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Heterogeneous Effects of Monetary Policy Shocks: Evidence from the Czech Labor Market

Using unique contract-level data from the Czech labor market, we investigate how monetary policy shocks, identified by the high-frequency surprises in interest rate futures, affect the distribution of wages and hours worked. Consistent with existing literature, our findings indicate that low-wage groups are more impacted by these shocks than high-wage counterparts. The novelty lies in our exploration of the heterogeneous effects across different demographic and sectoral groups. Our results reveal that age, education, sector of employment, and the length of employment contracts play important roles in how wages and working hours respond to policy shocks.

JEL codes: E2, E3, E4, E5
Keywords: monetary policy, heterogeneity, wage inequality

The global economy has recently experienced a period of pronounced inflationary pressures and in response, numerous central banks have implemented a more restrictive monetary policy. Such a pace and strength of the monetary contraction were almost inconceivable in previous decades. This tightening, which includes both the reversal of unconventional measures and conventional

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interest rate hikes, aims to curb inflation by cooling the overheated labor markets and lowering overall economic demand. Nevertheless, a closer examination of economic data indicates that the consequences of these policies are not evenly distributed among individuals.

Employing a comprehensive administrative data set on wage contracts, we examine the potential heterogeneity in the effects of monetary policy shocks across the wage distribution and among different demographic and sectoral groups. Our data set provides extensive information across both cross-sectional and temporal dimensions, enabling us to analyze wage distribution percentiles and delve into the diverse sectoral and demographic impacts of monetary policy shocks. Drawing on these detailed individual-level data from the Czech labor market, we document five key findings:

(i) Contractionary monetary policy shocks have a stronger negative impact on hourly wages and hours worked at the left tail of the wage distribution, with a smaller decline in hours at the right tail.
(ii) Hourly wages of higher educated workers are more resistant to the effects of contractionary monetary policy shocks.
(iii) Contractionary monetary policy has a more pronounced negative impact on the wages of young and mid-age workers.
(iv) Manufacturing jobs tend to respond to tighter monetary policy with wage reductions, whereas the service and agricultural sector is more likely to adjust by reducing working hours.
(v) The impact of monetary policy shocks on wages and hours does not vary materially by gender.

Our paper is related to the growing literature on the heterogeneous effects of monetary policy shocks. Earlier papers in this literature primarily relied on survey data, despite their significant limitations. Coibion et al. (2017) identify earnings heterogeneity as a key driver of rising inequality following expansionary monetary policy. The results from Mumtaz and Theophilopoulou (2017) suggest that lower income groups are disproportionately affected by monetary tightening. These findings are also supported by Ampudia et al. (2018) and Lenza and Slacalek (2024) for the Euro Area. Madeira and Salazar (2023) examine the impact of contractionary monetary shocks on labor productivity and employment participation across sectors and demographic groups using survey data for Chile, while Zens, Böck, and Zörner (2020) explore whether monetary policy effects on unemployment vary across different occupation groups in the United States using data from the current population survey.

Our study is part of the more recent literature that focuses on estimating the distributional effects of monetary policy using granular administrative, individual-level data. The findings of Andersen et al. (2023) on Danish data suggest that the income response to an expansionary monetary policy shock increases monotonically across the wage distribution. Our results support those of Amberg et al. (2022), who analyze Swedish data and Hubert and Savignac (2023) who use French data. Their papers find that the income effects exhibit a U-shaped pattern over the income distribution. However, in an advance over these papers, our study provides new evidence on the role of demographic and sectoral heterogeneity in understanding these distributional effects.

While our findings are based on the Czech context, their relevance likely extends to other small, open, and developed economies. Czechia shares characteristics with these economies, including an industrial focus, consistent GDP growth, global market integration, and EU membership. Its economic performance (2.4% average annual GDP growth from 2002 to 2020), resilience during crises, and reliance on exports are common traits. In terms of within-country income distribution, income inequality in the Czech Republic has mirrored the broader trend in developed countries, marked by significant increases in both the Gini coefficient and top-income shares. Similarly, the Czech National Bank's inflation-targeting strategy and institutional framework resemble those of other central banks. Despite experiencing volatility from global events, Czechia's inflation has remained relatively stable. Furthermore, the Online Appendix demonstrates similarities in wage distribution between Czechia, the United States, and Sweden, suggesting broader implications for our findings.[1]

The rest of the paper is organized as follows: Section 1 describes the data and illustrates some stylized facts. Section 2 details the estimation methods and the construction of the monetary policy shock series. We present and discuss the results in Section 3, while Section 4 concludes the paper.

1. DATA—LABOR MARKET CHARACTERISTICS

To analyze the response of the wage distribution to monetary policy shocks, we explore the universe of granular, contract-level data from the Czech labor market. These data are accessed via the administrative ISPV[2] data set, which provides rich contract-level information at annual frequency from 2002 to 2011 and bi-annual thereafter to 2020. The data are collected by the Czech Ministry of Labor and Social Affairs as the main source of information on average earnings and are used for budgetary planning of social security expenditure.

In each data vintage, the variables include the average wage per hour and its structure over the relevant period (including bonuses and other types of compensation), hours worked (with details on paid and unpaid leave, sick leave, etc.), employee characteristics, such as gender, age, and education level, and also characteristics of the employer, such as location and number of employees (full-time-equivalent). To gather

1. In particular, we follow Guvenen et al. (2017) and construct "worker betas"—the correlation between wage growth and aggregate GDP growth in each wage percentile. As shown in the Online Appendix, the distribution of these worker betas has a clear U-shape matching the findings for the United States and Sweden reported by Guvenen et al. (2017) and Amberg et al. (2022). This provides further evidence that results based on Czech data have more general policy implications. See the Online Appendix for more details on the Czech economy and this analysis.

2. Informační systém o průměrném výdělku (Average Earnings Information System), https://www.ispv.cz/en/homepage.aspx.

more information on employers, we merge the data with the RES[3] Business Register database, which provides information on the prevailing business sector in which the employer operates.

The data cover a large proportion of Czech labor market contracts, with around 1.5 million cross-sectional units (contracts) in the most recent vintages. While many contracts appear and disappear during the observed time sample, we can still follow the duration of each contract, which is a separate data entry. The inclusion of a contract in the sample depends on the size of the firm. Firms with 250+ employees are included in each vintage, while smaller firms are covered on a rotational basis to reduce the administrative burden on small businesses. To correct for any bias this may cause, the undersampled smaller firms are assigned a higher weight to represent those which were omitted from the vintage.

The data on hours worked reflect two main sources of variation. The first comes from the coverage of part-time agreements in the data. Of 1.2 million contracts covered in the 2022 vintage of the data, close to 77% are full-time. The rest comprises of contracts recorded as part-time contracts (close to 23%). However, a significant portion of these contracts is close to full-time.[4] Hours are adjusted for absence (paid and unpaid), overtime, and sickness. The data set also includes contracts, which start or terminate during the respective year. The variation coming from this source, however, does not provide much information about the supply of labor. Therefore, we extrapolate the hours worked under such contracts as if the contract lasted for the whole year. For example, if there were x hours worked under a contract terminated after a half of a year, we multiply these by 2.

The administrative character of the data set, together with its wide coverage, overcomes the usual pitfalls of survey data, such as imperfect coverage of the upper and lower tails of the wage distribution. However, the data have several limitations. The contract-level and anonymous nature of the granular data does not allow us to follow an individual through different employments. For the same reason, we also do not have access to information about the total income of individuals, who may have a substantial nonwage income or be employed under several simultaneous contracts. We therefore focus on wage inequality as a distinct channel of total income inequality. While we do not have information about employees' contract history, we can measure their turnover rate by observing the average length of the present contract.

Figure 1 shows the characteristics of employees and respective contracts along the wage distribution (i.e., percentiles of the average hourly wage), averaged over the period 2002–2020. Higher wage percentiles are associated with a higher education level, and the relationship is strictly increasing. Gender inequality is illustrated by lower shares of females in higher wage percentiles and by decreasing shares of females toward the higher end of the wage distribution. Both tails of the wage distri-

3. Registr ekonomických subjektů (Business Register), https://www.czso.cz/csu/res/business_register.

4. About 11% of these contracts have hours above 0.95 of full-time hours.

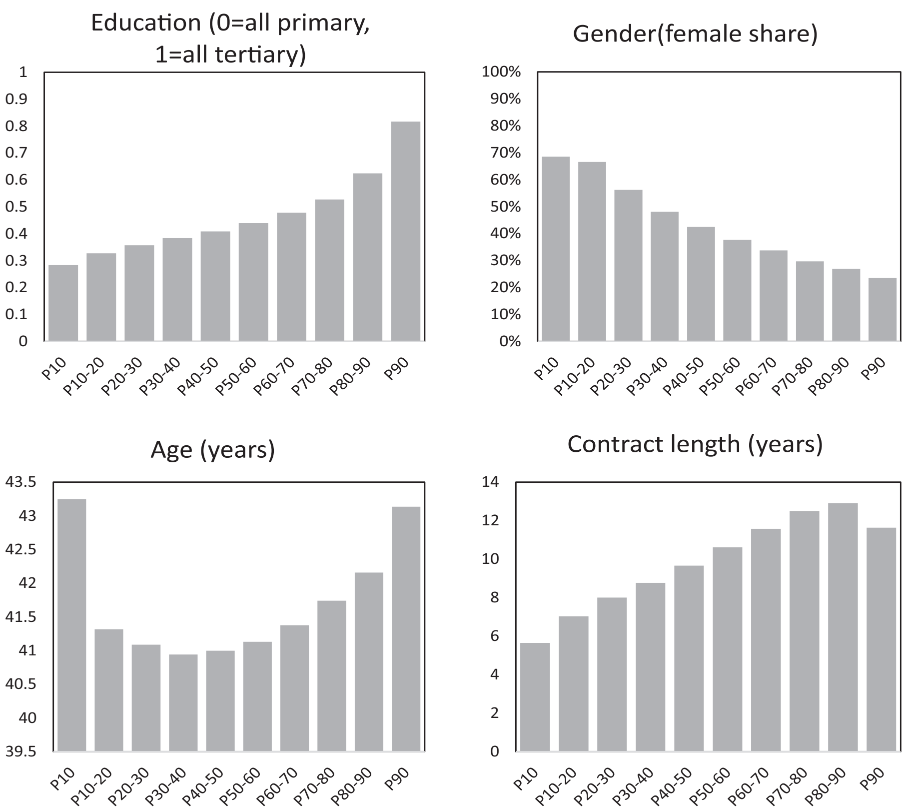

Fig. 1. Characteristics of Employees and Contracts along the Wage Distribution.

Note: P10 to P90 on the *X*-axis denotes the percentiles of the wage distribution.

bution are associated with a higher average age, marking the line between workers who were able to climb the seniority ladder and increase their wages over lifetime and those who struggled to do so, leaving them with a lower wage toward the end of their working lives. As a result, wage inequality increases with age. Contract lengths are longer at the right tail of the wage distribution.

The data reveal other several notable characteristics of the Czech labor market, which we present in more detail in the Online Appendix. First, the service sector stands out with high female representation, while, men dominate all other sectors. Second, the average hourly wage is slightly higher in the manufacturing sector, where the wage distribution is also more uniform, with most workers earning around the median wage or slightly above. In contrast, the service sector has a higher share on the tails of wage distribution. Third, workers tend to have more stable long-term employment relationships in manufacturing and the agriculture sectors, while in the service sector, the observed shorter contract lengths demonstrate more flexibility. Finally, older workers tend to have longer contracts. The average contract length for a worker under the age of 35 is less than 4 years, for a worker between the ages of 35 and 50, it is 10 years, and for workers above 50, the average length of their contract is close to 16 years.[5]

2. EMPIRICAL MODEL

Our benchmark model is the following mixed-frequency vector autoregression (VAR):

$$Y_t = c + \sum_{p=1}^{P} Y_{t-p} B_p + v_t, \tag{1}$$

where $v_t \sim N(0, \Sigma)$ and Y_t is a $1 \times N$ matrix of endogenous variables that includes the following variables:

$$Y_t = \left(m_t \ r_t \ y_t \ p_t \ u_t \ s_t \ \hat{z}_t \right)', \tag{2}$$

where m_t is a measure of the monetary policy shock described below. The short-term interest rate, the log of GDP, the log of the GDP deflator, the unemployment rate, and the log of the dollar exchange rate are denoted by r_t, y_t, p_t, u_t, and s_t, respectively. The data for these variables are quarterly and run from 2002Q1 to 2019Q4.[6] Finally, z_t denotes wages per hour or hours worked averaged for the survey participants, who fall within groups defined either by percentile of the wage distribution, or characteristics such as industry of employment, gender, and education. We provide details on the definition of the groups in the empirical analysis below. Note that wages are deflated by the consumer price index (CPI) to convert them to real terms.

2.1 Mixed Frequency

The vector of endogenous variables contains quarterly macro-economic variables and survey-based variables, which are available at a lower frequency. The survey-based variables z_t are observed in the fourth quarter of every year before 2012 and are then available twice a year. Following Schorfheide and Song (2015), we treat the

5. Additional characteristics of the Czech labor market can be seen in Section 3 of the Online Appendix.

6. All series are obtained from the FRED data base. The Fred mnemonics are CLVMNACSCAB1GQCZ, CZECPIALLQINMEI, IR3TIB01CZM156N, LRHUTTTTCZM156S, and CCUSMA02CZM618N for real GDP, CPI, short-term interest rate, unemployment rate, and the exchange rate, respectively.

quarterly observations of z_t as unobserved states. These are denoted by $\hat{z}_t$ in equation (2). The VAR model is augmented with the following observation equation:

$$Z_t = H \underbrace{\begin{pmatrix} Y_t \\ Y_{t-1} \\ Y_{t-2} \\ Y_{t-3} \end{pmatrix}}_{\beta_t} + \begin{pmatrix} E_t \\ 0 \\ 0 \\ 0 \end{pmatrix}, \tag{3}$$

where $Z_t = \left(m_t \; r_t \; y_t \; p_t \; u_t \; s_t \; z_t \right)'$ and $E_t = \left(0 \; 0 \; 0 \; 0 \; 0 \; 0 \; \tilde{v}_t \right)'$. Note that z_t is missing in $Q1$ to $Q3$ of each year and is observed only in $Q4$. in the sample before 2012. After 2012, z_t equals the missing value in $Q1$ and $Q3$ and is observed in the remaining quarters. If z_t is missing, then:

$$H = \begin{pmatrix} I_{N-1} & 0_{N-1,N} & 0_{N-1,N} & 0_{N-1.N} \\ 0_{1,N} & 0_{1,N} & 0_{1,N} & 0_{1,N} \end{pmatrix},$$

where I_N and $0_{N,N}$ denote the $N \times N$ identity matrix and an $N \times N$ matrix of zeros, respectively. Note that $var\,(\tilde{v})$ is set to a large number in this case. When z_t is observed once a year:

$$H = \begin{pmatrix} I_{N-1} & 0_{N-1,N} & 0_{N-1,N} & 0_{N-1.N} \\ e_N & e_N & e_N & e_N \end{pmatrix}$$

with $e_N = \left(0 \; 0 \; 0 \; 0 \; 0 \; 0 \; \frac{1}{4} \right)$ and $var\,(\tilde{v})$ is set to 0. In this case, the observation equation implies that $z_t = \sum_{i=0}^{3} \frac{\hat{z}_{t-i}}{4}$—that is, the observed value is assumed to be the average of the unobserved values in the current and the last three quarters. When z_t is observed twice a year:

$$H = \begin{pmatrix} I_{N-1} & 0_{N-1,N} & 0_{N-1,N} & 0_{N-1.N} \\ e_N & e_N & 0 & 0 \end{pmatrix}$$

with $e_N = \left(0 \; 0 \; 0 \; 0 \; 0 \; 0 \; \frac{1}{2} \right)$ and $var\,(\tilde{v})$ is set to 0. In this case, the observed value is the average of the current and previous quarters.

2.2 High-Frequency Identification of the Monetary Policy Shock

Following recent papers such as Gertler and Karadi (2015), Miranda-Agrippino and Ricco (2015), and Jarocinski and Karadi (2020), we adopt a high-frequency approach to identify the monetary policy shock. In particular, we use daily data on 3-month Prague interbank Libor rate futures (Pribor) at maturities of 1, 3, 6, and 9 months. We calculate the daily changes in these futures around monetary policy meetings.

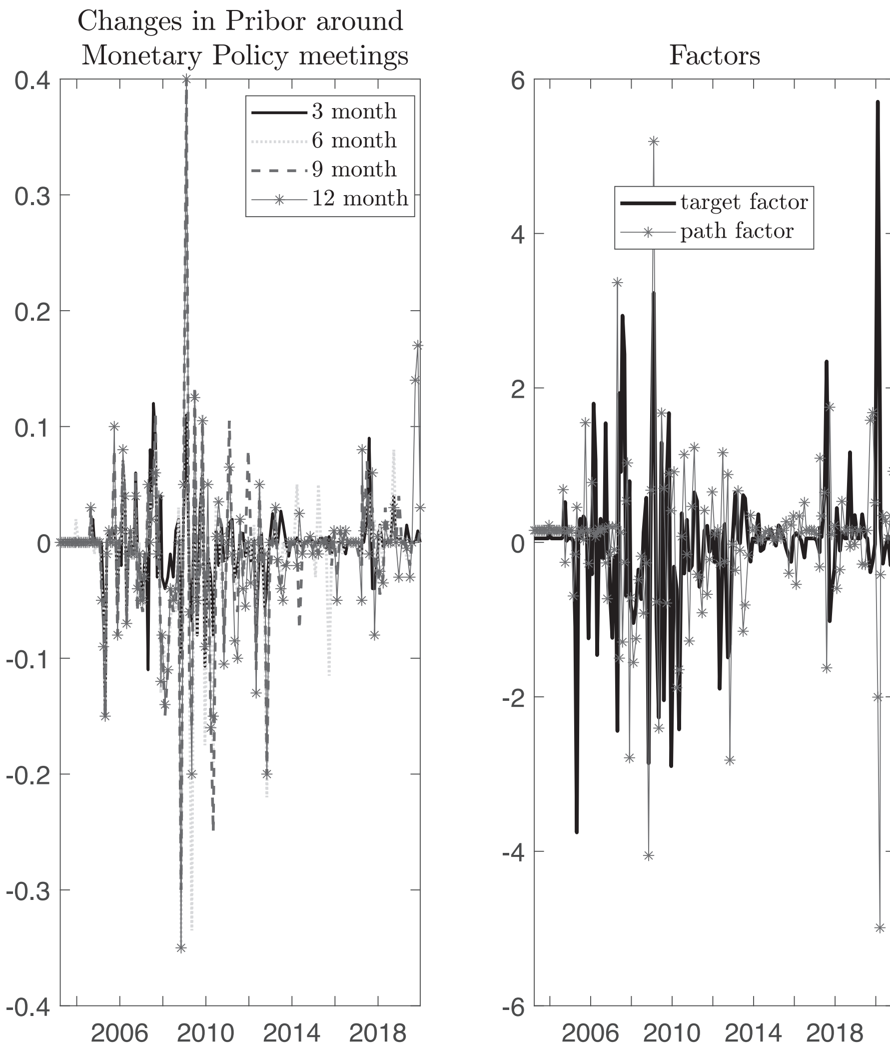

Fig. 2. Changes in Pribor Futures around Meetings of the Monetary Policy Distribution (Left Panel); Estimated Target and Path Factors (Right Panel).

As shown in the left panel of Figure 2, the change in future rates at the 9-month horizon shows the largest volatility, with large spikes occurring during the 2008–2010 period. It is also noticeable that the change in future rates is highly correlated. In fact, 91% of the cross-sectional variation in the futures is explained by the first two principal components. Given this feature, we follow Gürkaynak, Sack, and Swanson (2005) and use these principal components $\mathcal{P}_t$ to characterize monetary policy shocks.

As discussed in Gürkaynak, Sack, and Swanson (2005), the cross-section of futures captures multiple dimensions of monetary policy and contains information regarding the market reaction to expected changes in current rates and their future path. We follow the approach of Gürkaynak, Sack, and Swanson (2005) and rotate the principal components $\mathcal{P}_t$ to obtain factors $\mathcal{P}_t^*$. This orthogonal rotation imposes the restriction that the second factor in $\mathcal{P}_t^*$ has a zero loading at the 1-month maturity. Therefore, this factor can be interpreted as a "statement" or a "path" factor that captures changes in guidance on future policy rates. In contrast, the first factor in $\mathcal{P}_t^*$ that is allowed to load at the 1-month maturity is the "target" factor and is a proxy for current policy surprise.

One may be concerned that the use of daily windows allows these factors to be contaminated with news other than monetary policy.[7] However, the movements of $\mathcal{P}_t^*$ (right panel of Figure 2) accord well with the narrative of monetary policy events in Czechia.[8] The extreme values of the target and path factors identified from interest rate futures can be directly linked to surprising decisions at the relevant monetary policy meetings. For example, the monetary policy meeting on February 6, 2020, brought an unexpected 25 bp hike (a spike in the target factor), and the market expected this move to be corrected later on (a concurrent drop in the path factor). To give another example, the meeting on February 5, 2009, resulted in a cut of 50 bp, but a larger amount of easing had been expected, leading to a restrictive shock captured by a spike in the target factor. Additionally, a surprisingly hawkish rate forecast led to a positive spike in the path factor as well. Table 1 reports other prominent monetary policy decisions that are accurately captured by the target and path factors.

In our empirical analysis, our interest lies on conventional monetary policy. We, therefore, use the target factor as our instrument m_t. As in Jarocinski and Karadi (2020), the instrument is added directly to the VAR model, and impulse responses are calculated using a Cholesky decomposition with m_t ordered first. Plagborg-Møller and Wolf (2021) prove that the impulse responses obtained via this approach are asymptotically equivalent to those obtained using the instrumental variable or proxy VAR approach. Given our small sample size and the presence of missing data, we prefer the simpler approach of the recursive VAR.

2.3 Model Specification and Estimation

Based on the Schwarz information criterion, the lag length of the VAR model is set to 2. The mixed frequency VAR model is estimated using Bayesian techniques. In particular, we use the Gibbs sampling algorithm devised by Schorfheide and Song (2015). In short, each iteration involves sampling from the conditional posterior distributions of b, Σ, and $\hat{z}$, respectively, where b denotes the VAR coefficients in vec-

7. Ideally, we would like to use intraday data to calculate these changes. However, these date are not available for a sufficiently long time period for Czechia.

8. Moreover, we show in the robustness analysis that an alternative identification scheme based on sign restrictions produces estimates of the effects of monetary policy that are very similar to the benchmark results.

TABLE 1

Twelve Largest Observations of the Target and Path Factors

Date	Event	Target factor	Path factor
February 6, 2020	Unexpected 25bp hike	5.71	−2.00
September 26, 2018	Partially expected 25bp hike	1.17	−0.05
August 3, 2017	Partially expected 25bp hike	2.34	−1.62
May 3, 2012	Stability, cut was implied by the forecast and voted for by the governor	−1.89	−0.28
May 6, 2010	Cut 25bp by narrow majority, partially expected	−2.42	−1.65
December 16, 2009	Cut 25bp by narrow majority, partially expected	−2.90	0.40
February 5, 2009	Cut 50bp, but more was expected	3.23	5.19
November 6, 2008	Cut 75bp, less was expected	−2.86	−4.05
August 30, 2007	Partially expected 25bp hike, by narrow majority	2.43	−0.26
July 26, 2007	Partially expected 25bp hike	2.93	−1.29
April 26, 2007	Stability by narrow majority, hike partially expected	−2.44	3.36
April 28, 2005	Cut 25bp by narrow majority, partially expected	−3.76	0.45

torized form. The first two conditional posterior distributions are standard in the Bayesian VAR literature. Draws from the conditional posterior distribution of the state variables $\hat{z}$ can be obtained using the simulation smoother of Durbin and Koopman (2002). The Online Appendix provides details of the conditional posteriors and prior distributions that are standard. We use 21,000 iterations, dropping the first 1,000 as burn-in. Every fifth remaining iteration is saved for inference. We provide evidence for convergence of the algorithm in the Online Appendix.

3. RESULTS

3.1 The Macro-Economic Effects of a Monetary Policy Shock

Before describing the impact of monetary policy shocks on the distribution of wages and hours worked, we show that the responses of the main macro-economic variables are plausible and accord well with the theory.

Figure 3 demonstrates that a contractionary shock leads to an increase in the short-term interest rate r_t of about 0.1%. Both GDP and the GDP deflator fall in response to the shock, while the unemployment rate rises. The decline in GDP is sharp, with the peak response occurring at a 3-year horizon and this coincides with the peak increase in the unemployment rate. The fall in the price index occurs more slowly, with prices declining by about 0.2% after 4 years. The exchange rate appreciates sharply and s_t declines by 1.5% one-quarter after the shock. To sum up, a contractionary monetary

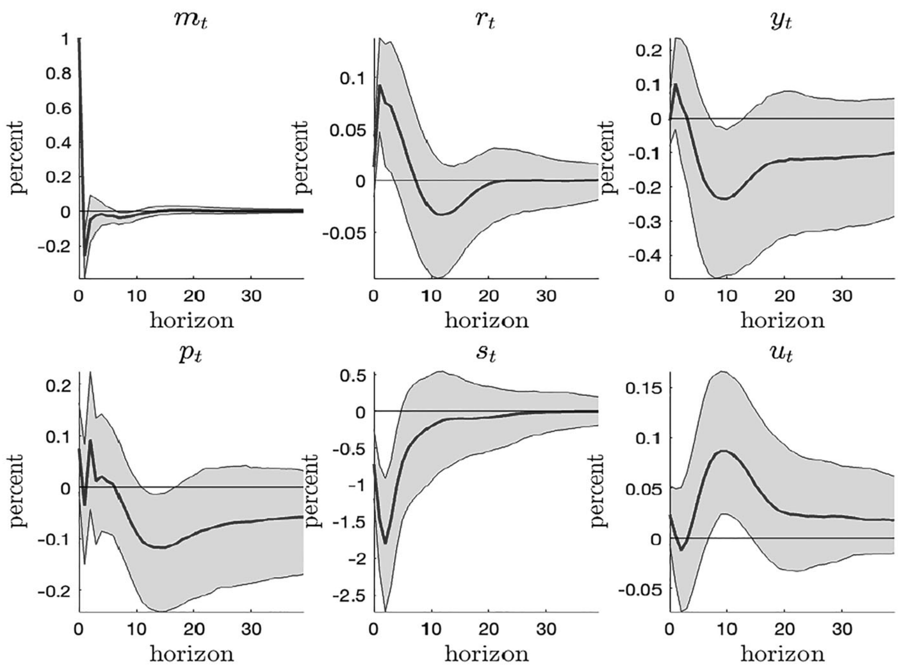

Fig. 3. Response of Macro-Economic Variables to a Monetary Policy Shock.

NOTE: The solid line shows the median response while the shaded area shows the 68% error band.

policy shock impacts the interest rate and exchange rate variation mostly in the short run; the effect on GDP and the price index peaks at a medium horizon.

Monetary Policy Shocks and the Distribution of Wages

We augment the benchmark model with data on average wages per hour and hours in each percentile. These variables are added one by one and the mixed-frequency VAR model is estimated in each case.[9] The granular nature and number of observations included in our data set means that average wages and hours worked within each percentile are estimated precisely. Therefore, unlike survey-based studies, we can examine the impulse responses at a finer level and, importantly, we can illustrate the behavior of the distribution at the tails, which may not be evident from a more aggregate analysis.

Figure 4 displays the cumulative response of wages and working hours over 20

9. While it would be preferable to add these variables jointly, the small sample size and large number of unobserved state variables make this computationally infeasible.

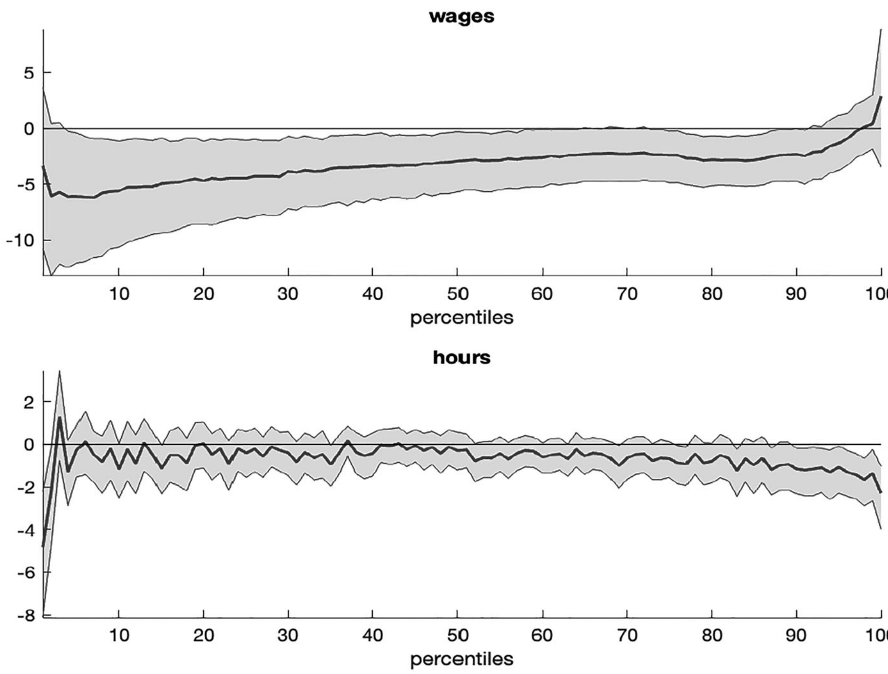

Fig. 4. Cumulated Response of Wage and Working Hours to Monetary Policy Shock at 20 Quarter Horizon.

Notes: The shock is a 1 unit contractionary monetary policy shock, which increases the interest rate by about 10 basis points. The solid lines are posterior medians while the shaded area represents the 68% error band.

quarters to the contractionary monetary policy shock in each percentile group.[10] The figure shows that within 5 years after the monetary contraction, the wage is depressed across almost the whole distribution. The largest adverse effect occurs at the left tail of the distribution. For low earners, the wage declines cumulatively by about 5%, while the wage of top earners is largely unaffected. The contractionary policy shock tends to reduce the number of working hours at the right tail of the distribution. While hours decline sharply for the first percentile, there is some evidence of an increase in hours in the remainder of the first decile providing some support to the results reported for the United States by Cantore et al. (2022).[11] It is important to investigate what drives this apparent heterogeneity in the reaction to monetary policy shocks. To

10. The cumulated response of these variables at different horizons is shown in Figure 5 in the Online Appendix.

11. Note that the results in Cantore et al. (2022) are based on actual hours worked from the US Current Population Survey. The measure of hours in this paper corresponds to usual hours.

conduct a more thorough examination of these questions, in the following subsection, we explore the reaction by demographic groups and sectors.[12]

Demographic and sectoral analysis. The structure of our data set allows us to extract primary demographic characteristics of employees, such as gender, age, and education. We also know the prevailing business sector in which the employer operates. In this section, we consider the role played by these characteristics in driving the heterogeneous response of wages and hours worked. In particular, we estimate the VAR model, adding average wages or hours in different demographic or sectoral groups one by one to the core set of six quarterly variables. Note that by limiting the low-frequency data to one series, we ensure that the number of state variables in the model remain manageable.[13]

3.2 Education

The top panel of Figure 5 shows the cumulative response of average real wages to a contractionary monetary policy shock for individuals with primary, secondary, or tertiary levels of education. As in the benchmark case, the shock is scaled to increase the interest rate by about 10 basis points. The shock reduces wages for individuals with primary education. In contrast, highly educated individuals experience a rise in their real wages per hour. The last column of the top row of the figure shows the response of the wage of individuals with tertiary level of education in deviation with those with primary education. The response of this series is positive and statistically different from zero, indicating that the difference across these groups is statistically different from zero. The bottom panel of Figure 5 shows that the shock is associated with a larger decline in hours for individuals with primary and tertiary education—the last columns show that the difference between the tertiary and the secondary group is statistically different from zero.

3.3 Age

Figure 6 presents impulse responses for average wages and hours in groups formed by age of the individual. The results provide some evidence that the decline in wages following a contractionary monetary policy shock is concentrated in lower age groups. The top panel shows that real wages decline for individuals younger than 50 years with the estimated responses statistically different from zero at medium-term horizons. The response of wages for individuals older than 50 years is imprecisely

12. As shown in the Online Appendix, the monetary policy shock also contributes to the forecast error variance for wages and working hours mainly at the tails of the distributions.

13. To check if differences across groups are statistically different from zero, we estimate additional VAR models where average hours or wages in groups of interest in deviation from a benchmark group are added as the low-frequency series in the model.

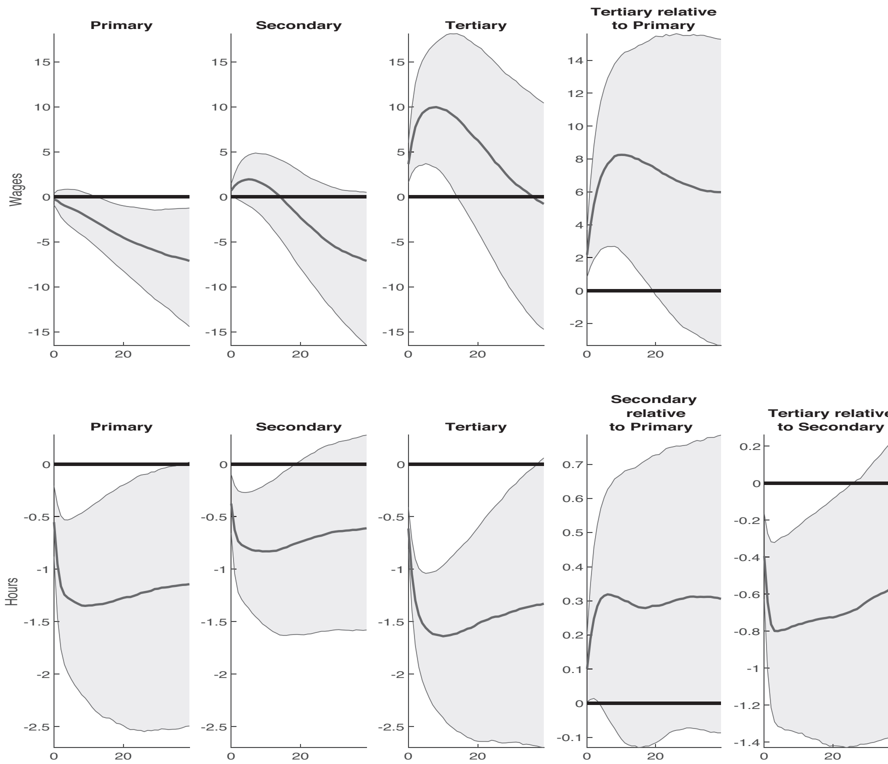

Fig. 5. Cumulated Response of Wages and Hours by Level of Education.

NOTES: The shock is a 1 unit contractionary monetary policy shock, which increases the interest rate by about 10 basis points. The solid lines are posterior medians while the shaded area represents the 68% error band. The *X*-axis denotes the horizon in quarters.

estimated over the entire horizon.[14] The bottom panel of the figure shows that hours decline by about 1% for all groups. However, as shown in the last column, the decline for older individuals is slightly larger than the 35–50 group.

3.4 Gender

The top panel of Figure 7 shows that the response of real wages for males and females is negative. There is some evidence that the initial decline for females is slightly smaller. We find that the difference in the magnitude of response of hours across these groups is minimal.

14. This imprecision implies that differences in the impulse responses between this group and younger individuals are not statistically different from zero (see the last two columns in the top row).

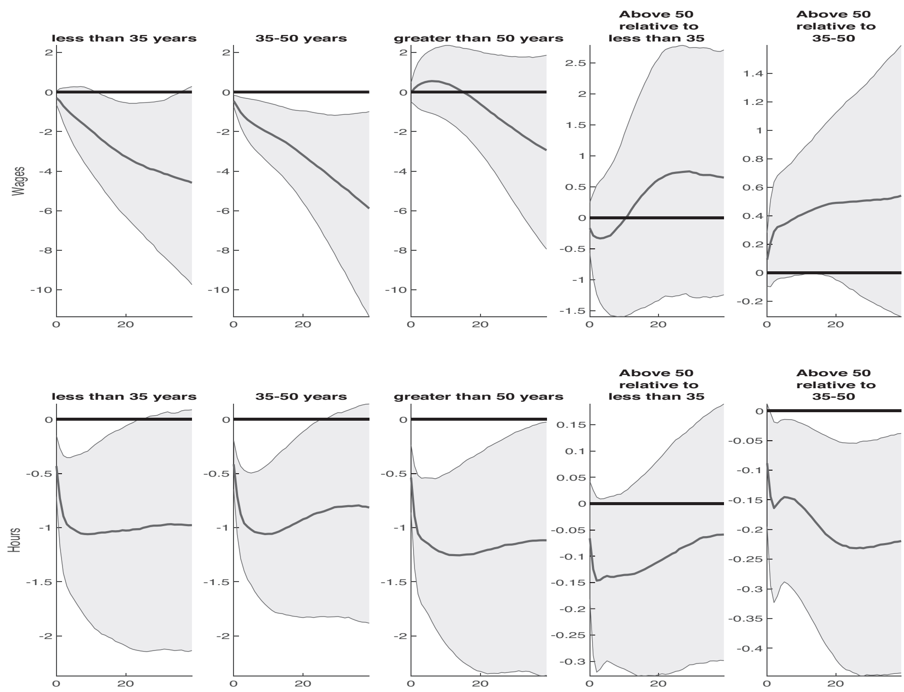

Fig. 6. Cumulated Response of Wages and Hours by Age.

NOTES: The shock is a 1 unit contractionary monetary policy shock, which increases the interest rate by about 10 basis points. The solid lines are posterior medians while the shaded area represents the 68% error band. The *X*-axis denotes the horizon in quarters.

3.5 Sectors

Figure 8 displays the impulse response to the policy shock by sector of employment. The top panel shows that the largest decline in real wages occurs in the manufacturing sector, while the effect in the remaining sectors is imprecisely estimated. The shock reduces hours across sectors, with the median response showing the largest decrease in services and agriculture.

3.6 Contract Duration

In Figure 9, we show the impulse responses of real wages and hours by duration of employment contracts. The responses are displayed for average hourly wages and hours in five groups formed by quintiles: $P1$ includes contracts below the 20th percentile, $P2$ includes contracts between the 20th percentile and the 40th percentile, and so on. The top panel of the figure shows limited evidence that the decline in wages occurs for workers with the longest contracts. In contrast, as the bottom row of the figure shows, the adjustment in hours mainly takes place through large declines at the left tail of the contract length distribution.

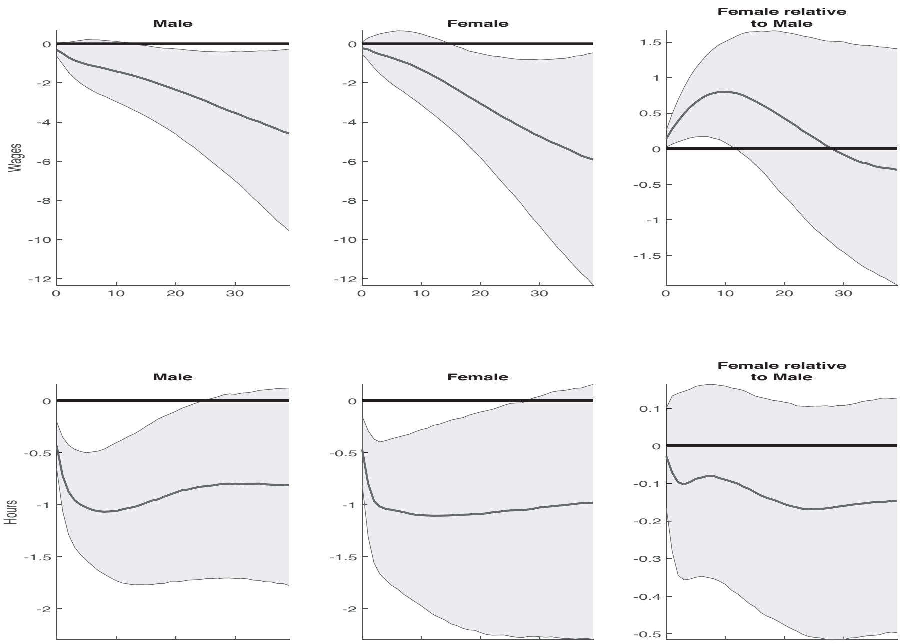

Fig. 7. Cumulated Response of Wages and Hours by Gender.

Notes: The shock is a 1 unit contractionary monetary policy shock, which increases the interest rate by about 10 basis points. The solid lines are posterior medians while the shaded area represents the 68% error band. The *X*-axis denotes the horizon in quarters.

We can summarize our main findings as follows.

(i) Contractionary monetary policy shocks have a larger negative effect on hourly wages at the left tail of the wage distribution. Hours drop substantially at the left tail of this distribution in response to this shock, but also show a smaller decline at the right tail.

(ii) Wages of workers with higher education are more resistant to the effects of contractionary monetary policy shocks. As shown in Figure 1 in Section 1, highly educated workers tend to dominate the right tail of the wage distribution, which also coincides with longer contract durations. This might provide these individuals higher bargaining power to protect their wages in the event of negative shocks. Our results suggest that adjustment for these workers takes place through a stronger decline in hours.

(iii) The analysis suggests that the wage of young and mid-age workers responds more negatively to a contractionary monetary policy shock than that of the senior workers. As discussed in Section 1, contracts of older workers are renegotiated less often. Our results suggest that older workers tend to react by reducing hours worked in the face of a negative shock.

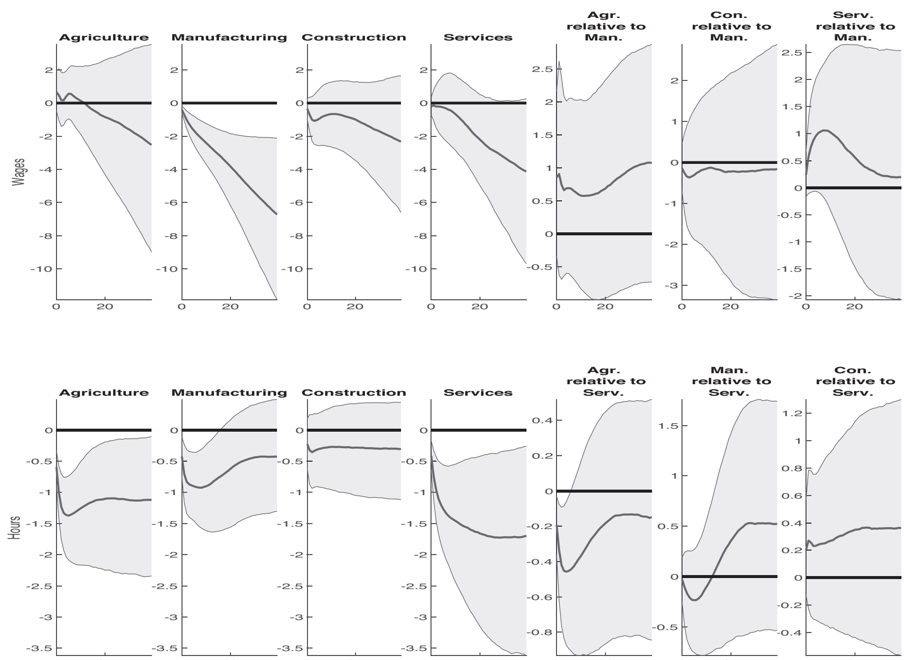

Fig. 8. Cumulated Response of Wages and Hours by Sector.

NOTES: The shock is a 1 unit contractionary monetary policy shock, which increases the interest rate by about 10 basis points. The solid lines are posterior medians while the shaded area represents the 68% error band. The *X*-axis denotes the horizon in quarters.

(iv) While jobs in manufacturing react to the restrictive shock with a reduction in wages, in services and agriculture, the response is more likely to materialize via fewer hours worked. This finding relates to the two types of labor proposed by Kaplan and Zoch (2020) (production-type and expansionary-type) and their different reactions to shocks.

(v) Despite the prevailing gender pay gap, we do not find a significant gender difference in the response to monetary policy shocks. This may result from two counteracting forces, as men are typically more represented in manufacturing jobs, which show a more pronounced wage response to the shock, while the gender pay gap suggests that women are more concentrated in the low-wage brackets, where the reaction to the shock is also stronger.[15]

15. See the Online Appendix for a discussion of these characteristics of the data.

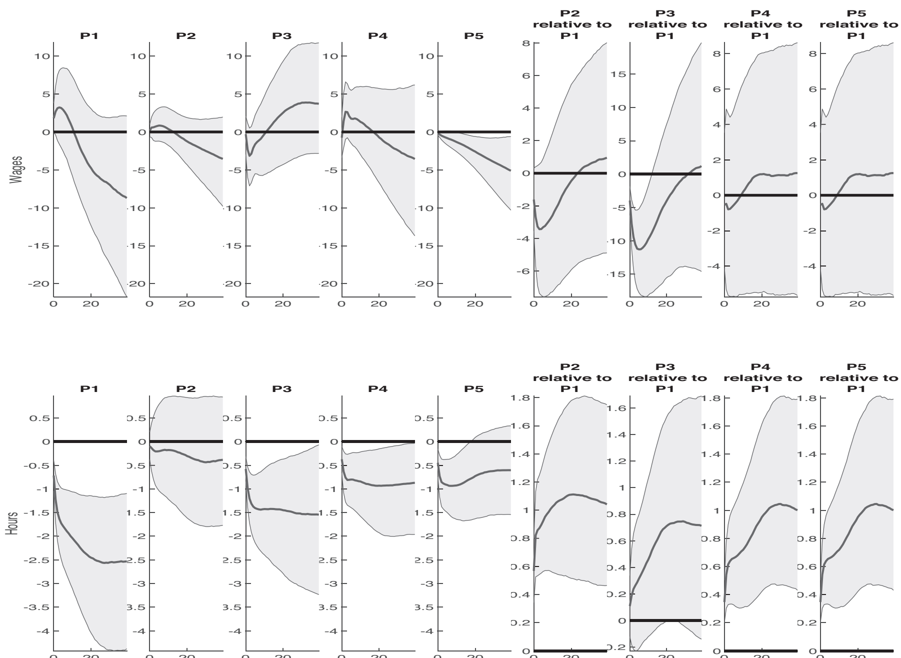

Fig. 9. Cumulated Response of Wages and Hours by Contract Duration.

NOTES: P1 to P5 refers to groups based on quintiles. The shock is a 1 unit contractionary monetary policy shock, which increases the interest rate by about 10 basis points. The solid lines are posterior medians while the shaded area represents the 68% error band. The *X*-axis denotes the horizon in quarters.

3.7 Further Results and Robustness Analysis

We carry out an extensive sensitivity analysis, which is described in the Online Appendix. In this section, we present a summary of these results:

(i) Unconventional monetary policy: our benchmark model focuses on conventional monetary policy shocks. The Czech national bank used the exchange rate as an additional policy instrument from November 2013 to April 2017. We show in the Online Appendix that the path factor extracted from an extended high-frequency data set that includes changes in the exchange rate captures this unconventional policy. Adding this factor to the benchmark VAR does not materially alter the benchmark results (see Figures 14 and 15 in the Online Appendix). Shocks to this path factor are estimated to have a smaller effect on the distribution of wages and hours than the conventional shock.

(ii) Sign restrictions: we use contemporaneous sign restrictions as an alternative identification scheme for the monetary policy shock. We assume that a contractionary monetary policy shock is associated with an increase in short-term interest rates, a decline in output and prices, a real exchange rate appreciation, and a rise in the unemployment rate. Figure 8 in the Online Appendix shows the estimated response of hours and wages. As in the benchmark case, wages decline substantially at the left tail of the distribution and wage inequality rises.

(iii) Model specification: we add the following variables to the benchmark model: (1) Euro-area GDP, (2) Euro-area CPI, and (3) oil prices. As shown in Figure 9 in the Online Appendix, the key results are unaffected. The contractionary monetary policy shock still has a disproportionately large effect on wages at the left tail of the wage distribution.

4. CONCLUDING REMARKS

This paper analyzes the heterogeneous effects of monetary policy on labor markets, particularly regarding wage distribution and hours worked, with an emphasis on the sectoral and demographic characteristics of workers. We use unique contract-level administrative data from the Czech labor market, which covers around 1.5 million contracts in recent data vintages. In order to identify monetary policy shocks, we employ a high-frequency approach, deriving surprises from interest rate futures data around monetary policy meetings. By exploring the maturity spectrum of futures, we differentiate between the interest rate target factor (surprise in rate decisions) and the path factor (surprise in guidance), using the target factor as a measure of conventional monetary policy shocks.

Embedding this information in a mixed-frequency monetary policy VAR model, we documented several new facts about the distributional effects across different demographic and sectoral groups. Our results indicate that contractionary monetary policy shocks have the largest effects on the wages of low-wage workers. The decline in hours is largest at the left tail of the wage distribution but hours also decline for workers on the highest wages. Higher educated workers show greater resilience to monetary policy shocks, while younger and mid-aged workers are more negatively affected than older workers, who experience reduced hours instead of wage cuts, possibly due to less frequent contract renegotiation. While wage reductions occur in manufacturing jobs, workers in the service and agriculture sectors primarily respond by reducing hours. Furthermore, despite the gender pay gap, we do not find significant gender differences in responses to monetary policy shocks.

These insights deepen our understanding of the complex interactions between monetary policy and labor market dynamics, offering novel findings not only in the context of the Czech labor market but also from an international perspective. Future research could aim to develop a theoretical explanation for the heterogeneous responses of wages and hours to monetary policy shocks.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Figure 1: Worker betas for each percentile of wage.
Figure 2: Log average hourly wage distribution in 2020
Figure 3: Characteristics of employees across different business sectors
Figure4: Characteristics of employees across sectors along the wage distribution.
Figure 5: Contract length in years across different age groups and across sectors along the wage distribution
Figure 6: Inefficiency factors
Figure 7: Contribution of the the monetary policy shock to the Forecast error variance of the main macroeconomic variables
Figure 8: Contribution of the the monetary policy shock to the Forecast error variance of hours and wages at different horizons
Figure 10: Using additional exogenous variables
Figure 11: Cumulated response of wages at different horizons
Figure 12: Cumulated response of hours at different horizons
Figure 13: Factor loadings on the target and path factors.
Figure 14: The path factor and the change in the exchange rate around policy meetings
Figure 15: IRF to shocks to target (red) and path factors(black)
Figure 16: Impulse response of wages and hours to contractionary conventional (target) and unconventional (path) policy shocks
Figure 17: The range of responses of macroeconomic variables from 200 mixed frequency VAR models.