

Overall, our results suggest that the transmission of monetary policy to wages is conditional on both the sign of the shock and labor market tightness. Expansionary monetary policy shocks lead to stronger wage growth, especially in tighter labor markets. In contrast, contractionary monetary policy shocks appear to have a negligible effect on wages. The interaction of these factors provides valuable insights into the mechanisms through which

Table 5: Expansionary and contractionary monetary policy shocks × LMT

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t^+}$	-0.81***	-0.87	-0.03
	(0.30)	(0.66)	(0.87)
$\Delta\widehat{i_t^-}$	-0.56**	0.64	0.82*
	(0.22)	(0.45)	(0.47)
$\Delta\widehat{i_t^+} \times LMT_{i,t-1}$	-0.66	-0.94	0.96
	(0.43)	(0.88)	(1.08)
$\Delta\widehat{i_t^-} \times LMT_{i,t-1}$	-0.85**	**1.62*****	**2.81*****
	(0.34)	(0.59)	(0.73)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

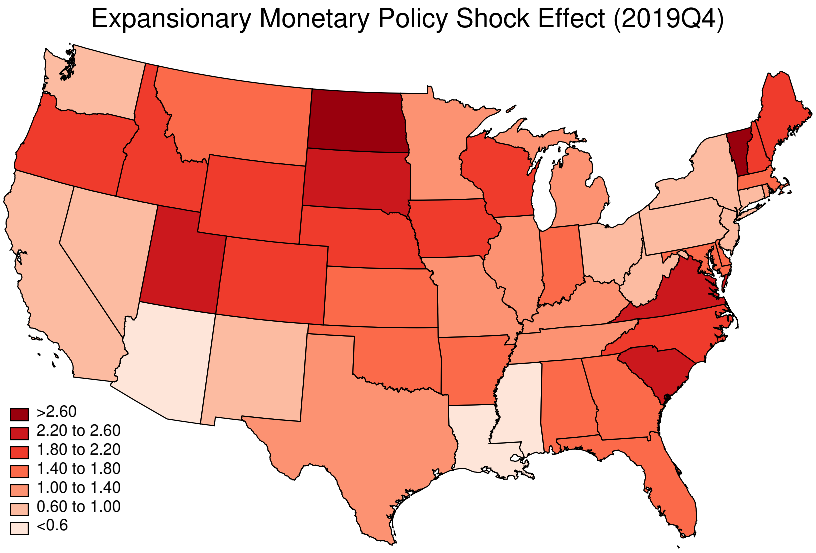
Notes: This table reports the effects of contractionary and expansionary monetary policy shocks and their interactions with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0$, 4, and 8, estimated using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following Bauer and Swanson (2023). The interaction terms capture potential state dependence in the transmission of monetary policy across local labor market conditions. All regressions include standard control variables and follow the specification in Equation 4. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

monetary policy affects wage dynamics and underscores the importance of labor market conditions in shaping these outcomes.

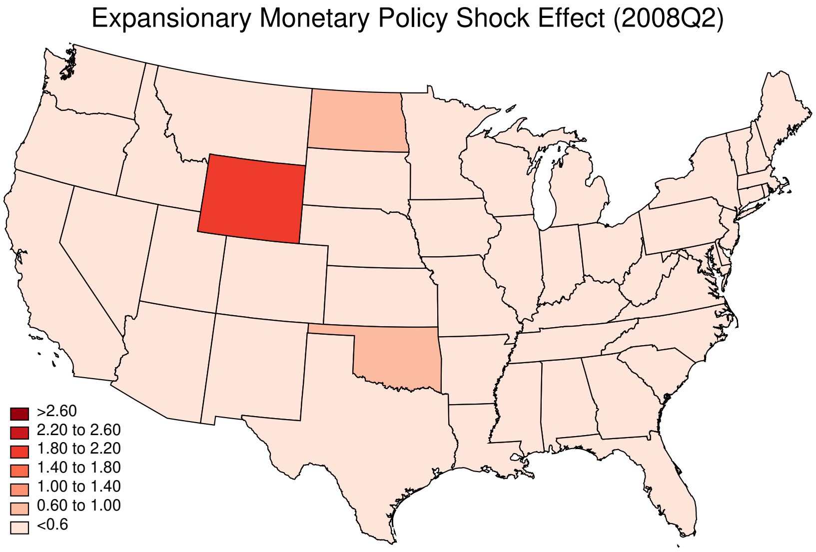
Importantly, downward nominal wage rigidity alone cannot account for the patterns we document. Rigidity predicts muted wage declines following contractionary shocks, consistent with our findings. However, it does not imply that expansionary wage responses should vary strongly with labor market tightness. Our results show that tightness governs the strength of wage amplification during expansions, while rigidity constrains adjustment during contractions. Nonlinear monetary transmission therefore arises from the interaction between labor market scarcity and asymmetric wage adjustment, rather than from either of the two mechanisms alone.

We summarize the main findings on the interaction between labor market tightness and

Figure 4: State-Level Wage Response to Expansionary Monetary Policy Shock



(a) Expansionary monetary policy shock in 2019Q4



(b) Expansionary monetary policy shock in 2008Q2

Notes: This figure shows the estimated regional responses to an expansionary monetary policy shock at the two-year horizon for different quarters. Panel (a) displays the effect in 2019Q4; Panel (b) shows the effect in 2008Q2. The estimates are based on local projection regressions using high-frequency identified monetary policy shocks, following Bauer and Swanson (2023). The dependent variable is the cumulative change in nominal hourly wages. Responses are aggregated at the state level and color bins reflect the magnitude of the cumulative wage response in percentage points. All specifications control for macroeconomic and labor market variables, as described in Section 4.

the sign-dependence of monetary policy shocks through a thought exercise. Specifically, we consider two distinct periods: one characterized by high labor market tightness (2019Q4) and another by low labor market tightness (2008Q2).[6] We then evaluate the effects of a monetary policy shock on a state-by-state basis, visualizing the results in a map plot (see Figure 4). In line with the findings from Table 5, we observe that during periods of high labor market tightness, expansionary monetary policy substantially increases wages across states. In contrast, during periods of low tightness, the effects are small and statistically insignificant for almost all states. This comparison further underscores how underlying labor market conditions shape the transmission of monetary policy to wages.

To further illustrate this mechanism, we also plot the impulse responses of wages to expansionary and contractionary monetary policy shocks at different levels of labor market tightness. Specifically, we evaluate the responses at the median level of tightness and at the 95th percentile (Figure 5). The results clearly reinforce our main finding. Following an expansionary shock, wages increase substantially when labor markets are very tight compared with the response at the median level of tightness. By contrast, contractionary shocks produce no clear pattern in wage responses across levels of labor market tightness.

5 Robustness and Sensitivity Checks

We perform a battery of robustness checks to our main results. For clarity of exposition, we include all the tables related to this section in Appendix C.

State-by-State analysis - We relax the restriction of homogeneous slope coefficients across states, which has been questioned in the literature (e.g., Pesaran and Smith (1995); Pesaran

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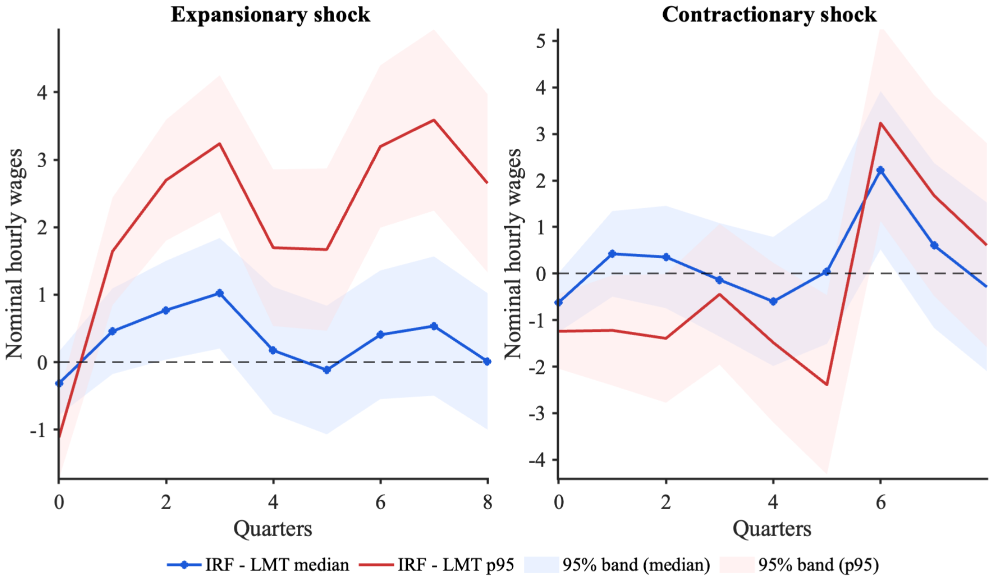
[6] Wyoming appears as an outlier in Figure 4b because its labor market was unusually tight in 2008Q2. The state's unemployment rate averaged about 2.7%, compared with roughly 5.3% nationally. This reflected strong labor demand in mining and energy sectors, which sustained hiring and kept vacancies high relative to unemployment, delaying the local downturn during the early phase of the Great Recession.



Notes: Impulse responses of wages to expansionary and contractionary monetary policy shocks at different levels of labor market tightness. The red solid line and red shaded bands correspond to the 95th percentile of labor market tightness, while the blue dotted line and blue shaded bands correspond to the median. Shaded areas represent 95% confidence bands.

Figure 5: Impulse responses to expansionary and contractionary monetary policy shocks

et al. (1999)). While our baseline specification allows for heterogeneity through state fixed effects and interactions with labor market tightness, it imposes common coefficients on other covariates. To assess the sensitivity of our results, we estimate separate regressions for each state and group states into four equally sized quartiles based on labor market tightness. For each quartile, we report the mean group estimator of Pesaran et al. (1999). Results are presented in Table C.1. Our main conclusions are unaffected.

Delta Modification - We estimate nonlinear impulse responses following the modified local projection approach proposed by Gonçalves et al. (2021), which addresses the inconsistency of standard LPs when the shock enters the model through a nonlinear transformation. Standard local projections may fail to recover the correct causal impulse response when the shock enters the regression through nonlinear transformations – such as sign splits or interaction terms – because a structural perturbation of the shock also changes these nonlinear components. Conventional implementations treat the transformed terms as separate regressors whose values are effectively held fixed and do not account for this mechanical adjustment when constructing impulse responses. The delta method defines the impulse response as the local (derivative) effect of the structural shock while allowing all nonlinear functions of the shock to adjust consistently. This approach is particularly suited to settings with sign- and state-dependent dynamics, such as those arising from censoring or interaction terms. In our implementation, we allow the response to vary nonlinearly with the size and sign of the monetary policy shock, and with the level of labor market tightness. The modified estimator accounts for how the nonlinear component of the shock changes following an intervention, while preserving consistency under minimal assumptions. We evaluate the impulse responses at $\delta = 0.25$ and $\delta = 1$, corresponding to 25 and 100 basis point shocks, in Panels A and B of Table C.2, respectively. While the interpretation of the coefficients naturally differs across these shock sizes, the results are very similar and scale approximately proportionally. In particular, the estimates for $\delta = 1$ closely match our baseline specification, indicating that the magnitude of the assumed shock does not materially affect our conclusions. Additional details on the methodology are provided in Appendix C.2.

Alternative state variables – To ensure that our state-dependent specification is not affected by endogeneity arising from the interaction between monetary policy shocks and labor market tightness, we also estimate a version of equations (2) and (4) in which the labor market tightness measure enters at $t-2$ and $t-3$ rather than $t-1$. This addresses the concern that monetary policy shocks may themselves influence labor market tightness within a short horizon, which would compromise the predeterminedness of the state variable in the baseline interaction design. By using lagged measures of tightness that clearly precede the monetary policy shock, we isolate the effect of the shock from any contemporaneous feedback into labor market conditions. We report the results under these alternative assumptions in Tables C.3-C.6. The results are robust to this alternative timing: the qualitative patterns remain unchanged, and although the estimated effects are slightly smaller in magnitude, they remain large and statistically significant.

Alternative monetary policy shock – We use the shock series of Jarociński and Karadi (2020), which disentangles monetary policy surprises from central bank information effects using high-frequency co-movements of interest rates and stock prices around FOMC announcements. Surprises are constructed using changes measured in a narrow 30-minute window, from 10 minutes before to 20 minutes after the press release. Specifically, their identification relies on changes in 3-month federal funds futures (FF4) and the S&P500 index within this window to separate policy shocks from information effects. Our main findings remain robust when employing this alternative monetary policy shock measure. Full results are reported in Table C.7, Table C.8, and Table C.9, respectively.

Controlling for inflation perceptions and expectations – We further address the potential concern that our monetary policy shock may partly reflect the systematic component of policy by augmenting the local projection specifications with professional forecasters' inflation perceptions and one-year-ahead inflation expectations from the Survey of Professional Forecasters (SPF) provided by the Federal Reserve Bank of Philadelphia. These variables proxy for the information set relevant to monetary policy decisions and absorb anticipated inflationary pressures to which the central bank may respond endogenously. Including both current inflation perceptions and expected inflation over the following year helps distinguish the wage effects of monetary policy shocks from predictable policy movements associated with inflation developments. Our results are robust to this additional set of controls: if anything, the estimated effects of expansionary monetary policy shocks on wages become stronger, particularly in tighter labor markets (see Table C.10, Table C.11, and Table C.12). This reinforces the interpretation that our baseline estimates capture the causal effect of monetary policy shocks rather than the systematic response of policy to perceived or expected inflation.

Including the labor force participation rate – Following Graves et al. (2023), we additionally control for the state-level labor force participation rate in our local projection regressions. Including participation helps capture an important margin of workers' responses to economic conditions – namely, individuals' decisions to enter or exit the labor force – which affects the composition of employed and unemployed workers and can influence measured labor-market tightness. By accounting for this adjustment margin, we ensure that our state-dependent estimates are not driven by changes in participation. Our main results remain essentially unchanged when including this control. Full results are reported in Table C.13, Table C.14, and Table C.15.

Including hires and separations – We additionally control for state-level hires and separations from the Quarterly Workforce Indicators (QWI) Explorer data produced by the U.S. Census Bureau. These variables capture worker flows into and out of employment, providing a measure of employment adjustment beyond the stock variables included in our baseline specification. Adding these controls is useful because wage dynamics may depend not only on employment levels or labor-market tightness, but also on the way firms adjust their workforce over the business cycle. Hires reflect job creation and transitions into new employment relationships, while separations capture quits, layoffs, and other employment exits. By accounting for these margins, we ensure that our estimated responses to monetary policy shocks are not driven by state-level hiring or separation dynamics. Our main results remain essentially unchanged when including these controls. Full results are reported in

Table C.16, Table C.17, and Table C.18.

Controlling for the level of the interest rate – A potential worry with our baseline specification is that using lags of the change in the interest rate implicitly imposes a particular dynamic structure – one in which only innovations in policy matter for wage dynamics – while omitting the potential role of the level of the interest rate itself. If the level of the policy rate captures slower-moving monetary conditions, excluding it could in principle bias the estimated response to the shock. To address this concern, we re-estimate the local projection regressions replacing lagged changes in the interest rate with lags of the level of the interest rate. The resulting impulse responses are nearly identical to those from our baseline specification, confirming that our findings are not sensitive to how monetary policy conditions are controlled for (see Tables C.19-C.21).

Excluding the post-pandemic period – Finally, we assess whether our results are driven by the exceptional dynamics of the post-pandemic period. To this end, we re-estimate our local projection specifications restricting the sample so that the final forecast horizon, H, does not extend beyond 2019:Q4. This ensures that all impulse responses are estimated using only pre-pandemic observations. While this restriction reduces the effective sample size, the results remain broadly in line with our baseline estimates using the full sample (see Table C.22, Table C.23 and Table C.24). Expansionary monetary policy shocks continue to raise wages strongly, with pass-through substantially larger in tight labor markets than in slack ones. This confirms that our main conclusions are not driven by the post-pandemic episode.

6 Conclusion

This paper studies how labor market tightness shapes the transmission of monetary policy to wages. Using high-frequency-identified monetary policy shocks and cross-state variation in labor market tightness, we provide direct evidence that wage responses are strongly nonlinear. Expansionary monetary policy raises wages substantially more in tight labor markets, whereas contractionary shocks generate little wage adjustment regardless of labor market conditions, consistent with downward nominal wage rigidity. Taken together, our findings document three dimensions of nonlinear wage adjustment: state dependence with respect to labor market tightness, pronounced sign asymmetry, and a strong interaction between the two. To our knowledge, these three dimensions of nonlinear wage adjustment have not previously been jointly identified and documented. Our results suggest that an important source of nonlinear monetary transmission operates at the wage-setting stage, which is likely to lie behind the recently documented nonlinearities in inflation dynamics.

Our findings have important implications for the conduct of monetary policy. When labor markets are exceptionally tight, monetary expansions are likely to generate disproportionately strong wage growth and inflationary pressure, whereas contractionary policy has much weaker effects on wages because downward nominal wage rigidity limits wage adjustment. The effectiveness of monetary policy therefore depends not only on the size of the policy intervention, but also on prevailing labor market conditions.

Our results also help interpret recent U.S. macroeconomic experience. Because wage pass-through is substantially stronger in tight labor markets, periods of unusually high tightness, such as 2021–2022, can generate unusually rapid wage growth for a given monetary policy impulse. Conversely, the muted response of wages to contractionary shocks implies that tightening cycles are likely to produce only gradual wage disinflation, which could explain why inflation remained persistent despite rapid increases in policy rates.

More broadly, our findings imply that the transmission of monetary policy is poorly summarized by a single average estimate. The effects of identical monetary policy actions on wages and inflation depend critically on prevailing labor market tightness. More generally, our results suggest that understanding monetary transmission requires understanding how labor market conditions shape wage adjustment before they are reflected in inflation.

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Appendix

A Data Description for State-Level Data

Wages: Average Hourly Earnings of All Employees: Total Private. Source: Federal Reserve Bank of St. Louis (FRED); U.S. Bureau of Labor Statistics (BLS) (U.S. Bureau of Labor Statistics (BLS) Series ID: SMUXX000000500000003).[7]

Employment Rate: Employment, (Ths). Source: U.S. Bureau of Labor Statistics (BLS): Local Area Unemployment Statistics (LAUS); Moody's Analytics (Moodys' Mnemonic: LBE.XX, U.S. Bureau of Labor Statistics (BLS) Series ID: LASSTXX0000000000005).

Real Disposable Income: Disposable personal income: Total, (Mil. Ch. 2017 USD, SAAR). Source: U.S. Bureau of Economic Analysis (BEA); Moody's Analytics (Moodys' Mnemonic: RYPDPI$Q.XX).

Working Population: Calulcated as the sum of the Population (Resident): Total - Age 20 to 64. Source: U.S. Census Bureau (BOC): Population Estimates, Projections; Moody's Analytics (Moodys' Mnemonic: RPOP2024Q.XX, RPOP2544Q.XX, RPOP4564Q.XX).

Net Migration Rates: Net migration, (Ths.). Source: U.S. Census Bureau (BOC): Population Estimates; U.S. National Center for Health Statistics; Moody's Analytics (Moodys' Mnemonic: RFNMQ.XX).

Unemployment: Unemployment, (Ths., SA). Source: U.S. Bureau of Labor Statistics (BLS): Local Area Unemployment Statistics (LAUS) (U.S. Bureau of Labor Statistics (BLS) Series ID = LASSTXX0000000000004).

Vacancies: Job Openings and Labor Turnover: Job openings - Total nonfarm, (Ths., SA).

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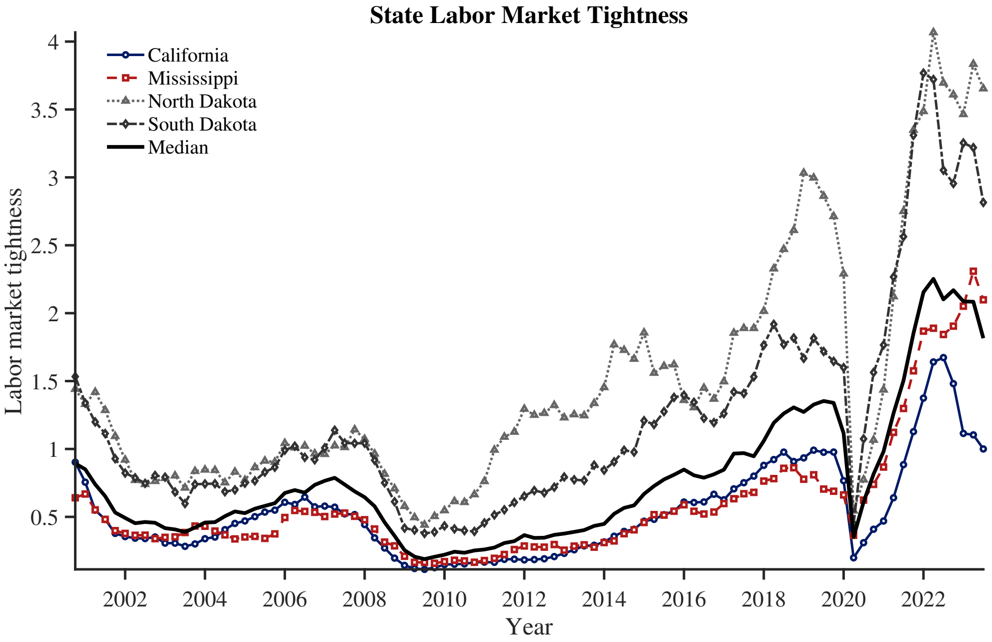
[7] XX denotes the two-digit U.S. state abbreviations as defined by the U.S. Bureau of Labor Statistics and Moody's Analytics database.

Source: U.S. Bureau of Labor Statistics (BLS): Job Openings and Labor Turnover Survey (JOLTS); Moody's Analytics (Moodys' Mnemonic: LBJJOM.XX, U.S. Bureau of Labor Statistics (BLS) Series ID: [JTS000000XX0000000JOL).

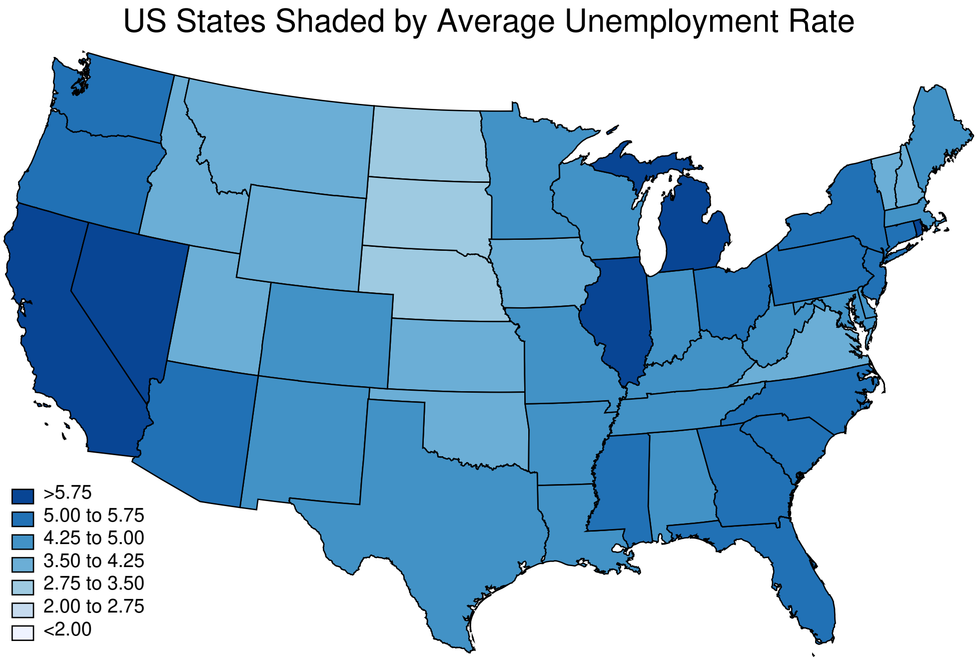
B Data plots

Figure B.1: State-Level Labor Market Tightness Across Selected U.S. States



Notes: The figure plots labor market tightness (vacancy-to-unemployment ratio, V/U) for selected U.S. states from 2007Q1 to 2023Q1. The black line shows the cross-sectional median across states at each date.

Figure B.2: State-Level Averages of Unemployment Rates Across the U.S.



Notes: This figure displays the average unemployment rate across U.S. states over the sample period. State-level averages are computed from monthly data and reflect the unadjusted headline unemployment rate. Darker shades correspond to higher average unemployment rates. All values are expressed in percentage points and reflect the full sample period used in the analysis.

C Robustness analysis

C.1 State-by-State analysis

For each State i, we estimate the following specification:

$$\Delta_h w_{i,t+h} = \alpha_{i,h} + \beta_h^+ \Delta\widehat{i_t^+} + \beta_h^- \Delta\widehat{i_t^-} + \sum_{p=1}^{n} \Gamma_{i,h} \mathbf{X}_{i,t-p} + \eta_{i,t+h}. \tag{5}$$

With N states and H horizons, this yields two $N \times H$ matrices capturing the response to contractionary and expansionary shocks. The mean group estimator for quartile q at horizon H is then computed as the cross-sectional average of the corresponding responses within that group as:

$$\beta_{q,H}^{Exp.} = \frac{1}{N_q} \sum_{j \in q} \beta_{j,h}^{-}$$

$$\beta_{q,H}^{Cont.} = \frac{1}{N_q} \sum_{j \in q} \beta_{j,h}^{+}$$

Table C.1: Mean Group Estimates by Labor Market Tightness Quartile

	Q1	**Q2**	**Q3**	**Q4**
Expansionary shock				
$h = 0$	0.54	**1.02*****	**1.02****	**0.72****
	(0.38)	(0.26)	(0.41)	(0.30)
$h = 4$	0.09	**2.39*****	1.21*	**1.79****
	(0.75)	(0.90)	(0.62)	(0.90)
$h = 8$	1.28	**4.87*****	**3.19*****	**4.57*****
	(0.79)	(0.92)	(0.91)	(0.99)
Contractionary shock				
$h = 0$	-0.33	0.56	-0.40	0.35
	(0.57)	(0.57)	(0.74)	(1.44)
$h = 4$	-3.18	-0.54	-1.97	-0.16
	(1.95)	(1.44)	(1.59)	(2.28)
$h = 8$	-2.19	1.29	0.83	3.81
	(1.95)	(1.60)	(2.36)	(3.13)

Notes: This table reports mean group estimates of the effects of expansionary and contractionary monetary policy shocks across quartiles of labor market tightness. States are grouped into quartiles according to average labor market tightness, and separate regressions are estimated for each state, allowing all coefficients to differ across states. Reported coefficients are the mean group estimates of Pesaran and Smith (1995). Standard errors are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

C.2 Delta Modification

Following Gonçalves et al. (2021), we adapt our estimation approach to account for nonlinearities arising from both sign and state dependence in the response to monetary policy shocks. In particular, we implement the so-called delta modification, which corrects the inconsistency of conventional local projections when the shock enters the regression through a nonlinear transformation (such as a positive-part operator).

Let MP_t denote the identified monetary policy shock. When the regression specification includes nonlinear functions of the shock, a structural perturbation of the shock by an amount δ mechanically changes these nonlinear terms. The delta modification therefore defines the impulse response as the expected change in the outcome when the shock increases from MP_t to $MP_t + \delta$, allowing all nonlinear transformations of the shock to adjust consistently.

Equation 3, which captures asymmetric responses to the sign of the shock, can then be written as, for a contractionary shock,

$$IRF^{LP}_{h,\delta} = \alpha_h \delta + \alpha^+_h \, \mathbb{E}\left[(MP_t + \delta)^+ - MP^+_t\right].$$

Similarly, Equation 4, which allows for both sign and state dependence, becomes

$$IRF^{LP}_{h,\delta} = \delta(\alpha_h + \beta_h LMT_{t-1}) + (\alpha^+_h + \beta^+_h LMT_{t-1}) \, \mathbb{E}\left[(MP_t + \delta)^+ - MP^+_t\right].$$

Rearranging terms highlights that the nonlinear impulse response consists of a sign-dependent and a state-dependent component:

$$\begin{aligned} IRF^{LP}_{h,\delta} = {} & \underbrace{\alpha_h \delta + \alpha^+_h \mathbb{E}\left[(MP_t + \delta)^+ - MP^+_t\right]}_{\text{Sign dependence}} \\ & + \underbrace{LMT_{t-1}\left[\beta_h \delta + \beta^+_h \mathbb{E}\left[(MP_t + \delta)^+ - MP^+_t\right]\right]}_{\text{State dependence}}. \end{aligned}$$

An analogous expression applies for an expansionary shock of size δ, which loads on the negative-part terms:

$$IRF^{LP}_{h,-\delta} = -\alpha_h \delta + \alpha^-_h \, \mathbb{E}\big[(MP_t - \delta)^- - MP^-_t\big]\,,$$

and, with state dependence,

$$IRF^{LP}_{h,-\delta} = -\delta(\alpha_h + \beta_h LMT_{t-1}) + (\alpha^-_h + \beta^-_h LMT_{t-1})\mathbb{E}\big[(MP_t - \delta)^- - MP^-_t\big]\,,$$

where $(x)^+ = \max(x, 0)$ and $(x)^- = \max(-x, 0)$. The table below reports the estimated coefficients from this delta-modified specification. We evaluate the impulse responses at $\delta = 0.25$, corresponding to a 25 basis point monetary policy shock, and $\delta = 1$, corresponding to a 100 basis point monetary policy shock.

Table C.2: Asymmetric effects of monetary policy, applying the δ-modification

	$h = 0$	$h = 4$	$h = 8$
Panel A: $\delta = 0.25$ **(25 basis points)**			
$\Delta\widehat{i}_t^+$	-0.20***	-0.21	-0.00
	(0.07)	(0.16)	(0.21)
$\Delta\widehat{i}_t^-$	-0.14**	0.16	0.20*
	(0.05)	(0.11)	(0.11)
$\Delta\widehat{i}_t^+ \times LMT_{i,t-1}$	-0.16	-0.23	0.23
	(0.10)	(0.21)	(0.27)
$\Delta\widehat{i}_t^- \times LMT_{i,t-1}$	**-0.21****	**0.41*****	**0.70*****
	(0.08)	(0.14)	(0.18)
Panel B: $\delta = 1$ **(100 basis points)**			
$\Delta\widehat{i}_t^+$	-0.81***	-0.86	-0.02
	(0.30)	(0.66)	(0.86)
$\Delta\widehat{i}_t^-$	-0.56**	0.64	0.82*
	(0.22)	(0.44)	(0.47)
$\Delta\widehat{i}_t^+ \times LMT_{i,t-1}$	-0.65	-0.94	0.95
	(0.43)	(0.87)	(1.00)
$\Delta\widehat{i}_t^- \times LMT_{i,t-1}$	**-0.84****	**1.62*****	**2.80*****
	(0.33)	(0.58)	(0.73)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table reports estimated coefficients from the delta-modified local projection specification of Gonçalves et al. (2021). Panel A evaluates impulse responses for $\delta = 0.25$ (25 basis points) and Panel B for $\delta = 1$ (100 basis points). The estimates allow for sign- and state-dependent effects of monetary policy shocks on nominal hourly wages. The regression includes the same controls as the baseline specification of equation (4). *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

C.3 Alternative State Variable

Table C.3: Monetary policy shock × LMT_{t-2}

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t}$	-0.02	**-0.62****	-0.19
	(0.15)	(0.31)	(0.37)
$\Delta\widehat{i_t} \times LMT_{i,t-2}$	0.25	**-1.11****	**-1.88*****
	(0.21)	(0.40)	(0.48)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table presents the estimated effects of a standard monetary policy shock and its interaction with labor market tightness (LMT_{t-2}) on nominal hourly wages at horizons $h = 0$, 4, and 8. The dependent variable is the cumulative change in nominal hourly wages over the respective horizon. The shock is identified using high-frequency monetary policy surprises, as in Bauer and Swanson (2023). The interaction term captures state dependence in the transmission of monetary policy across local labor market conditions. All regressions are estimated using the local projection method specified in Equation 2 and include standard control variables. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table C.4: Monetary policy shock × LMT_{t-3}

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t}$	-0.07	-0.62*	-0.20
	(0.15)	(0.32)	(0.39)
$\Delta\widehat{i_t} \times LMT_{i,t-3}$	0.20	**-0.95****	**-1.76****
	(0.23)	(0.43)	(0.54)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table presents the estimated effects of a standard monetary policy shock and its interaction with labor market tightness (LMT_{t-3}) on nominal hourly wages at horizons $h = 0$, 4, and 8. The dependent variable is the cumulative change in nominal hourly wages over the respective horizon. The shock is identified using high-frequency monetary policy surprises, as in Bauer and Swanson (2023). The interaction term captures state dependence in the transmission of monetary policy across local labor market conditions. All regressions are estimated using the local projection method specified in Equation 2 and include standard control variables. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table C.5: Monetary policy shock by type × LMT_{t-2}

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t^+}$	-0.84**	-1.06	0.06
	(0.31)	(0.67)	(0.87)
$\Delta\widehat{i_t^-}$	-0.44*	0.52	0.55
	(0.23)	(0.46)	(0.51)
$\Delta\widehat{i_t^+} \times LMT_{i,t-2}$	-0.60	-1.29	0.92
	(0.43)	(0.88)	(1.07)
$\Delta\widehat{i_t^-} \times LMT_{i,t-2}$	-0.71*	**1.29****	**2.38****
	(0.36)	(0.62)	(0.74)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table reports the effects of contractionary and expansionary monetary policy shocks and their interactions with labor market tightness (LMT_{t-2}) on nominal hourly wages at horizons $h = 0$, 4, and 8, estimated using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following Bauer and Swanson (2023). The interaction terms capture potential state dependence in the transmission of monetary policy across local labor market conditions. All regressions include standard control variables and follow the specification in Equation 4. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table C.6: Monetary policy shock by type × LMT_{t-3}

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t^+}$	-0.77*	-1.18	0.07
	(0.32)	(0.69)	(0.90)
$\Delta\widehat{i_t^-}$	-0.33	0.46	0.63
	(0.24)	(0.48)	(0.53)
$\Delta\widehat{i_t^+} \times LMT_{i,t-3}$	-0.35	-1.18	1.14
	(0.43)	(0.90)	(1.11)
$\Delta\widehat{i_t^-} \times LMT_{i,t-3}$	-0.48	1.00	**2.54****
	(0.39)	(0.68)	(0.79)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table reports the effects of contractionary and expansionary monetary policy shocks and their interactions with labor market tightness (LMT_{t-3}) on nominal hourly wages at horizons $h = 0$, 4, and 8, estimated using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following Bauer and Swanson (2023). The interaction terms capture potential state dependence in the transmission of monetary policy across local labor market conditions. All regressions include standard control variables and follow the specification in Equation 4. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

C.4 Alternative Monetary Policy Shock

Table C.7: Standard Monetary policy shock interacted with LMT

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t}$	0.03	**-0.79****	**-0.66***
	(0.16)	(0.32)	(0.37)
$\Delta\widehat{i_t} \times LMT_{i,t-1}$	**0.58****	**-0.83****	**-1.97*****
	(0.20)	(0.39)	(0.46)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table presents the estimated effects of a standard monetary policy shock and its interaction with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0, 4,$ and 8. The dependent variable is the cumulative change in nominal hourly wages over the respective horizon. The shock is identified using high-frequency monetary policy surprises, as in Jarociński and Karadi (2020). The interaction term captures state dependence in the transmission of monetary policy across local labor market conditions. All regressions are estimated using the local projection method specified in Equation 2 and include standard control variables. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table C.8: Monetary policy shock by type

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i}_t^{+}$	0.07	-1.18	0.08
	(0.39)	(0.79)	(1.07)
$\Delta\widehat{i}_t^{-}$	**0.64*****	**1.32*****	**2.42*****
	(0.18)	(0.37)	(0.45)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table presents the estimated effects of a standard monetary policy shock and its interaction with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0$, 4, and 8. The dependent variable is the cumulative change in nominal hourly wages over the respective horizon. The shock is identified using high-frequency monetary policy surprises, as in Jarociński and Karadi (2020). All specifications include standard macroeconomic and labor market controls and are based on Equation 3. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table C.9: Expansionary and contractionary monetary policy shocks × LMT

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i}_t^+$	-1.12**	-2.16*	-1.16
	(0.57)	(1.22)	(1.67)
$\Delta\widehat{i}_t^-$	-0.39*	0.58	1.23**
	(0.25)	(0.53)	(0.59)
$\Delta\widehat{i}_t^+ \times LMT_{i,t-1}$	-1.53*	-1.75	0.68
	(0.63)	(1.32)	(1.68)
$\Delta\widehat{i}_t^- \times LMT_{i,t-1}$	-1.21***	1.00*	**2.56*** **
	(0.32)	(0.60)	(0.72)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table reports the effects of contractionary and expansionary monetary policy shocks and their interactions with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0$, 4, and 8, estimated using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following Jarociński and Karadi (2020). The interaction terms capture potential state dependence in the transmission of monetary policy across local labor market conditions. All regressions include standard control variables and follow the specification in Equation 4. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

C.5 Controlling for inflation perceptions and expectations

Table C.10: Standard Monetary policy shock interacted with LMT, including one-year-ahead inflation expectations and inflation perceptions

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t}$	**-0.33****	**-0.92*****	-0.51
	(0.14)	(0.28)	(0.37)
$\Delta\widehat{i_t} \times LMT_{i,t-1}$	-0.20	**-1.79*****	**-2.37*****
	(0.24)	(0.49)	(0.58)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table presents the estimated effects of a standard monetary policy shock and its interaction with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0$, 4, and 8. The dependent variable is the cumulative change in nominal hourly wages over the respective horizon. The shock is identified using high-frequency monetary policy surprises, as in Bauer and Swanson (2023). The interaction term captures state dependence in the transmission of monetary policy across local labor market conditions. All regressions are estimated using the local projection method specified in Equation 2 and include standard control variables and additionally one-year-ahead inflation expectations. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table C.11: Monetary policy shock by type, including one-year-ahead inflation expectations and inflation perceptions

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i}_t^+$	**-0.72****	**-1.09****	-0.70
	(0.28)	(0.51)	(0.57)
$\Delta\widehat{i}_t^-$	**0.48****	**1.25*****	**1.53****
	(0.23)	(0.43)	(0.61)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table reports the estimated effects of contractionary and expansionary monetary policy shocks on nominal hourly wages at horizons $h = 0$, 4, and 8, using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following the approach in Bauer and Swanson (2023). All specifications include standard macroeconomic and labor market controls and additionally one-year-ahead inflation expectations and are based on Equation 3. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table C.12: Expansionary and contractionary monetary policy shocks × LMT, including one-year-ahead inflation expectations and inflation perceptions

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t^+}$	**-0.99*****	-0.87	-0.18
	(0.29)	(0.62)	(0.69)
$\Delta\widehat{i_t^-}$	0.35	**1.84*****	**2.31*****
	(0.23)	(0.41)	(0.57)
$\Delta\widehat{i_t^+} \times LMT_{i,t-1}$	-0.08	-1.19	1.53
	(0.49)	(0.96)	(1.53)
$\Delta\widehat{i_t^-} \times LMT_{i,t-1}$	-0.04	**2.09*****	**3.74*****
	(0.40)	(0.71)	(0.97)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table reports the effects of contractionary and expansionary monetary policy shocks and their interactions with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0$, 4, and 8, estimated using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following Bauer and Swanson (2023). The interaction terms capture potential state dependence in the transmission of monetary policy across local labor market conditions. All regressions include standard control variables and additionally one-year-ahead inflation expectations and follow the specification in Equation 4. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

C.6 Controlling for the labor force participation rate

Table C.13: Standard Monetary policy shock interacted with LMT, including LFP

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t}$	0.02	**-0.71****	-0.44
	(0.15)	(0.29)	(0.35)
$\Delta\widehat{i_t} \times LMT_{i,t-1}$	0.28	**-1.18*****	**-2.04*****
	(0.20)	(0.39)	(0.48)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table presents the estimated effects of a standard monetary policy shock and its interaction with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0$, 4, and 8. The dependent variable is the cumulative change in nominal hourly wages over the respective horizon. The shock is identified using high-frequency monetary policy surprises, as in Bauer and Swanson (2023). The interaction term captures state dependence in the transmission of monetary policy across local labor market conditions. All regressions are estimated using the local projection method specified in Equation 2 and include standard control variables and additionally the labor force participation rate. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table C.14: Monetary policy shock by type, including LFP

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t^+}$	-0.37	-0.12	0.94
	(0.25)	(0.56)	(0.74)
$\Delta\widehat{i_t^-}$	0.18	**1.05*****	**1.91*****
	(0.18)	(0.34)	(0.40)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table reports the estimated effects of contractionary and expansionary monetary policy shocks on nominal hourly wages at horizons $h = 0, 4$, and 8, using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following the approach in Bauer and Swanson (2023). All specifications include standard macroeconomic and labor market controls and additionally the labor force participation rate and are based on Equation 3. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table C.15: Expansionary and contractionary monetary policy shocks × LMT, including LFP

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i}_t^+$	-0.84***	-0.85	0.09
	(0.30)	(0.66)	(0.87)
$\Delta\widehat{i}_t^-$	-0.56**	0.68	0.85*
	(0.22)	(0.45)	(0.47)
$\Delta\widehat{i}_t^+ \times LMT_{i,t-1}$	-0.70*	-0.98	1.06
	(0.44)	(0.89)	(1.08)
$\Delta\widehat{i}_t^- \times LMT_{i,t-1}$	-0.84**	**1.64*** **	**2.81*** **
	(0.33)	(0.59)	(0.73)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table reports the effects of contractionary and expansionary monetary policy shocks and their interactions with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0$, 4, and 8, estimated using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following Bauer and Swanson (2023). The interaction terms capture potential state dependence in the transmission of monetary policy across local labor market conditions. All regressions include standard control variables and additionally the labor force participation rate and follow the specification in Equation 4. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

C.7 Controlling for Hires and Separations

Table C.16: Standard monetary policy shock interacted with LMT, including hires and separations

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i}_t$	0.05	**-0.70*** **	-0.49
	(0.14)	(0.30)	(0.36)
$\Delta\widehat{i}_t \times LMT_{i,t-1}$	0.27	**-1.19*** **	**-2.07*** **
	(0.21)	(0.41)	(0.51)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table presents the estimated effects of a standard monetary policy shock and its interaction with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0, 4$, and 8. The dependent variable is the cumulative change in nominal hourly wages over the respective horizon. The shock is identified using high-frequency monetary policy surprises, as in Bauer and Swanson (2023). The interaction term captures state dependence in the transmission of monetary policy across local labor market conditions. All regressions are estimated using the local projection method specified in Equation 2 and include standard control variables and additionally hires and separations. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table C.17: Monetary policy shock by type, including hires and separations

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i}_t^+$	-0.35	-0.26	0.56
	(0.25)	(0.60)	(0.80)
$\Delta\widehat{i}_t^-$	0.20	**1.05*****	**1.92*****
	(0.19)	(0.35)	(0.42)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table reports the estimated effects of contractionary and expansionary monetary policy shocks on nominal hourly wages at horizons $h = 0, 4,$ and 8, using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following the approach in Bauer and Swanson (2023). All specifications include standard macroeconomic and labor market controls and additionally hires and separations and are based on Equation 3. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table C.18: Expansionary and contractionary monetary policy shocks × LMT, including hires and separations

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i}_t^+$	-0.73**	-1.01	-0.42
	(0.30)	(0.73)	(0.95)
$\Delta\widehat{i}_t^-$	-0.52**	0.64	0.76
	(0.23)	(0.46)	(0.49)
$\Delta\widehat{i}_t^+ \times LMT_{i,t-1}$	-0.96**	-1.52	0.21
	(0.49)	(0.99)	(1.21)
$\Delta\widehat{i}_t^- \times LMT_{i,t-1}$	**-0.98*****	**1.39*****	**2.56*****
	(0.36)	(0.64)	(0.70)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table reports the effects of contractionary and expansionary monetary policy shocks and their interactions with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0$, 4, and 8, estimated using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following Bauer and Swanson (2023). The interaction terms capture potential state dependence in the transmission of monetary policy across local labor market conditions. All regressions include standard control variables and additionally hires and separations and follow the specification in Equation 4. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

C.8 Controlling for the level of the policy rate

Table C.19: Standard Monetary policy shock interacted with LMT

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t}$	0.12	**-0.60****	-0.51
	(0.15)	(0.29)	(0.35)
$\Delta\widehat{i_t} \times LMT_{i,t-1}$	0.53**	**-0.86****	**-2.05*****
	(0.22)	(0.42)	(0.51)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table presents the estimated effects of a standard monetary policy shock and its interaction with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0, 4,$ and 8. The dependent variable is the cumulative change in nominal hourly wages over the respective horizon. The shock is identified using high-frequency monetary policy surprises, as in Bauer and Swanson (2023). The interaction term captures state dependence in the transmission of monetary policy across local labor market conditions. All regressions are estimated using the local projection method specified in Equation 2 and include standard control variables. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table C.20: Monetary policy shock by type

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t^+}$	-0.55**	0.21	0.79
	(0.22)	(0.49)	(0.65)
$\Delta\widehat{i_t^-}$	0.18	**1.82*****	**2.63*****
	(0.23)	(0.40)	(0.45)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table reports the estimated effects of contractionary and expansionary monetary policy shocks on nominal hourly wages at horizons $h = 0, 4,$ and 8, using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following the approach in Bauer and Swanson (2023). All specifications include standard macroeconomic and labor market controls and are based on Equation 3. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table C.21: Expansionary and contractionary monetary policy shocks × LMT

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i}_t^{+}$	-0.63**	-0.27	-0.79
	(0.27)	(0.57)	(0.78)
$\Delta\widehat{i}_t^{-}$	-0.63**	1.36***	0.94*
	(0.29)	(0.52)	(0.55)
$\Delta\widehat{i}_t^{+} \times LMT_{i,t-1}$	0.31	-0.19	0.37
	(0.47)	(0.94)	(1.21)
$\Delta\widehat{i}_t^{-} \times LMT_{i,t-1}$	-0.87**	**1.57***	**2.52*****
	(0.38)	(0.64)	(0.78)
Observations	2448	2448	2448
Controls	Yes	Yes	Yes

Notes: This table reports the effects of contractionary and expansionary monetary policy shocks and their interactions with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0$, 4, and 8, estimated using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following Bauer and Swanson (2023). The interaction terms capture potential state dependence in the transmission of monetary policy across local labor market conditions. All regressions include standard control variables and follow the specification in Equation 4. Standard errors are clustered at the regional level and are robust to heteroskedasticity and autocorrelation. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

C.9 Excluding the post-pandemic period

Table C.22: Monetary policy shocks × LMT

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i}_t$	-0.65***	-0.58	-0.15
	(0.21)	(0.45)	(0.56)
$\Delta\widehat{i}_t \times LMT_{i,t-1}$	-0.11	-0.54	-0.88
	(0.24)	(0.51)	(0.63)
Observations	1938	1938	1938
Controls	Yes	Yes	Yes

Notes: This table reports the effects of monetary policy shocks and their interactions with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0$, 4, and 8, estimated using a local projection framework. Monetary policy shocks are identified using high-frequency surprises, following Bauer and Swanson (2023). The interaction term captures potential state dependence in the transmission of monetary policy across local labor market conditions. All regressions include standard control variables and follow the specification in Equation 4. Standard errors are OLS standard errors. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table C.23: Expansionary and contractionary monetary policy shocks

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i}_t^{+}$	-0.55*	0.14	0.41
	(0.30)	(0.65)	(0.82)
$\Delta\widehat{i}_t^{-}$	**0.69*****	**1.03*****	**1.10*****
	(0.16)	(0.33)	(0.42)
Observations	1938	1938	1938
Controls	Yes	Yes	Yes

Notes: This table reports the effects of contractionary and expansionary monetary policy shocks on nominal hourly wages at horizons $h = 0$, 4, and 8, estimated using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following Bauer and Swanson (2023). All regressions include standard control variables and follow the specification in Equation 4. Standard errors are OLS standard errors. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table C.24: Expansionary and contractionary monetary policy shocks × LMT

	$h = 0$	$h = 4$	$h = 8$
$\Delta\widehat{i_t^+}$	-0.88**	0.79	1.48
	(0.43)	(0.91)	(1.12)
$\Delta\widehat{i_t^-}$	0.47	1.58**	1.38
	(0.33)	(0.70)	(0.87)
$\Delta\widehat{i_t^+} \times LMT_{i,t-1}$	-0.53	1.65	2.40*
	(0.54)	(1.15)	(1.42)
$\Delta\widehat{i_t^-} \times LMT_{i,t-1}$	-0.13	**1.84****	**2.70*****
	(0.37)	(0.78)	(0.97)
Observations	1938	1938	1938
Controls	Yes	Yes	Yes

Notes: This table reports the effects of contractionary and expansionary monetary policy shocks and their interactions with labor market tightness (LMT) on nominal hourly wages at horizons $h = 0$, 4, and 8, estimated using a local projection framework. Monetary policy shocks are identified using high-frequency surprises and decomposed by sign, following Bauer and Swanson (2023). The interaction terms capture potential state dependence in the transmission of monetary policy across local labor market conditions. All regressions include standard control variables and follow the specification in Equation 4. Standard errors are OLS standard errors. *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.