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Monetary Policy and Earnings Inequality: Asymmetric Effects Across the Distribution

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UNIVERSITÄT DUISBURG ESSEN
RWI
#1233

Imprint

Ruhr Economic Papers

Ruhr Economic Paper #1233 "Monetary Policy and Earnings Inequality: Asymmetric Effects Across the Distribution"

Responsible Editor: Volker Clausen

Jointly published by

RWI – Leibniz-Institut für Wirtschaftsforschung e.V.
Hohenzollernstr. 1-3, 45128 Essen, Germany

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RWI – Leibniz Institute for Economic Research, Hohenzollernstr. 1–3, 45128 Essen, Germany
www.rwi-essen.de

RWI is funded by the Federal Government and the federal state of North Rhine-Westphalia.
The Institute has the legal form of a registered association; Vereinsregister, Amtsgericht Essen VR 1784

The working papers published in the series constitute work in progress circulated to stimulate discussion and critical comments. Views expressed represent exclusively the authors' own opinions and do not necessarily reflect those of the editors and institutions.

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ISSN 1864-4872 (online)
ISBN 978-3-96973-419-3
DOI https://dx.doi.org/10.4419/96973419

Monetary Policy and Earnings Inequality: Asymmetric Effects across the Distribution

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Working paper version:
November 12, 2026

Abstract

This paper studies the asymmetric effects of monetary policy on earnings and unemployment across the earnings distribution, and evaluates whether these asymmetries have implications for inequality. I combine newly constructed high-frequency monetary policy surprises for the German Bundesbank with established Euro Area shocks and novel monthly measures of earnings inequality derived from German administrative data (1984–2023). While conventional symmetric specifications suggest that monetary tightening modestly increases earnings inequality, allowing for asymmetries reveals fundamentally different mechanisms. Expansionary shocks significantly compress earnings inequality by raising earnings across the distribution, with the largest gains accruing to low-wage workers. By contrast, contractionary shocks primarily increase unemployment among low-paid workers, generating compositional changes rather than increases in earnings inequality among the employed. These findings reject the assumption of symmetry, are consistent with downward wage rigidity and suggest that the scope for monetary policy to generate higher earnings dispersion in the long term is limited.

Keywords: monetary policy, asymmetry, earnings, wage inequality, temporal disaggregation, high-frequency surprises

JEL Codes: C43, E24, E32, E52

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1 Introduction

How does monetary policy affect inequality? This question is central to understanding the dynamics of inequality and assessing whether central banks should account for the distributional consequences of their policies. The interaction between monetary policy and inequality has received considerable attention, highlighting the distributional effects of the transmission and effectiveness of monetary policy (Kaplan et al., 2018). Most empirical studies find that monetary tightening temporarily increases earnings inequality (e.g. Amberg et al., 2022). However, the evidence remains inconclusive, with some studies documenting effects in the opposite direction (e.g. Hubert and Savignac, 2023).[1] Establishing the relationship between monetary policy and inequality is far from trivial. Inequality measures are scarce and typically available at lower frequency than monetary policy changes, and the appropriate form of nonlinearity in this relationship remains unclear. A common assumption is that monetary policy has symmetric effects: expansionary and contractionary shocks affect inequality in opposite but equally sized ways. This assumption is restrictive in light of robust evidence that output and employment flows responds more strongly to contractionary than to expansionary monetary policy (e.g. Cover, 1992; Garibaldi, 1997). If contractionary monetary policy has stronger effects than expansionary policy, its adverse consequences for inequality may accumulate over time, potentially generating long-term distributional effects. Yet, little is known about whether monetary policy has asymmetric effects on earnings and inequality and, if so, what drives these asymmetries.

This paper contributes to the literature by distinguishing the impact of expansionary and contractionary monetary policies on earnings and unemployment across the earnings distribution, and their consequences for earnings inequality. Moreover, it assesses the role of downward wage rigidity across the distribution as the underlying reason for asymmetric monetary policy effects. Two central challenges arise in this context: (i) identifying exogenous monetary policy variation across multiple tightening cycles to have sufficient observations of expansionary and contractionary shocks, and (ii) obtaining earnings and inequality measures at a frequency that matches monetary policy announcements

[1] See Colciago et al. (2019) for a review of the literature on the effects of monetary policy on income and wealth inequality.

to clearly distinguish between effects of positive and negative surprises. To address these challenges, this paper derives new high-frequency monetary policy surprises for the German Bundesbank (1984–1999), in addition to well-known shocks for the Euro Area (Altavilla et al., 2019). To construct monthly earnings percentiles and inequality measures, I follow a new approach by exploiting within-year observations from German social security data (SIAB) to interpolate monthly dynamics for the period 1984–2023 (Groiss, 2023). As the largest Euro Area economy, Germany's unique SIAB data is of interest beyond its borders, since many countries have experienced rising earnings inequality amid persistent downward wage rigidity.

The empirical analysis combines monthly data on earnings and unemployment across the earnings distribution with high-frequency monetary policy surprises in a flexible local projection framework. This approach allows to identify both the distributional consequences of monetary policy and the extent to which these effects differ between expansionary and contractionary shocks. As the ECB period includes a phase at the zero lower bound and two extraordinary crises - the Global Financial Crisis (GFC) and the COVID-pandemic - clearly identifying conventional monetary policy effects remains challenging. Therefore, I have extended the shock series to include high-frequency changes in German interbank rates around the Bundesbank's policy announcements between 1984 and 1998. This generates a new set of high-frequency shocks that can be used in a wide range of analyses, enabling to examine 40 years of monetary policy across four business cycles. My approach follows and complements state-of-the-art high-frequency literature, resulting in consistent, exogenous effects of monetary policy on financial and macro variables.

In line with the existing literature, I find that a monetary tightening — when shocks are treated symmetrically — reduces earnings, increases unemployment, and modestly raises earnings inequality among employed. Allowing for asymmetries, however, reveals substantially different transmission mechanisms. Expansionary monetary policy shocks generate a meaningful and statistically significant decline in earnings inequality, whereas contractionary shocks produce only limited distributional effects.

Contractionary shocks lead to a pronounced increase in unemployment within a year, with the adjustment concentrated among workers at the bottom of the earnings distribution. The sharp rise in unemployment following a tightening induces a compositional shift

in employment: low-paid workers are disproportionately displaced from the workforce, mechanically raising earnings percentiles across the distribution and leaving measured earnings inequality largely unchanged. The combination of strongly rising unemployment and relatively stable real earnings of remaining workers after contractionary shocks is consistent with downward wage rigidity. The presence of downward wage rigidity across the distribution is also confirmed by an earnings function approach. Firms' ability to adjust wages downward after an adverse shock is limited, instead they adjust employment.

Expansionary shocks operate through a different channel. Because wage rigidities are less binding in expansions, accommodative monetary policy raises earnings throughout the distribution, with the largest gains accruing to low-wage workers. At the same time, expansionary shocks reduce unemployment only gradually and by a comparatively modest amount. Monetary expansions therefore stimulate aggregate demand not only by lowering unemployment, but also by improving earnings growth and job quality among workers at the bottom of the distribution, generating the equalising effects documented in the literature. These equalising effects are quantitatively stronger than the distributional effects associated with contractionary shocks, which explains why analyses imposing symmetry typically conclude that monetary policy reduces earnings inequality overall.

More broadly, the results show that both expansionary and contractionary monetary policy shocks affect earnings inequality among employed workers, albeit through distinct mechanisms. Contractionary shocks primarily operate through compositional changes induced by unemployment dynamics, whereas expansionary shocks work through differential real earnings growth, particularly for low-paid workers. The asymmetric distributional effects of monetary policy therefore arise from fundamentally different adjustments in earnings and employment across the earnings distribution.

Although the precise effects differ between the Bundesbank period (1984–1998) and the ECB period (1999–2023), asymmetric responses can be observed in both periods, which highlights the robustness of the results across monetary regimes. This also suggests that the findings are not primarily driven by the zero lower bound, which could create its own asymmetries. The results are also not driven by differences in the state of the economy, shock size, or other adjustments to the empirical specification. These findings are important for understanding the effects of monetary policy on inequality and for

reconciling partly opposing results in the empirical literature. They also call for downward wage rigidity to be implemented in heterogeneous agent models in order to correctly capture the asymmetric policy effects at the bottom of the distribution.

Finally, the results are also relevant for policymakers. Focusing solely on expansionary periods, or failing to consider asymmetries, could lead to misleading conclusions. This applies not only to the aggregate outcomes of monetary policy, but also to its distributional effects. Furthermore, while expansionary monetary policy can increase wealth or capital income inequality by benefiting asset owners, it can also reduce earnings inequality. At the same time, the results demonstrate that the distributional effects of monetary policy are mostly transitory. In fact, the equalising effects of expansionary monetary policy on earnings are stronger than the unequalising effects of contractionary policy. This suggests that there is no cause for concern regarding the accumulation of unequal outcomes beyond unemployment, enabling central banks to prioritise aggregate outcomes.

Related literature. This study relates to three strands of the literature. First, it contributes to the studies that identify exogenous monetary policy shocks using high-frequency data. Since Kuttner (2001) identified policy surprises through daily changes around monetary policy announcements, this approach has been extended by several papers (e.g. Gürkaynak et al., 2005; Swanson, 2021). Altavilla et al. (2019) have constructed a database capturing monetary policy surprises in the Euro Area, and Jarociński and Karadi (2020) show how to control for central bank information effects. Bredin et al. (2009) use daily changes in German market rates (1989-1998) to describe the effects of unexpected policy changes on the stock market. However, these monetary policy surprises are not publicly available and do not control for central bank information effects to provide a consistent framework for describing policies in both periods.[2]

Second, this study contributes to the literature on the asymmetric effects of monetary policy. Since the pioneering work of Cover (1992), many researchers have demonstrated that contractionary monetary policy has a stronger negative impact on output than expansionary monetary policy has a positive impact (e.g. Barnichon and Matthes, 2018; Debortoli et al., 2025; Tenreyro and Thwaites, 2016). This finding also holds for the Eu-

[2]Cloyne et al. (2022) use archival data of the Bundesbank in a quasi-narrative approach to construct monetary policy shocks for the Bundesbank in the spirit of Romer and Romer (2004).

ropean economy (Karras, 1996), employment dynamics (Garibaldi, 1997; Alessandri et al., 2025) and wages (Jackson and Kurt, 2025). For prices, the findings are more mixed, with mostly symmetric responses (Karras, 1996; Angrist et al., 2018), similar to the symmetric responses at the European financial markets (Altavilla et al., 2019). So far, little attempt has been made to analyse the asymmetric consequences of monetary policy on earnings and employment across the distribution and, consequently, on inequality.

Third, this paper contributes to the rapidly growing body of literature on the relationship between monetary policy and inequality. The majority of publications find that expansionary monetary policy boosts wages and reduces earnings inequality within different institutional frameworks - in the US (Coibion et al., 2017), Sweden (Amberg et al., 2022), Germany (Groiss, 2023; Mitman et al., 2022), and the EU (Lenza and Slacalek, 2018). This is supported by the theoretical insight that reductions in unemployment following expansionary monetary policy benefit poorer households relatively more than richer households (Gornemann et al., 2016). However, empirical studies have also found reverse (or insignificant) effects, such as those observed in Japan (Inui et al., 2020) and France (Hubert and Savignac, 2023). The literature has in common that it implies that the effects of monetary policy on the labour market are symmetric. However, asymmetric effects of monetary policy call this assumption into question, and the mixed findings of the inequality literature point to possible misspecifications.

It is not clear ex ante whether the distributional effects of monetary policy are linear. Recent evidence points to important nonlinearities. Merikül and Rottner (2025) show that the transmission of monetary policy depends on the inflation environment, while Hsueh et al. (2025) find that fiscal and monetary policy affect consumption inequality differently across the business cycle, but report no state dependence for wage inequality. These findings suggest competing channels: if contractionary policy has stronger real effects, tightening may disproportionately reduce earnings and increase inequality; conversely, strong downward wage rigidities may dampen earnings declines at the bottom, allowing expansionary policy to generate larger equalising effects.

Early on, Furceri et al. (2018) distinguish between expansionary and contractionary shocks and conclude that tightening has a stronger impact on net income inequality. This paper revisits and extends their findings along several dimensions. First, I identify

monetary policy shocks at the meeting level rather than annually, allowing for a sharper distinction between expansionary and contractionary surprises. Second, I focus on gross earnings across the distribution rather than aggregate inequality measures such as the disposable income Gini coefficient,[3] thereby isolating labour income dynamics from transfers and capital income. In contrast to Furceri et al. (2018), I find that contractionary shocks have limited distributional effects, while expansionary shocks significantly compress the earnings distribution. Third, using granular SIAB data over several business cycles (1984-2023), I show that downward wage rigidity is consistently explaining these asymmetries, with effects originating from the bottom of the distribution.

The paper is structured as follows. Section 2 introduces theoretical concepts related to the research question. Section 3 derives high-frequency monetary policy surprises considering the institutional differences between Bundesbank and ECB. Section 4 describes the labour market data used and the estimation of the monthly wage dynamics. Section 5 presents the econometric framework and the general results, before testing the asymmetry of monetary policy effects. Section 6 concludes.

2 Theoretical Motivation

This section develops the theoretical motivation for why monetary policy may affect earnings inequality asymmetrically. The central argument is that monetary policy affects wages, and employment differently across the earnings distribution, and that these responses need not be symmetric for expansionary and contractionary shocks. In particular, downward wage rigidity can make employment the main margin of adjustment after contractionary shocks, especially among low-paid workers, while expansionary shocks can raise earnings more directly once wage rigidities are no longer binding.

Monetary policy affects earnings only indirectly. Expansionary monetary policy eases financial conditions, and stimulates consumption, investment, and labour demand. Contractionary monetary policy operates in the opposite direction by tightening financial

[3]The Gini coefficient does not show where the distributional effects come from, collapsing all information into one indicator that is sensitive to changes in the middle of the distribution and hard to interpret.

conditions and reducing demand. These aggregate effects are transmitted to households through changes in employment probabilities, hours, wages, and job quality. Because workers differ in their exposure to unemployment risk, bargaining power, labour supply elasticities, and position in the wage distribution, monetary policy has distributional consequences in addition to its aggregate effects. A key mechanism is the *earnings heterogeneity channel*, which describes how monetary policy affects earnings inequality through heterogeneous earnings responses across workers.[4]

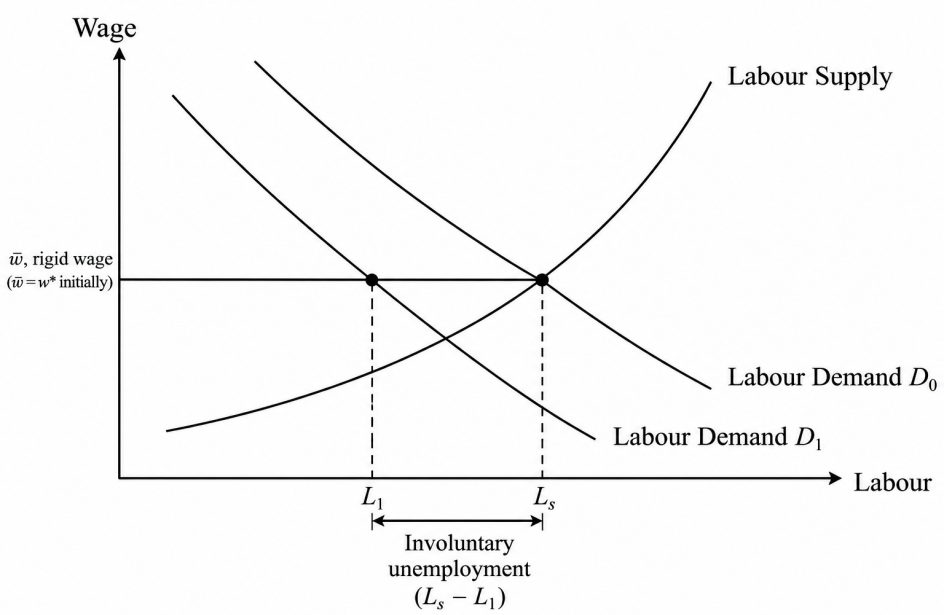
Theoretical predictions regarding the effect of monetary policy on earnings inequality are not unambiguous. In the models of Gornemann et al. (2016) and Lee (2026), contractionary monetary policy has unequalising effects because low-paid workers face higher unemployment risk and have fewer opportunities to insure themselves against adverse labour market shocks. A monetary tightening therefore reduces labour income particularly strongly at the bottom of the distribution. This prediction is consistent with empirical evidence showing that unemployment risk is concentrated among low-income workers during recessions (Krueger et al., 2010) and after contractionary monetary policy shocks (Mitman et al., 2022). In this view, tighter monetary policy raises inequality because workers at the bottom of the earnings distribution are more exposed to employment losses and income declines.

On the other hand, Faia et al. (2022) emphasises a labour mobility channel through which contractionary monetary policy can reduce measured earnings inequality among employed workers. If firms lay off the least productive or lowest-paid workers first, the composition of employment changes. Low-paid workers leave employment, while the remaining workforce has higher average earnings. As a result, earnings inequality measured among employed workers may decline or remain stable.[5] Therefore, a contractionary shock may reduce labour demand most strongly for low-paid workers. If these workers become unemployed, they exit the earnings distribution observed among employees. This mechanically raises lower earnings percentiles among the employed and can mute, offset, or even reverse the direct unequalising effect of job losses. Hence, the effect of contractionary monetary policy on measured earnings inequality among employed workers is theoreti-

[4]See Coibion et al. (2017) and Colciago et al. (2019) for overviews of the distributional channels of monetary policy.

[5]Dolado et al. (2021) argue that contractionary monetary policy can reduce inequality by lowering investment in new technologies and thereby compressing skill premia.

Figure 1: Convex labour supply with downward wage rigidity



cally ambiguous. By contrast, an expansionary shock increases labour demand and may improve earnings for low-paid workers without producing the same negative selection out of employment.

An important reason to expect asymmetric effects is downward wage rigidity. A large literature documents that wages are more flexible upward than downward, both because of institutional constraints and because nominal wage cuts can reduce effort, and worker retention (Dickens et al., 2007). In macroeconomic models with downward wage rigidity, aggregate supply is convex and output responds more strongly to contractionary than to expansionary monetary policy shocks (Abbritti and Fahr, 2013; Benigno and Antonio Ricci, 2011). When adverse demand shocks occur, firms cannot easily reduce wages, especially if wages are close to contractual, institutional, or reservation-wage constraints. Instead, they adjust on the extensive margin by reducing employment. When demand improves, however, wage increases are less constrained, allowing earnings to respond.

Figure 1 illustrates this intuition. If wages are close to the reservation value or to a wage floor ($\bar{w}$), a negative labour demand shock cannot be fully absorbed by lower wages. A small decline in wages may therefore be associated with a large reduction in employment. By contrast, when labour demand increases, wages can rise more freely and employment adjusts more gradually. The same demand shock can therefore have different effects

depending on its sign: contractionary shocks generate stronger employment responses, while expansionary shocks generate stronger earnings responses among employed workers.

These asymmetries should be particularly relevant at the bottom of the earnings distribution. Low-paid workers are more likely to be close to reservation wages, collectively bargained minima, or other wage floors. Downward wage rigidity is therefore more likely to bind for low-paid workers than for high-paid workers. This implies that firms facing a contractionary monetary policy shock are more likely to reduce employment among low-paid workers rather than cut their wages. In contrast, after an expansionary shock, low-paid workers may benefit from stronger labour demand through higher wages, longer hours, improved job matches, or transitions into better-paid employment.

The insider-outsider framework provides an explanation for why these effects differ across the distribution (Lindbeck and Snower, 2001). Insiders, such as workers with permanent contracts, higher tenure, union coverage, or firm-specific skills, are better protected against wage cuts and dismissals. Outsiders, including low-paid, temporary, or marginal workers, bear a larger share of employment adjustment. During downturns, firms may therefore preserve wages and employment conditions for insiders while reducing employment among outsiders. During expansions, stronger labour demand can improve the outside options of low-paid workers and increase their wage growth. This reinforces the prediction that contractionary shocks operate mainly through unemployment at the bottom of the distribution, whereas expansionary shocks operate more strongly through earnings growth.

Taken together, the theoretical literature implies that monetary policy can affect earnings inequality through two distinct margins. First, it changes earnings among employed workers. Second, it changes the composition of employment by moving workers into and out of employment. Downward wage rigidity suggests that these margins respond asymmetrically. Contractionary monetary policy should generate stronger employment losses than wage declines, especially among low-paid workers. Expansionary monetary policy should generate stronger earnings gains, because upward wage adjustment is less constrained. Consequently, the effect of contractionary policy on earnings inequality among employed workers may be limited or ambiguous, while expansionary policy is expected to reduce earnings inequality due to strong earnings gains at the bottom.

The empirical analysis is therefore guided by the following hypotheses:

H1: Monetary policy has asymmetric effects on labour market outcomes. Contractionary shocks have stronger effects on unemployment than expansionary shocks, whereas expansionary shocks have stronger effects on earnings among employed workers than contractionary shocks.

H2: Monetary policy effects are heterogeneous across the earnings distribution. Earnings and employment responses are stronger at the bottom of the earnings distribution than at the top.

H3: The asymmetry between expansionary and contractionary monetary policy is strongest at the bottom of the earnings distribution, where downward wage rigidity and employment risk are most relevant.

3 Monetary Policy Identification

In order to measure the causal effect of monetary policy on the labour market, it is crucial to control for the economic fundamentals to which central bankers respond. Focusing on a narrow window around the announcement of monetary policy decisions can help to overcome this identification challenge. This allows the unexpected variation in policy to be disentangled from the expected changes, thereby controlling for omitted variable bias as well as reversed causality (Kuttner, 2001).

I use the high-frequency financial market variables provided by Altavilla et al. (2019) to identify exogenous monetary policy changes by the ECB. However, there is no comparable shock series available for the German Bundesbank.[6] In order to utilise most the of German social security data available and to analyse a period not subject to the zero lower bound (ZLB), I derive unexpected monetary policy shocks from Germany for the period 1984 to 1998. Although analysing two different institutions requires accounting for this structural break, its impact is arguably limited. Firstly, the ECB was established in Germany, and its structure, statutes, and objectives closely align with those of the Bundesbank.

[6] Bredin et al. (2009) use daily changes in German market rates (1989-1998) to describe unexpected monetary policy changes, but did not make them publicly available.

Furthermore, Germany is the Euro Area's largest economy, accounting for around 25% of its GDP, so that Euro Area indicators tend to follow German ones. Furthermore, West German financial and labour market variables have been reported consistently over time. The results for different sub-periods and alternative variables in Section 5.6 confirm the similarity between the Bundesbank and the ECB and demonstrate the robustness of my findings.

3.1 Institutional Setting

The Zentralbankrat (central bank council) of the **German Bundesbank** was responsible for discussing and deciding on Germany's monetary policy. The Zentralbankrat met every two weeks on Thursdays, although on some special occasions it was necessary to extend the meeting to two days. Meetings usually ended in the late afternoon, after which a press release was sent out in the event of a change in the policy rate. As newspapers did not publish this information until the evening edition at the earliest, and usually the following day, German financial markets were unlikely to be affected on the day of the decision (Hardy, 1998). Even if financial market experts were waiting for the press release, they were usually unable to react immediately, as the German stock and bond markets closed between 16:00 and 17:00 in the 1980s and early 1990s (Göppl et al., 1999).[7] Therefore, most of the financial market responses are expected to occur on the next day, which is supported by the data. Although the daily frequency of financial variables available for the Bundesbank period is inferior to the ECB period's tick data, the Bundesbank's less transparent institutional setting and the slower media coverage of the late 20th century allow monetary policy surprises to be identified.[8]

The policy tools decided upon were the Diskont rate and the Lombard rate, which are comparable to the Deposit Facility rate and the Marginal Lending Facility rate of the ECB. Therefore, monetary policy was primarily implemented through short-term nominal interest rates. According to the minutes, economic conditions were discussed at

[7] The switch from floor trading to a more flexible electronic trading system only occurred in 1997 with the introduction of Xetra (Gomber, 2016).

[8] Gürkaynak et al. (2005) and Altavilla et al. (2019) show the similarity in the monetary policy surprises using daily instead of hourly windows. Kaen et al. (1997) show that German repo rates sometimes changed before Diskont rate changes were announced due to speeches and other events. This can be controlled for by the daily windows applied.

every meeting, but interest rates were changed at most once per month except for March 1993 (see Table A.2). The German Bundesbank is renowned for its money growth targets, which, however, have always been set in line with an inflation target. Research by Clarida and Gertler (1997) has shown that the objectives and reaction function of the Bundesbank were similar to those of other central banks, such as the Federal Reserve. Controlling for the announcement of a new monetary growth target does not alter the results.

The **European Central Bank's** Governing Council decides on the monetary policy of the Euro Area, including Germany. The Governing Council meets every two weeks, however, monetary policy decisions were on the agenda only once a month after November 2001 and have been discussed every six weeks since 2015. Compared to the Bundesbank era, monetary policy has become more transparent, with decisions communicated more broadly and swiftly. The dates and times of monetary policy decisions are announced in advance, and the decisions are communicated via a press release and press conference held after the meeting in the early afternoon. Both are available on the ECB's website. Consequently, the announcement affects financial markets on the same day, meaning that a narrower window is needed to capture monetary policy surprises. Further details on monetary policy decision-making by the ECB can be found in Altavilla et al. (2019).[9]

3.2 Monetary Policy Surprises

Monetary policies are dated according to the last day of the respective decision-making council's policy meeting. To capture unexpected changes, the measurement windows must be adjusted according to the prevailing settings. During the time of the Bundesbank, rates were announced in the media with delay and became effective on the next day. Therefore, monetary policy surprises arise between $t+1$ and t. In contrast, the ECB's decisions affect the market on the same day, so intra-day data must be used to compare financial market variables before and after the policy meeting. Data capturing changes in financial market indicators within a 3-hour window around the press conference are used for the

[9]The ECB introduced new monetary policy tools like Forward Guidance and the Asset Purchase Programme (Quantitative Easing) to affect medium to long-term interest rates after the GFC. While I focus here on conventional measures, the interested reader is refereed to Groiss (2023) for a detailed comparison.

ECB (Altavilla et al., 2019).[10]

For both periods, I focus on high-frequency changes in short-term nominal interest rates in order to capture the impact of monetary policy announcements. For the Bundesbank period, I use the daily changes in the three-month German (Frankfurt) interbank rate to measure unexpected changes in monetary policy, in line with Amberg et al. (2022) for Sweden. For the ECB period, I use changes in the three-month overnight index swap (OIS) rates within a 3-hour window around the policy announcement as a benchmark. I follow the literature (e.g. Gertler and Karadi, 2015; Jarociński and Karadi, 2020) by using the 3-month rates as it captures the expectations regarding the following meeting even at six-week intervals. This aligns with the quarterly frequency of central bank forecasts.[11]

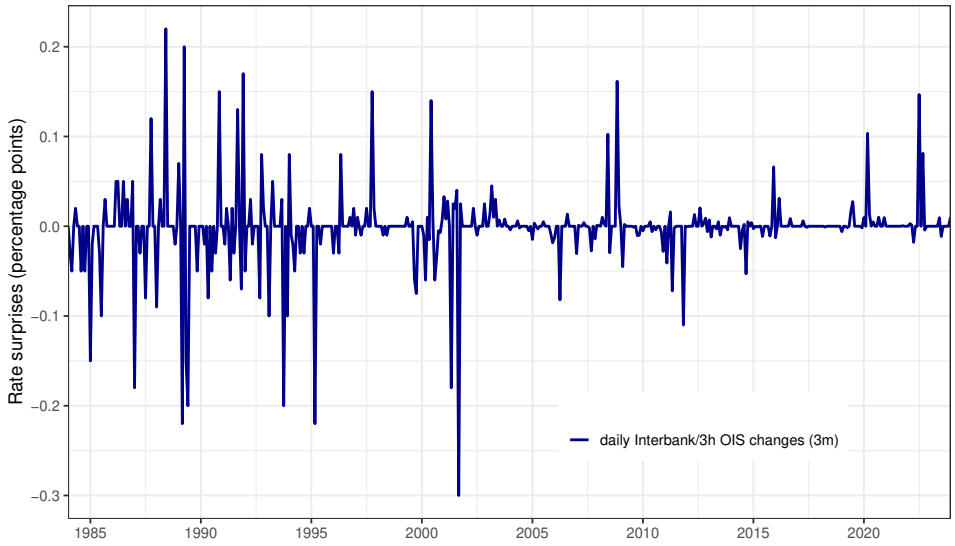
In order to control for central bank information effects, I apply poor man's sign restrictions, as described in Jarociński and Karadi (2020), before aggregating the shocks at a monthly frequency. Specifically, I use monetary policy surprises where daily stock price (DAX) changes were opposite to interest rate changes, to proxy pure monetary policy shocks. Otherwise, I set the surprise to zero. Out of the 364 Bundesbank and 300 ECB policy meetings, around a quarter in both periods are identified as information events. Figure 2 visualises the resulting monetary policy surprises between 1984 and 2023. Summary statistics are documented in Table A.3. As monthly aggregation combines two surprises during the Bundesbank and early ECB periods, I check for months with opposing surprise directions. Only ten of 480 months contain both positive and negative surprises, potentially blurring the identification of asymmetric effects. Excluding these months leaves the results unchanged.

To test the reliability of the monetary policy shock series and to compare it to the existing literature, I regress daily changes in policy rates and financial market variables on my high-frequency shocks. Table 1 shows the estimates for the Bundesbank period

[10]Using daily data instead of data from 3-hour windows around announcements involves a trade-off. While it is more likely to capture the full adjustment in financial markets, interest rate changes are more likely to be affected by other monetary policy related shocks. To account for this possibility, I check the exogeneity in both periods by regressing monetary policy surprises onto high-frequency financial and monthly macro data following Bauer and Swanson (2023) (see Table A.5), and controlling for lagged macro indicators in my regression analysis.

[11]While I cannot reduce the window size during the Bundesbank period, as intraday data are unavailable, I analyse daily changes in the 3-month EA OIS rate and the 3-month German interbank rate over the ECB period. I find a high correlation between these two daily indicators and the 3-hour OIS rate changes (0.68 and 0.74), and achieve similar results when using them in the analysis.

Figure 2: Monetary policy shocks



Note: Monetary policy shocks based on daily changes in the Interbank rates from Germany (1984-1999) and 3 hours changes in OIS rates of the EA-MPD by Altavilla et al. (2019). The shocks are cleaned for information effects.

(Panel A) and the ECB period (Panel B). Changes in the Diskont rate and the main refinancing operations rate are strongly and positively related with the monetary policy shocks, pointing to the good approximation of short-term market rates to capture the policy stance.[12] Moreover, the immediate responses of government bond yields, the stock market, and exchange rates are as expected and similar for both periods. However, while the long-term effects of policy rate changes are stronger during Bundesbank times - most likely because of the absence of unconventional monetary policy tools - the stock market effects are stronger than during the ECB period.

Moreover, the responses of key macroeconomic variables to the monetary policy shocks are consistent with the empirical literature (see Jarociński and Karadi (2020) for the EA and Bauer and Swanson (2023) for the US).[13] Real GDP declines and reaches its trough after 12 months. The inflation rate declines, albeit more slowly, achieving the strongest policy effect after 30 months. Following a contractionary shock, the unemployment rate increases steadily, reaching its maximum after 25 months. The impulse response functions

[12]Using the alternative $t-(t-1)$ window for the Bundesbank period results in an insignificant coefficient of 0.3, indicating little information provided on the meeting day.

[13]I estimate local projections as defined by equation (1) in Section 5.1, but with macro indicators as dependent variable and assuming symmetry. Figure C.1 test for asymmetric monetary policy effects on GDP and inflation.

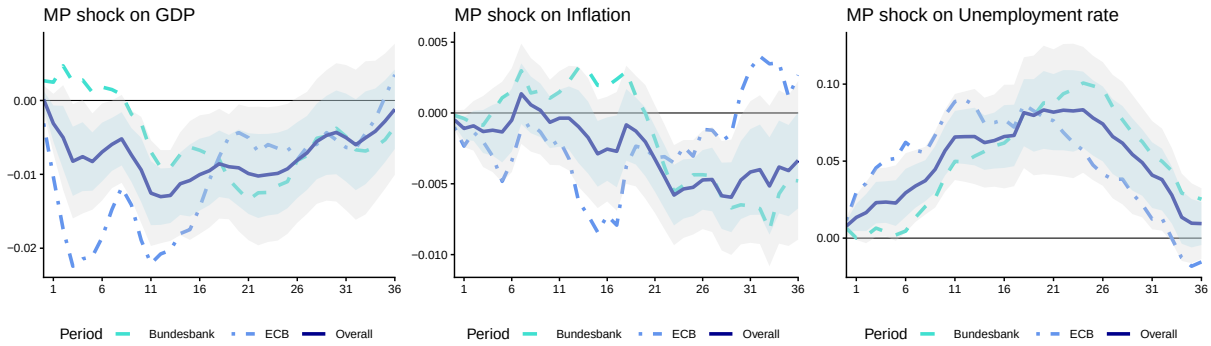
Table 1: Monetary Policy Shocks - Financial Market Effects

	Dependent variable:						
	Policy Rate	3m Gov bond	1y Gov bond	2y Gov bond	10y Gov bond	DAX	GER-US
	Panel A: Bundesbank period (1984-1998)						
MP Shock	0.905***	0.310***	0.828***	0.365***	0.256***	−0.085***	0.002
	(0.188)	(0.118)	(0.165)	(0.089)	(0.055)	(0.015)	(0.018)
Constant	-0.002	−0.003	0.002	−0.005	−0.001	0.0002	−0.001
	(0.008)	(0.003)	(0.004)	(0.004)	(0.002)	(0.001)	(0.001)
Meetings	364	99	119	364	364	364	364
R^2	0.060	0.067	0.176	0.045	0.057	0.085	0.00002
	Panel B: ECB period (1999-2023)						
MP Shock	1.253***	0.316***	0.333***	0.540***	0.046	−0.213***	−0.035
	(0.294)	(0.100)	(0.087)	(0.122)	(0.099)	(0.030)	(0.024)
Constant	0.009	−0.008***	0.001	0.004	0.003	−0.001	0.0005
	(0.009)	(0.003)	(0.003)	(0.004)	(0.003)	(0.001)	(0.001)
Meetings	300	300	300	300	300	300	300
R^2	0.054	0.032	0.047	0.061	0.001	0.143	0.007

Note: The table presents OLS regressions of the daily changes in the policy rate (Diskont rate or main refinancing operations rate), (3 month, 1 year, 2 year, 10 year) German government bond yields, German stock market index (DAX) and exchange rates (Mark-US or Euro-US) on the monetary policy surprises (1 pp increase) for the Bundesbank period (1984-1998) and the ECB period (1999-2023). Robust standard errors in the parenthesis.
*p<0.1; **p<0.05; ***p<0.01

(IRFs) also compare the responses to Bundesbank monetary policy surprises (dashed turquoise) and ECB surprises (dot-dashed light blue). While the strength of the response varies, the qualitative results are consistent, and for most horizons, the responses remain within the confidence bands of the overall period. This indicates the reliability of monetary policy shocks for the Bundesbank and the similarity between the institutions.

Figure 3: Macro responses to monetary policy shocks



Note: The figure plots the responses of real GDP growth (interpolated with the industrial production index), inflation (y-o-y GDP deflator, interpolated by CPI) and the unemployment rate to monetary policy surprises (+25 bp). Controls include the lags of the dependent variable, monetary policy surprises, and various macro indicators as in the main analysis in Section 5. The solid dark blue line represents the overall period (1984-2023), the dashed turquoise line the Bundesbank period (1984-1998) and the dot-dashed light blue line the ECB period (1999-2023). The shaded area depict the 68% and 90% confidence bands for the overall period based on Newey-West standard errors.

4 Measuring Inequality

While monetary policy is identified at a monthly frequency, earnings and inequality measures are usually only available annually. To link earnings distribution information to monetary policy changes without mixing expansionary and contractionary surprises, labour market data at a higher frequency are required. The spell structure of the Sample of Integrated Labour Market Biographies (SIAB), which contains numerous within-year observations, enables annual earnings percentiles to be interpolated at a monthly frequency.

4.1 SIAB data

The SIAB is a 2% random sample of the German labour force, containing all notifications to the social security system. I use the factually anonymised data (Schmidtlein et al., 2025a) containing the employment history of over two million workers, covering the period from 1975 to 2023. These data are representative of all individuals covered by the social security system, excluding civil servants and the self-employed.[14] The main advantages of the SIAB, besides covering half a century, are its large sample size of over 300,000 workers each month, the reliability of the reported earnings, and the daily frequency with which job change information is updated. Since 1992, the SIAB has also covered East German workers. However, to maintain a consistent sample, I focus on West German employees only.[15] Importantly, the reported values are daily gross wages. They do not take into account taxes or subsidies, which could distort the analysis of the earnings distribution.

The SIAB also has its drawbacks. Wages are right-censored by the social security contribution limit, affecting 6% to 13% of workers per month. Therefore, I use the 80–20 percentile ratio as my baseline measure of earnings inequality, as this is not affected by top-coding.[16] Furthermore, the SIAB data does not contain information on hours worked. Consequently, all subsequent results must be interpreted as a combined change in hourly

[14] The SIAB captures between 80% and 85% of the German labour force every year.

[15] After the Reunification, the East German economy accounted for only 10% of Germany's overall GDP, and its share is still only at 16%, which limits the impact of exclusion on my results.

[16] On average, 8.7% of wages are censored. Imputing the censored wages according to Dauth and Eppelsheimer (2020) and estimating the results for the 90-10 ratio leads to similar results. Consistently, Amberg et al. (2022) and Merikül and Rottner (2025) do not find significantly different monetary policy responses between the top 1% and the median earnings.

wages and hours worked. Details on the SIAB can be found in the IAB's data report (Schmidtlein et al., 2025b).[17]

The SIAB has a rather complicated spell structure, with individual-level reports for each notification to the social security provider. Following Dauth and Eppelsheimer (2020), I create a monthly panel dataset by summing earnings in cases of multiple jobs and focusing on the longest spell in cases of several jobs within a month. Over time, changes in the data have made it necessary to adjust for potential structural breaks. Bonus payments have been included in the earnings measure since 1984. Therefore, in line with the availability of other data, the analysis begins in 1984. Marginal workers have only been included since 1999 and have therefore been removed for consistency. Furthermore, the definition of part-time workers changed in 2011. In order to capture the distribution of the labour market more broadly and avoid a structural break, both part-time and full-time employees have been included. The final sample comprises 203 million monthly observations of workers aged 20–60, subject to social security contributions, working in West Germany. Unemployed workers are excluded when calculating earnings percentiles, since they do not earn wages. However, observations of unemployed workers are used to calculate monthly unemployment rates.[18] I use the German Consumer Price Index (CPI) to deflate nominal earnings.

4.2 Monthly inequality

While annual earnings deciles are directly observable in the data due to mandatory annual reporting, this is not the case at monthly frequency. However, due to the large number of additional reports submitted during each year, it is possible to extract monthly earnings dynamics for a sub-sample of workers, which can be used to inform the overall sample as shown in Groiss (2023).

For temporal disaggregation, I apply the approach of Litterman (1983), who regresses each low-frequency variable (annual earnings deciles) on an annualised high-frequency indicator series (seasonally adjusted monthly earnings deciles). This approach interpolates

[17] In line with inequality literature, I use the term 'earnings' and 'earnings inequality', which refer to average daily gross wages, instead of 'wages' and 'wage inequality' as used in the official data reports.

[18] This includes workers receiving social benefits under the German Social Code Book II or III.

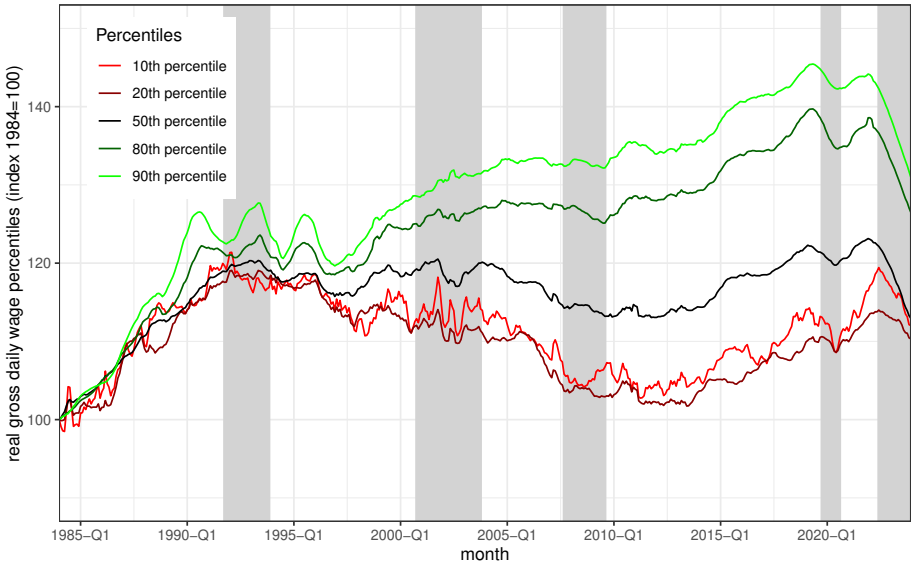
the missing monthly dynamics of the earnings deciles of the overall sample, while ensuring that the annual average of the monthly estimates is consistent with the observed annual values. This implies that the new monthly time series closely follows the annual earnings deciles, while still allowing for reasonable monthly dynamics that can be linked to the monthly monetary policy series. Further details on the temporal disaggregation approach and its robustness can be found in the Online Appendix B.1.

A crucial element of the Litterman (1983) approach is the selection of a suitable indicator series. This series should be observed at a high frequency, cover the same period, have explanatory power with respect to the low-frequency series, and demonstrate similarity across outcome variables. These criteria are fulfilled by constructing monthly earnings deciles of a sub-sample of workers with within-year reports. However, workers who start or end their job differ significantly from the overall sample, and these changes may be affected by monetary policy itself. To avoid exaggerating the dynamics, I calculate the monthly earnings deciles of all employed workers who have to submit additional reports due to other reasons. These include a change of health insurance company, a change of contribution group, a change of payroll accounting system, external wage compensation, parental leave, statutory official duties (e.g. jury duty) and extra payment. These reasons are not related to changes in monetary policy (see Table B.2). Additionally, this sub-sample of workers is highly comparable to the overall sample in terms of age, education, and tenure over time, and their annualised earning deciles develop similarly (Groiss, 2023). Due to the large overall sample size, this sub-sample contains an average of 4,500 observations per month, which can be used to calculate monthly earnings deciles (see Table B.1). All monthly series are seasonally adjusted.[19] Assuming that the dynamics of the seasonally adjusted sub-sample are representative of the overall population enables monthly earnings percentiles to be derived.

Figure 4 depicts the interpolated monthly earnings deciles of the employed population. It illustrates the growing disparity in earnings between low and high earners in West Germany since the 1980s, as well as the modest decline in earnings inequality since 2015. While top earners have seen a significant increase in real labour income, low earners have

[19] I apply the X-13ARIMA-SEATS for the seasonal adjustment, and include a level shift in 1992-M1 and allow for different seasonal patterns before and after 1992 due to the German Reunification. Outliers in 1988-M12 and 1997-M3 are controlled for.

Figure 4: Monthly earnings percentile development



Note: The figure shows the monthly development of real earnings at the 10th, 20th, 50th, 80th and 90th percentile of the earnings distribution compared to the base year 1984 (=100). Grey shaded areas depict recessions according to the German council of economic experts.

gained only ten percent over 40 years.

4.3 German labour market institutions

The German labour market is traditionally shaped by a highly coordinated system that rests on sector-wide collective bargaining and robust institutional arrangements. Pay setting is largely determined through negotiations between employers' associations and trade unions, which culminate in collective agreements (Tarifverträge) concluded at the sectoral and, in some cases, regional level. Over time, however, the reach of this system has diminished. While more than 80% of work contracts were covered in the 1980s, only about half of all employees were still directly affected by a collective agreement in 2015. Wage negotiations are typically conducted in a staggered manner across industries, with some influential sectors setting the pace, most notably the metal industry. As a result, wage developments across sectors are interlinked, although actual wage adjustments take effect at different points throughout the year. Collective agreements are usually renegotiated every one to two years, and longer-term agreements often include predefined annual wage

increases (Oberfichtner and Schnabel, 2019).[20]

In general, collective agreements are only binding for the members of employer associations and trade unions. However, many non-organised employers follow the wage setting too by signing firm contracts with the respective trade union. At the same time, recent agreements include clauses that for deviations under specific conditions to implement more flexibility. This framework is complemented by negotiations at the firm level. Works councils that exist in nearly all larger firms bargain with the individual employer. While the the collective agreements usually serve as a lower bound, the parties negotiate about payments above the tariff norm or other workplace conditions (Bauer et al., 2007).

The most crucial labour market reform in the last 25 years were the so-called Hartz reforms. Implemented in Germany between 2003 and 2005, they constituted a comprehensive restructuring of the labour market with implications for wage formation and income distribution. The reforms aimed to increase labour market flexibility and reduce structural unemployment by tightening eligibility for unemployment benefits, promoting job placement services, and incentivising low-wage and part-time employment. A side effect of these reforms was the expansion of the low-wage sector, as the reforms increased labour supply, particularly among long-term unemployed and marginally attached workers, thereby exerting downward pressure on wages at the lower end of the distribution (Dustmann et al., 2014).

Due to the declining number of collective bargaining coverage and increasing earnings inequality, Germany introduced a nationwide statutory minimum wage, initially set at €8.50 per hour in 2015 and affecting around 10% of employed workers (Fitzenberger and Seidlitz, 2020). This minimum wage has been increased several times since then, and as of January 1, 2026, it is set at €13.90 per hour. The Minimum Wage Commission, composed of representatives from both sides of industry and independent experts, is responsible for recommending adjustments to the minimum wage.

Because of the infrequent negotiation of collective agreements and minimum wages, the German labour market exhibits wage rigidity in the short term, especially downwards. While limited, adjustments in wages are still possible through extra payment, changing

[20]Detailed information on the collective agreements can be found in the Tarifarchiv: https://www.wsi.de/de/tarifrunden-16600.htm

jobs and wage contracts not covered by the collective bargaining agreements. Moreover, firms can respond through changes in employment or hours worked, which influences the earnings distribution as well. Importantly, the monetary policy effects on earnings shown in this analysis capture both, changes in the hourly wage as well as the change in working hours, which cannot be separated by the information provided in the SIAB.

5 Results

To link monetary policy shocks with monthly inequality measures, I apply a flexible local projection (LP) framework, as described in Section 5.1. As a benchmark, Section 5.2 presents labour market responses under the assumption of symmetry. Next, I distinguish between the impact of expansionary and contractionary shocks on earnings inequality in Section 5.3, and explain the findings in terms of downward wage rigidity in Section 5.4 and reject other possible reasons.

5.1 Econometric approach

To test whether monetary policy has an asymmetric effect on earnings across the earnings distribution, a flexible econometric framework that allows for non-linear relationships is required. Local projections (Jordà, 2005) can easily be adjusted and allow interaction effects to be included and interpreted (e.g. Tenreyro and Thwaites, 2016; Alessandri et al., 2025). Moreover, LPs are less susceptible to miss-specifications than VARs (Olea et al., 2025), and extensions with instrumental variables (IV) are possible (Stock and Watson, 2018). While non-linearities are easily integrated into LP, Gonçalves et al. (2021) show that consistent response functions are not guaranteed. Therefore, I adopt their approach to non-linear LP with exogenous shocks and estimate the following equation:

$$ln(y_{t+h}) - ln(y_{t-1}) = c^h + \sum_{p=1}^{P} \alpha_p^h ln(y_{t-p}) + \beta_1^h \varepsilon_t + \beta_2^h \varepsilon_t^+ + \phi^h X_{t-1} + u_{t+h}^h, \tag{1}$$

where y_t represents a real gross earnings decile or a ratio of two deciles measuring earnings inequality, e.g. the 80-20 percentile ratio, at the monthly frequency. The dependent

variable is the cumulative relative change of y_t between horizon h and the pre-policy shock period $t-1$. To reduce noise in local projection estimation, I smooth y_t using a backward-looking moving average (current and previous two months) like Cloyne et al. (2020). In line with the recommendation of Olea et al. (2025), I include P lags of the dependent variable (with a baseline of $P = 12$ months) to control for the serial correlation caused by the persistence of the earnings indicators. Further, X_{t-1} includes macro and financial control variables to improve the efficiency of the estimation and address any remaining concerns about the exogeneity of the policy shocks. c is the constant and u_{t+h} is the error term.

The coefficients of interest are β_1 and β_2, which enable the distinction between contractionary and expansionary monetary policy. ε_t contains all shocks from the high-frequency series as defined in Section 3.2, while ε_t^+ only contains positive (contractionary) shocks ($\varepsilon > 0$), being zero otherwise. Including ε and ε^+ is equivalent to including ε^- and ε^+ as done in Cover (1992) and Tenreyro and Thwaites (2016). To exclude the possibility of serial correlation, three lags of the monetary policy shocks (ε_t and ε_t^+) are included in X_{t-1}. Moreover, X_{t-1} includes twelve lags of the Consumer Price Index (CPI), the Industrial Production Index, the Commodity Price Index and a recession dummy. To account for potential differences in economic dynamics between the Bundesbank and ECB periods, I include a dummy variable indicating the ECB as the monetary authority, and allow for interaction effects between the ECB indicator and the macro controls. Excluding individual controls or changing the lag length does not significantly alter the results, as shown in the Online Appendix. Following Gonçalves et al. (2021), I derive the unconditional impulse functions.[21] The standard errors are estimated according to Newey and West (1987), accounting for potential serial correlation in the residuals.

5.2 Responses under symmetry

Before distinguishing the effects of expansionary and contractionary monetary policies, I present the estimation results based on the assumption of symmetry. This involves

[21] The response of y to a monetary policy shock of size δ at horizon h can be estimated by: $IRF_{h,\delta} = \beta_1^h \delta + \beta_2^h E\{(\varepsilon_t + \delta)^+ - \varepsilon_t^+\}$, where $(\varepsilon_t + \delta)^+ = max(\varepsilon_t + \delta, 0)$. Because the perturbation can move a surprise across zero, both coefficients generally contribute to the expansionary and contractionary IRFs.

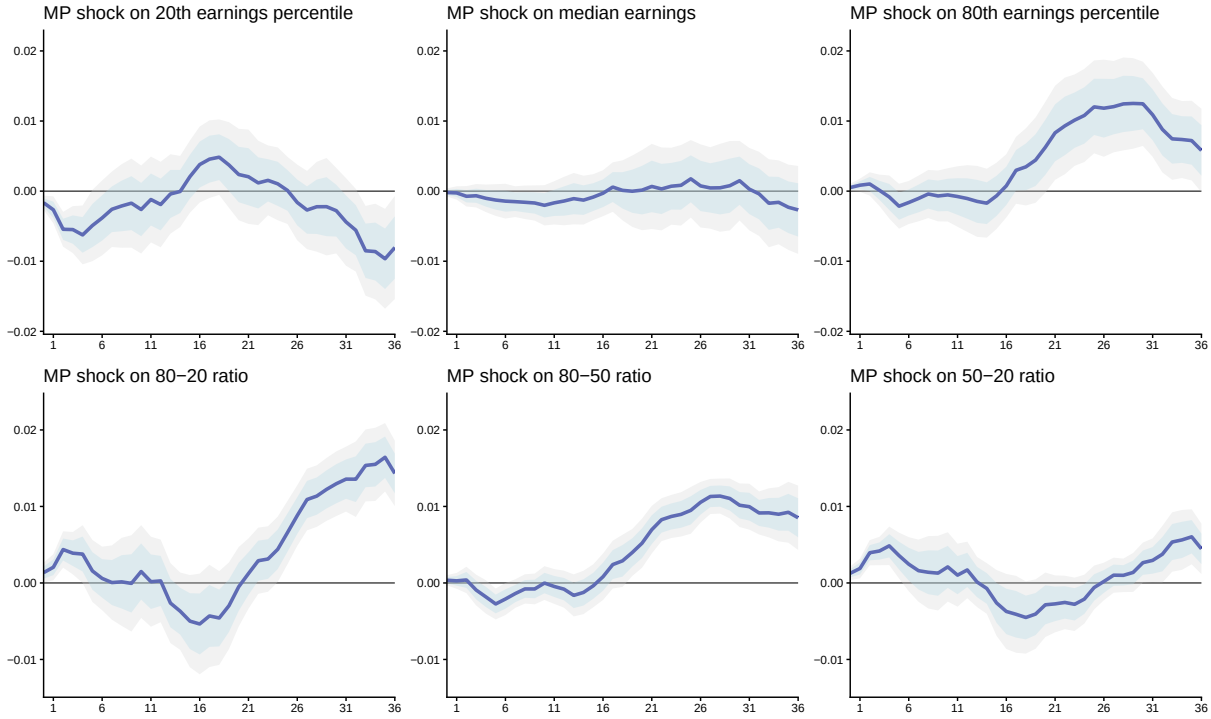
dropping β_2 from equation (1) and only estimating β_1, while keeping everything else equal. This enables the results to be linked to existing literature and provides a benchmark for the subsequent distinction.

Figure 5 shows the IRFs of the 20th, 50th and 80th earnings percentile (upper row), as well as the IRFs of the 80-20, 80-50 and 50-20 percentile ratios (lower row) to a positive monetary policy surprise (+25 bp), not allowing for non-linearities. The shaded areas depict the 68% and 90% Newey-West confidence bands. In line with the majority of empirical studies (e.g. Coibion et al., 2017; Mitman et al., 2022; Samarina and Nguyen, 2023), earnings inequality among employed increases significantly two years after a positive monetary policy shock. Most of the increase in the 80–20 earnings percentile ratio stems from the top of the distribution; however, inequality in the bottom half also increases slightly. Examining the earnings across the distribution in more detail reveals that this development is driven by a decline in the lowest earnings following tighter financial conditions. At the same time, median earnings remain unaffected and the 80th earnings percentile even increases.

While a positive earnings response to tighter monetary policy is contrary to theoretical expectations, it could indicate compositional changes resulting from different unemployment responses reflected in earnings percentiles. Faia et al. (2022) explains the distributional effects of monetary policy due to changes in worker composition, arguing that the least productive workers are laid off first. Figure 6 presents evidence of such a compositional change, showing that the increase in unemployment is largest for low-wage workers. Replacing the dependent variable in equation (1) with the unemployment rate of different earnings decile groups assesses the responses to unemployment along the earnings distribution.[22] The IRFs clearly show that workers between the first and second earnings decile are more likely to become unemployed following tighter monetary policy, than those workers with earnings between the seventh and eight earnings decile. While the unemployment response is already weak for the median worker, it is essentially non-existent at the top, in line with the unemployment responses across the earnings distribution in Coglianese et al. (2025) and Merikül and Rottner (2025). This implies a shift in the

[22]The last month's average non-zero earnings over the last three years are used to assign unemployed and employed workers to the earnings decile groups. The unemployment development is depicted in Figure B.3. In line with the earnings percentiles, I apply a seasonal adjustment and smooth the unemployment rates with a 3-month backward moving average to avoid noisy impulse responses.

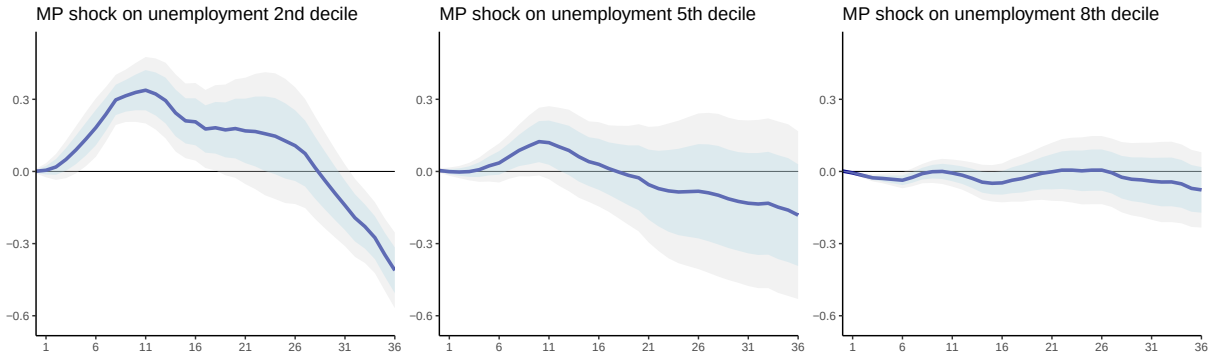
Figure 5: Earnings and inequality responses to monetary policy shocks



Note: The figure plots impulse responses as well as 68% and 90% confidence intervals (blue and grey shaded areas) of earnings deciles and percentile ratios to a 0.25 pp monetary policy surprise. Impulse responses are at the monthly frequency using data from January 1984 to December 2023. The graph depicts Newey-West standard errors.

earnings distribution (conditionally on being employed) to the right following a monetary policy shock, whereby workers with individually stable earnings are shifted to a lower percentile rank.

Figure 6: Unemployment responses to monetary policy shocks

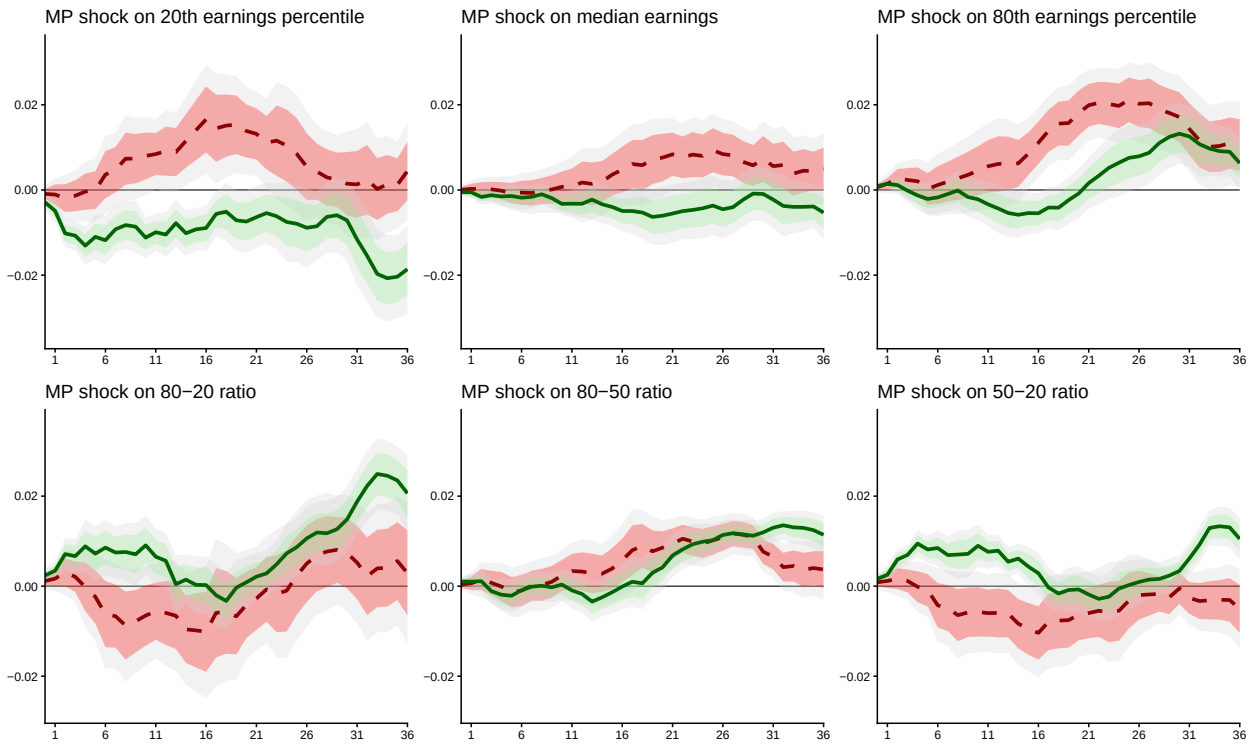


Note: The figure plots impulse responses as well as 68% and 90% confidence intervals (blue and grey shaded areas) of the unemployment rate at different earnings groups to a 0.25 pp monetary policy surprise. Impulse responses are at the monthly frequency using data from January 1984 to December 2023. The graph depicts Newey-West standard errors.

5.3 Asymmetric monetary policy effects

Distinguishing between expansionary and contractionary monetary policy shocks in equation (1) allows us to test the symmetry assumption. Figure 7 shows the responses of earnings percentiles and percentile ratios to contractionary (+0.25 pp, dashed, red) and expansionary (-0.25 pp, solid, green) monetary policy shocks. To directly asses symmetry, all IRFs are scaled to a 0.25 pp contractionary shock, i.e., the scale of the expansionary responses has been inverted. If the green and red lines (and their confidence bands) overlap, this suggests that the responses are similar except for direction, indicating symmetry. However, in many cases, there is a significant difference, which rejects the assumption of symmetric monetary policy effects. Inference is robust to using block wild bootstrapped standard errors (Gadea and Jordà, 2025) instead of Newey-West standard errors (see Figure C.2).

Figure 7: Contractionary vs expansionary monetary policy responses



Note: The figure plots impulse responses of earnings deciles and percentile ratios to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are using data from January 1984 to December 2023. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure 7 shows that an expansionary monetary policy shock (-25 bp) leads to a 2%

increase in real earnings at the bottom of the earnings distribution over three years.[23] This effect is quicker and more pronounced at the bottom of the distribution than at the middle and top. This also holds true when considering the other earnings deciles, as indicated in the Appendix (see Figure C.3). Therefore, monetary policy easing has equalising effects. The 80–20 percentile ratio declines significantly, with effects stemming from both the bottom (50–20 ratio) and top (80–50 ratio) halves of the distribution.

In most cases, the effects of contractionary monetary policy shocks do not offset these responses. A +25 bp shock does not lead to a decline, but rather an increase in the 20th, 50th and 80th earnings percentiles among employed workers. This suggests that in addition to downward wage rigidity, which reduces negative earnings responses, also compositional effects might matter. The compositional effects observed under symmetry may be particularly pertinent to contractionary monetary policy, when earnings adjustment is limited, and affect the entire distribution. As the differences between the top and bottom of the distribution are minimal, neither the 80–20 nor the 50–20 percentile ratios respond statistically significantly. Only inequality at the upper end of the distribution increases slightly two years after a contractionary shock.

To test for asymmetry in the impact of monetary policy on earnings percentiles and earnings inequality, beyond a graphical assessment, F-statistics at different time horizons are calculated. Table 2 reports whether β_h^+ from equation (1) is significantly different from zero after 12, 24, and 36 months, indicating different responses to contractionary than expansionary shocks. While there is a clear rejection of symmetric responses at the 20th earnings percentile over all estimation horizons, the effects are only weakly significant at most horizons for the 50th and 80th earnings percentiles. Regarding inequality, the 80–50 percentile ratio exhibits the most symmetrical response to monetary policy, reflecting the weaker asymmetry at the upper end of the earnings distribution. In contrast, the 50–20 and 80–20 ratios respond significantly differently to monetary policy shocks, especially towards the end of the estimation horizon. Response differences for each horizon are depicted in Figure C.5. As the estimates of local projections are not independent across horizons, I estimate a joint Wald test across the full horizon based on block bootstrapped covariance matrices (Table 2 fourth row). Accounting for the relationship with blocks of

[23] Although the responses to expansionary shocks are inverted to assess symmetry, I describe them according to their actual effects.

36 months and 999 drawn samples confirms the asymmetric monetary policy effects at the bottom of the earnings distribution.

Table 2: Symmetry test - F-Statistics

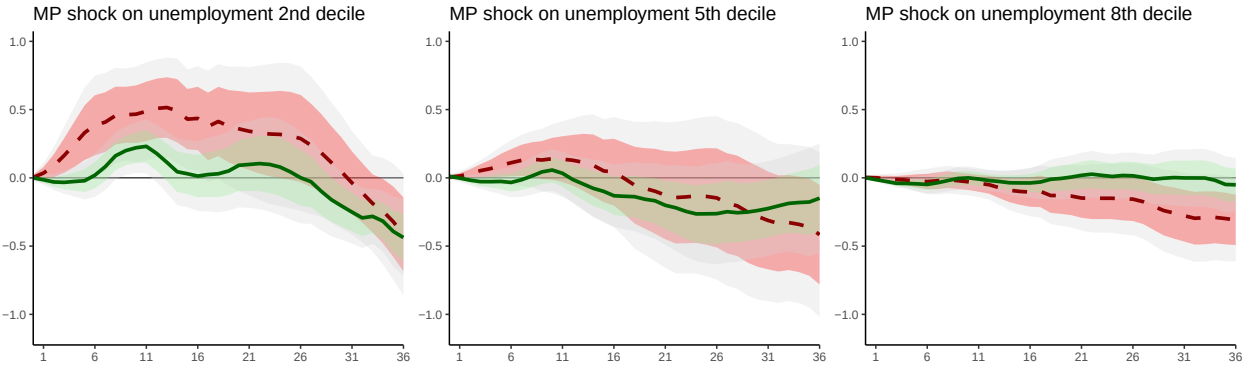
	20th perc	50th perc	80th perc	80-20 ratio	80-50 ratio	50-20 ratio
$\beta^+_{12} = 0$	4.407***	0.640	2.567*	1.557*	0.950	4.149***
$\beta^+_{24} = 0$	2.813**	1.717*	1.935*	0.844	0.004	0.603
$\beta^+_{36} = 0$	3.891***	1.127*	0.184	2.700**	1.472*	4.536***
$\sum_t \beta^+_t = 0$	53.36***	25.43	37.07	64.94***	62.63***	50.33**

Note: This table reports F-Statistics to test the hypothesis of symmetry of monetary policy shocks on earnings percentiles and inequality measures across time (12 months, 24 months, 36 months). The last row reports joint Wald statistics, testing asymmetry over the full horizon, based on block bootstrapped covariances. * p<0.32, ** p<0.10, *** p< 0.05

As the positive responses of earnings percentiles to contractionary monetary policy point to compositional effects, I test for differences in the responses of unemployment across the earnings distribution, as in Section 5.2. Figure 8 confirms that policy tightening increases unemployment only among the lowest earnings decile group, leading to compositional shifts. For the median worker, there are hardly any effects, and at the top, the unemployment rate even declines slightly. This might be explained by the observation that job quits decline after contractionary monetary policy shocks due to higher risk of job loss (Graves et al., 2023). The distinction between expansionary and contractionary monetary policy reveals that there are less compositional effects following expansionary shocks. As with policy tightening, there are no significant effects at the middle or top of the distribution. However, in the bottom earnings decile group, responses are mostly insignificant and only lead to slightly lower unemployment in the first year after the policy shock. The unemployment responses in the other earnings decile groups are consistent with the above findings as shown in Figure C.4. The findings regarding unemployment align well with those of Garibaldi (1997), who found stronger effects of contractionary monetary policy on the labour market than expansionary policy. My decomposition shows that these effects appear to be mainly driven by low-wage workers.

To get a better understanding of the role of downward wage rigidity and the workforce composition on the findings, I fix the composition, i.e. the inflow and outflow of workers to and from employment. I repeat the analysis using only workers employed during the 12 months before and 36 months after a monetary surprise. This prevents the earnings

Figure 8: Contractionary vs expansionary monetary policy responses - unemployment



Note: The figure plots impulse responses of the unemployment rate to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1984 to December 2023. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

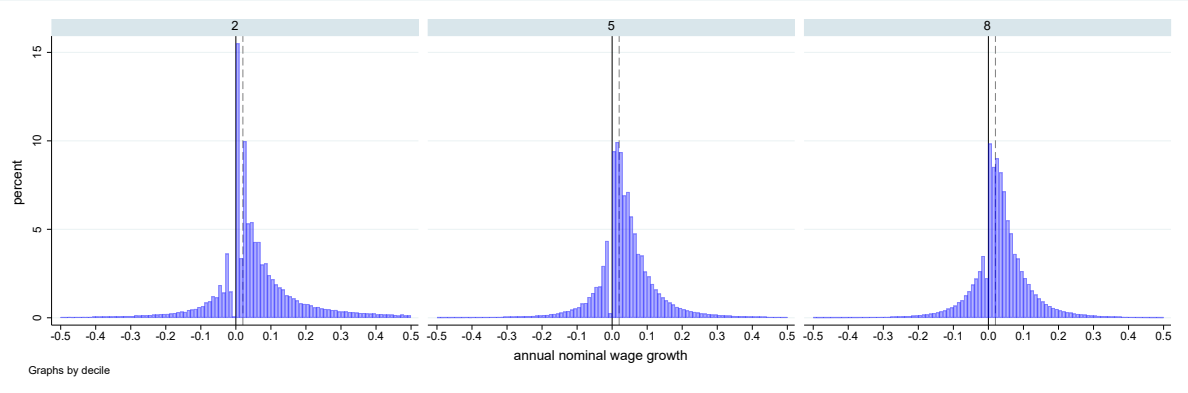
percentiles from being shifted by workers leaving or entering the workforce at different points in the distribution. To control for the indirect earnings effects of workers changing their employment status, I add the lagged unemployment rate of West Germany as a control variable in equation (1). When the composition is held fixed, earnings percentiles become stable following a contractionary monetary policy shock (Figure C.6). Unlike Figure 7, the earnings percentiles either do not respond or respond only slightly, in line with the presence of downward wage rigidity. This is an indication that the positive responses of the earnings percentiles to monetary tightening can be attributed to the substantial increase in unemployment at the bottom of the distribution. Notably, earnings still increase significantly after an expansionary monetary policy shock when only long-term employees are considered (and downward wage rigidity is not a factor). However, the impact of monetary policy on earnings, and especially on inequality, is weaker when the job creation channel is shut down (Groiss, 2023; Lenza and Slacalek, 2018).[24]

[24] Abbritti and Fahr (2013) propose an alternative explanation. They argue that nominal wages react more slowly to monetary policy than prices do, so real wages temporarily increase in the presence of downward wage rigidity. Figure C.7 shows that, while weaker, the responses of nominal earnings percentiles are still positive, especially at the top of the distribution. Therefore, differences in response speed alone cannot fully explain the positive earnings responses following monetary tightening.

5.4 Downward wage rigidity

The empirical analysis clearly points to the asymmetric effects of monetary policy shocks on low earnings and earnings inequality. To understand the underlying mechanism, I link these findings and measures of downward wage rigidity to economic theory and labour market institutions. Florio (2004) suggests various explanations for asymmetric monetary policy effects, among which, convex supply curves due to downward wage rigidity explain the findings best, in line with the three hypotheses derived in Section 2. Small (or positive) earnings responses and increasing unemployment after contractionary monetary policy surprises, and increasing earnings with little unemployment responses after expansionary monetary policy indicate the presence of downward wage rigidity.[25]

Figure 9: Earnings growth distribution across earnings decile groups



Note: The figure plots the distribution of annual nominal earnings growth rate for the 2nd, 5th and 8th earnings decile group across the whole period (1984-2023). The dashed lines represent the average inflation rate over the period (1.9%). Skewness: 2) 0.45, 5) 0.12 and 8) -0.08

Downward wage rigidity plays a crucial role in the German labour market, but its relevance varies depending on the position of the earnings distribution. Figure 9 illustrates the distribution of annual nominal earnings growth rates for the second, fifth and eighth earnings decile groups. These are the same groups that were used in the unemployment analysis. Clear spikes are evident at zero earnings growth, with further spikes close to the inflation rate. Notably, there are few small negative changes in wages, which indicates downward wage rigidity. Importantly, these spikes, the shortfall of downward wage adjustments and the right-skewness are more pronounced at the bottom of the earnings distribution than at the top. Therefore, downward wage rigidity seems to be weaker

[25] Based on the data available, I report on the downward rigidity of gross daily wages, taking into account changes in both hourly wages and hours worked.

for higher earnings groups.[26] This is consistent with stronger employment responses to monetary policy for low-paid workers.

As it is difficult to distinguish between nominal and real downward wage rigidity and to quantify the differences in the distribution graphically, I also apply an earnings function approach to the SIAB data (Bauer et al., 2007). After splitting the sample into deciles based on earnings, I estimate the proportion of workers that can be assigned to a flexible wage regime, a nominal rigidity regime, or a real rigidity regime, as well as the proportion of earnings that are constrained. Details of the approach can be found in the Online Appendix D. Table 3 shows the share of constrained earnings across the distribution for selected years. More earnings are constrained in the second earnings decile than in the higher ones. This is primarily due to nominal downward wage rigidity being significantly higher for low-paid workers. At the same time, the relatively consistent share of constrained earnings in the real regime across the distribution indicates that downward wage rigidity is a persistent feature of the German labour market. In line with my findings, Bauer et al. (2007) show that the extent of real rigidity has declined over time alongside inflation, while it is still present and accelerates unemployment growth. Holden and Wulfsberg (2009) shows that downward wage rigidity is especially relevant in countries with strict employment protection legislation and high union density, such as Germany. This might also explain the differing findings between the US (Jackson and Kurt, 2025) and Germany. While contractionary monetary policy leads to negative employment and average real earnings responses in the US, the German labour market mainly experiences negative employment responses.

In line with the empirical findings, **H1** states that contractionary monetary policy has a stronger effect on employment than expansionary monetary policy, but a weaker effect on earnings due to a convex supply curve. I observe such asymmetric responses to unemployment among the lowest earners, as shown in Figure 8. Regarding earnings, the hypothesis compares the size of positive earnings effects of expansionary monetary policy with the size of negative earnings effects of contractionary monetary policy. Therefore, after taking into account the compositional changes, H1 holds also for earnings. They re-

[26] The findings hold not only for the overall period, but also for an annual perspective. See the distribution for 1995 and 2015 (Figures D.1 and D.2), and the share of zero-earnings-growth over time (Figure D.3) in the Online Appendix.

Table 3: Share of Constrained Wages by Decile Group

	2nd Decile		5th Decile		8th Decile	
Year	**Nominal Regime**	**Real Regime**	**Nominal Regime**	**Real Regime**	**Nominal Regime**	**Real Regime**
1985	0.190	0.269	0.101	0.266	0.096	0.206
1990	0.144	0.151	0.063	0.380	0.066	0.363
1995	0.222	0.228	0.086	0.323	0.071	0.305
2000	0.436	0.281	0.122	0.198	0.122	0.198
2005	0.574	0.302	0.153	0.166	0.153	0.166
2010	0.494	0.209	0.176	0.152	0.176	0.152
2015	0.316	0.171	0.156	0.180	0.156	0.180
2020	0.163	0.053	0.102	0.055	0.102	0.055

Note: The values represent the share of workers whose earnings are constrained by nominal and real rigidity for each decile group. Values for each year can be found in Table D.2.

spond more positively to expansionary monetary policy than negatively to contractionary monetary policy.

According to **H2**, monetary policy shocks have a stronger effect on earnings and employment at the bottom of the distribution than at the top. While this is the case for employment, it is unclear whether the same applies to earnings. The distinction between contractionary and expansionary monetary policies is important, as illustrated in Figure 7. Expansionary policy shocks result in stronger earnings responses at the bottom of the distribution than at the top. However, contractionary shocks result in very similar earnings responses across the distribution, as wages are rigidly set downwards.

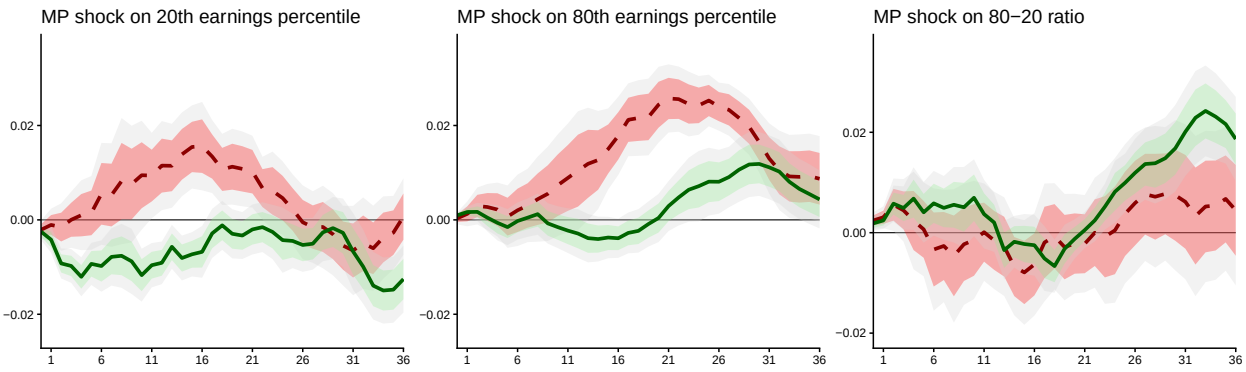
Finally, **H3** combines the dimensions of inequality and asymmetry, stating that monetary policy responses are most asymmetric at the bottom of the earnings distribution. As Figure 7 shows, the largest deviation between expansionary and contractionary shock responses occurs at the 20th percentile. This also leads to significantly asymmetric responses in the 50–20 percentile ratio. H3 also holds true for the unemployment rate across the earnings distribution (see Figure 8). The asymmetric responses observed in unemployment originate from the first and second earnings decile group, whereas differences are limited for high-wage earners. Given that Germany's strong labour market institutions mostly affect the bottom of the earnings distribution, for example, the minimum wage, these differences across the earnings distribution are in line with the insider-outsider theory, explaining downward wage rigidities.

5.5 Alternative reasons for non-linear responses

To rule out alternative explanations for the asymmetric effects of monetary policy, I evaluate other sources of non-linearity, such as the ZLB, credit market imperfections, or the economic state (Tenreyro and Thwaites, 2016; Merikül and Rottner, 2025).

Zero Lower Bound. One reason why output and employment might react more strongly to contractionary shocks is the asymmetric nature of monetary policy. While central banks can increase interest rates to limit inflation and reduce output as much as they want, they are bound by the zero lower bound when it comes to stimulating the economy. Therefore, Figure 10 shows the asymmetric effects of monetary policy for the non-ZLB period (1984-2011). Again, the assumption of symmetry is rejected for low earnings due to an increase in earnings percentiles following both expansionary and contractionary monetary shocks. In line with the baseline period, there also is evidence of asymmetric earnings responses at the top of the distribution during the non-ZLB period. Regarding the 80–20 percentile ratio, asymmetric responses are less evident, but still significant in the last six months of the horizon. This difference stems from stronger compositional responses during the Bundesbank period.

Figure 10: Asymmetric monetary policy responses - non-ZLB



Note: The figure plots impulse responses of earnings deciles and percentile ratios to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from 1984-2011. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Credit market imperfections. The literature suggests that credit market imperfections could also explain asymmetric monetary policy responses (Florio, 2004). A strong reduction in demand following tighter monetary policy may be caused by the macroeconomic consequences of bank failures or an increase in the external finance premium.

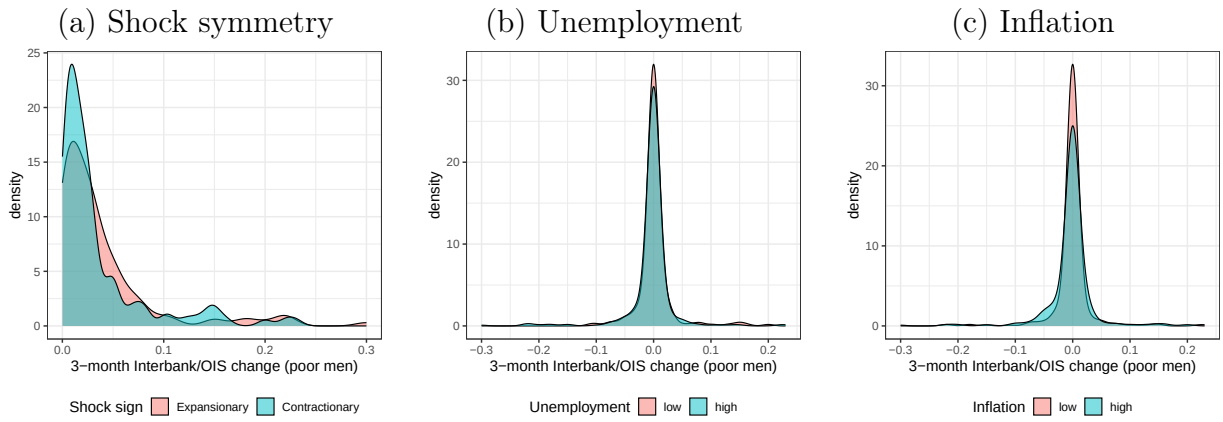
Monetary easing cannot reverse these effects to the same extent. In this case the large output effects cause large prices effects, so that the asymmetry works in the same direction. However, as unemployment reacts more strongly to contractionary monetary policy while earnings react more strongly to expansionary monetary policy (H1), credit market imperfections are not dominating the asymmetric effects at the labour market. In line with Altavilla et al. (2019), I do not find asymmetric monetary policy effects on sovereign bond yields, lending rates, or exchange rates (Table A.4). Thus, the asymmetric effects do not seem to stem from financial markets.

State dependence. While the monetary policy shocks are assumed to be exogenous to economic conditions, the distinction between expansionary and contractionary shocks may not be random. Therefore, Figure 11 (a) shows the distribution of the shock series split into positive and negative (inverted) shocks. In both cases, most of the surprises are below 10 basis points, and there are a small number of large positive and negative surprises. Given the similar composition, the shock characteristics are unlikely to drive the results. The exogeneity of the monetary policy shock series is also tested using regressions with various financial and macroeconomic indicators (Bauer and Swanson, 2023). As shown in Table A.5, these indicators have little to no explanatory power. To address any remaining concerns, the LP controls for lagged inflation rates, commodity prices, and the industrial production index, while also including a recession dummy to ensure the policy shocks are independent of the economic state.

Figure 11 (b) tests whether the shocks are state-dependent by comparing the shock distribution during phases of low (boom) and high (recession) unemployment (Alessandri et al., 2025). The conditional distributions are nearly the same across sub-samples, suggesting that state dependence is unlikely to bias the results. Finally, Figure 11 (c) evaluates the dependence of shocks on whether the period is high- or low-inflation. Although the surprises are, on average, smaller in absolute terms during periods of low inflation, the distribution shows that positive and negative surprises can occur independently of the preceding inflation rate. A formal Kolmogorov–Smirnov test does *not* reject the null hypothesis that the distributions are the same across sub-samples at the 10% level for all three cases of Figure 11. This means that the monetary policy shocks and the split between expansionary and contractionary surprises are mostly independent of the economic

state and the conclusions are not driven thereby. While I cannot exclude the possibility of state-dependent earnings responses, Hsueh et al. (2025) does not find evidence that the impact of monetary policy on earnings inequality is state-dependent in the US.

Figure 11: Monetary Policy shock distribution



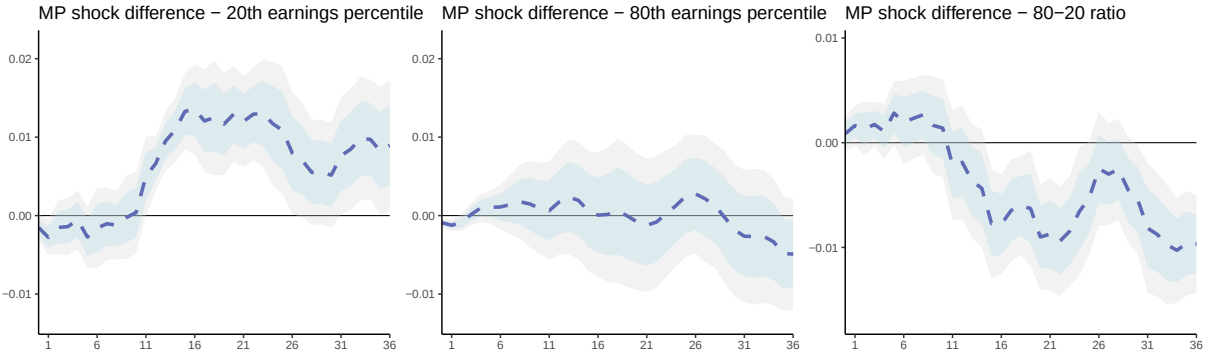
Notes: The figure shows a) the symmetry of the monetary policy shock distribution, b) the similarity of the monetary policy shocks conditional on the unemployment rate (above vs below median) in the year before the shock, and c) the similarity of monetary policy shocks conditional on the inflation rate (above vs below median) in the year before the shock.

Shock size. Finally, the non-linear monetary policy effects might stem from varying effects by shock size. Under a symmetric shock distribution, even transformations, such as the absolute value, clearly distinguish sign asymmetry from size-dependent responses (Caravello and Martinez-Bruera, 2024). Equation (1) contains an equivalent even-function specification because $\varepsilon_t^+ = (\varepsilon_t + |\varepsilon_t|)/2$. Using the monetary policy shocks in absolute form ($|\varepsilon|$) instead of the positive shocks (ε^+) in equation (1) confirms the asymmetric effects of monetary policy. Figure 12 shows the respective coefficients (β^{abs}) at different horizons and find significant asymmetry at the bottom of the earnings distribution and for inequality. Furthermore, excluding small shocks (<1 SD) from the shock series and estimating equation (1) - allowing for asymmetric effects - confirms the limited influence of the size of monetary surprises (see Figure C.8).

5.6 Robustness

To verify the robustness of the asymmetric monetary policy effects on the earnings distribution, I undertake a comprehensive set of sensitivity checks. The respective figures are

Figure 12: Asymmetry test - absolute value



Note: The figure plots the sign differences in responses to monetary policy surprises measured by an absolute value term (β^{abs}). IRF are at the monthly frequency using data from January 1984 to December 2023. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

presented in the Online Appendix.

Alternative policy shocks. While there are no alternative monetary policy shocks available for the Bundesbank period,[27] I can compare the responses to changes in the 3-month OIS rate during the ECB period with the responses to shocks provided by other authors such as Miranda-Agrippino and Nenova (2022). As shown in Figure C.9, these shocks lead to IRFs that are similar to mine and also reject the symmetry assumption. Extending the announcement window of the Bundesbank to two days ($t+1-t-1$) in case some market participants react already on Thursday evenings, also result in robust results. Figure C.10 shows slightly larger earnings responses to expansionary surprises and supports the asymmetric findings.

IV estimation. Using high-frequency shocks controls for endogeneity, but the interpretation is difficult because we present a 25 bp surprise in the interbank rate rather than a change in the policy rate. Moreover, it is not clear if the chosen window captures the effects of a monetary policy announcement completely or if the financial markets need more time to incorporate the news. Hence, Stock and Watson (2018) suggest to use the exogenous shock series as instrumental variables for the change in the policy rate. Figure C.11 in the Online Appendix shows that the results are very similar to Figure 5 when instrumenting the policy rate changes with the surprise series, but less efficient.[28]

[27] Bredin et al. (2009) and Cloyne et al. (2022) have not published their Bundesbank shock series (yet).

[28] The monetary policy surprise series is not only exogenous by construction, but also a relevant instrument for policy rate changes, as shown in Table C.1.

Bundesbank vs ECB period. As this analysis combines two distinct periods of monetary policy institutions, it is possible that the findings will differ between the two periods. The Bundesbank experienced larger shocks, while the ECB's period was longer. However, Figure C.12 shows that monetary policy has an asymmetric effect on low earnings in both periods, with expansionary and contractionary policy shocks increasing the 20th earnings percentile. While the results indicate that earnings percentiles respond asymmetrically across the entire distribution during the Bundesbank period, the differences are not statistically significant for the ECB period, partly due to greater uncertainty arising from smaller sample sizes. Moreover, earnings inequality, as measured by the 80–20 ratio, has responded differently to expansionary versus contractionary monetary policy since the introduction of the euro, but no significant difference can be detected prior to this. Consistent with stronger downward wage rigidity in the 1980s and 1990s, the unemployment rate responds more at the bottom of the distribution in the first half of the sample period (see Figure C.13).

Alternative regression specification. Changing the number of lags of the dependent variable or of the control variables do not alter the results significantly. See Figure C.14 for the baseline specification with only three lags of the dependent variable and Figure C.15 with three lags of all control variables instead of twelve.[29]

Alternative distributional measures. Finally, I also test the sensitivity of the results to alternative earnings deciles and inequality measures. Figure C.3 shows the responses of all earnings deciles and presents the similarity among the effects at the bottom (10th, 20th or 30th percentile) and among the effects at the top (70th, 80th or 90th percentile.) However, the 10th earnings percentile responds more volatile and the 90th earnings percentile includes imputed top-coded earnings. Therefore, the responses of the 90-10 percentile ratio are more uncertain and only reject the symmetry of the monetary policy effects at the end of the forecast horizon.

[29]Increasing the lags of all control variables quickly results in instability due to the limited degrees of freedom.

6 Conclusion

This paper derives new, high-frequency monetary policy shocks alongside monthly earnings percentiles and inequality measures to examine the widely held assumption that earnings responses are symmetrical across the earnings distribution in the event of changes in monetary policy. First, the established monetary policy shock series for the ECB is extended to include surprises in the monetary policy decisions of the German Bundesbank. This increases the number of observations and tightening cycles that are unaffected by the ZLB, and enables more shocks to be split into expansionary and contractionary surprises. Secondly, granular social security data from Germany are used to interpolate monthly dynamics in inequality, as described by earnings percentiles and percentile ratios. These two elements are then combined within a local projection framework to examine the symmetry of monetary policy in the labour market.

The paper rejects the symmetry assumption. While expansionary monetary policy leads to a reduction in inequality, the effects of contractionary monetary policy are unclear. Following an expansionary shock, earnings at the bottom of the distribution increase, whereas at the top, they respond little. This occurs simultaneously with a gradual reduction in the unemployment rate of low-wage workers. This results in a compressed earnings distribution. Conversely, the earnings percentiles across the distribution increase similarly following a contractionary monetary policy shock. Due to the significant rise in unemployment at the bottom of the distribution with no corresponding change in the middle or top, the entire distribution shifts. Consistent with downward wage rigidity, contractionary shocks mainly affect the unemployment rate, whereas expansionary shocks lead to earnings growth as they can adjust more freely, resulting in stronger and asymmetric responses. Consequently, there is no indication that monetary policy widens the earnings dispersion persistently, if at all, it reduces earnings inequality among employed.

The findings imply that, to correctly estimate the effects of monetary policy on inequality and to identify the channels through which it is transmitted, the different responses to contractionary and expansionary shocks must be considered. Accounting for asymmetric monetary policy effects in different institutional settings and implementing downward wage rigidity in heterogeneous agent macroeconomic models are topics for future research.

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Online Appendix

Table A.1: Overview: Macroeconomic and financial variables

Variable	Description	Source
Interbank surpise	3-month German money market rate, daily changes	Bundesbank
Interbank rate	3-month German money market rates, monthly average	Bundesbank
OIS surprise	3-month (1-year) Overnight Index Swap rate, 3h window changes	EA-MPD
OIS surprise daily	3-month (1-year) Overnight Index Swap rate, daily changes	Refinitiv
OIS rate	3-month (1-year) Overnight Index Swap rate, monthly average	Refinitiv
Gov bond yields	3-month to 10-year German government bond yields, daily/monthly avg	Refinitiv
Yield curve	Difference in the 10-year to 2-year government bond yield	
DAX	German stock index (DAX), daily/monthly avg	Refinitiv
FX GER-US	Foreign exchange rate - D-Mark/US-Dollar or Euro/US-Dollar, daily/monthly avg	Refinitiv
US gov bond	3-month US government bond yield, daily	Refinitiv
real GDP	German real Gross Domestic Product by expenditure, seasonally adjusted, monthly interpolated by IPI	OECD
Recession	Recession indicator (1 = recession) according to the Council of German Economic Experts	SVR
Commodity Price	Producer Price Index: all commodities, monthly	BLS
IPI	German Industry Production Index (B-D), seasonal adjusted, monthly	Bundesbank
CPI	German Consumer Price Index, seasonal adjusted, monthly	Bundesbank
Unemployment rate	West German unemployment rate, seasonal adjusted, monthly	Bundesbank
Unemployment SIAB	Share of unemployed according to SIAB sample defined in 4.1, seasonal adjusted, monthly	SIAB
Earnings percentile	Percentiles from real gross daily wage distribution, sample defined in 4.1, monthly interpolated (see 4.2)	SIAB
Percentile ratio	80-20, 80-50 and 50-20 percentile ratio based on earnings percentiles	SIAB
Lombard rate	Lombard rate set by the German Bundesbank	Bundesbank
Discont rate	Diskont rate set by the German Bundesank	Bundesbank
MRO rate	Main refinancing operations rate set by the ECB, variable and fixed tender	ECB
Deposit rate	Deposit facility rate set by the ECB, variable and fixed tender	ECB

Note: Bundesbank = Bundesbank time-series database, SVR = Sachverständigenrat (German economic experts), BLS = U.S. Bureau of Labor Statistics, variable period from 1/1/1984 till 31/12/2023 or as long as possible

A Monetary policy surprises

Table A.2: Monetary Policy Changes

Date	Policy Rate	Δ	Note	Date	Policy Rate	Δ	Note
1984-06-28	4.50	0.50		1985-08-15	4.00	-0.50	
1986-03-06	3.50	-0.50		1987-01-22	3.00	-0.50	
1987-12-03	2.50	-0.50		1988-06-30	3.00	0.50	
1988-08-25	3.50	0.50		1989-01-19	4.00	0.50	
1989-04-20	4.50	0.50		1989-06-29	5.00	0.50	
1989-10-05	6.00	1.00		1991-01-31	6.50	0.50	
1991-08-15	7.50	1.00		1991-12-19	8.00	0.50	new money growth target
1992-07-16	8.75	0.75		1992-09-14	8.25	-0.50	
1993-03-04	8.00	-0.25		1993-03-18	7.50	-0.50	
1993-04-22	7.25	-0.25		1993-07-01	6.75	-0.50	
1993-09-09	6.25	-0.50		1993-10-21	5.75	-0.50	
1994-02-17	5.25	-0.50		1994-04-14	5.00	-0.25	
1994-05-11	4.50	-0.50		1995-03-30	4.00	-0.50	
1995-08-24	3.50	-0.50		1995-12-14	3.00	-0.50	new money growth target
1996-04-18	2.50	-0.50					
1999-04-08	2.50	-0.50		1999-11-04	3.00	0.50	
2000-02-03	3.25	0.25		2000-03-16	3.50	0.25	
2000-04-27	3.75	0.25		2000-06-08	4.25	0.50	
2000-08-31	4.50	0.25		2000-10-05	4.75	0.25	
2001-05-10	4.50	-0.25		2001-08-30	4.25	-0.25	
2001-09-17	3.75	-0.50		2001-11-08	3.25	-0.50	
2002-12-05	2.75	-0.50		2003-03-06	2.50	-0.25	
2003-06-05	2.00	-0.50		2005-12-01	2.25	0.25	
2006-03-02	2.50	0.25		2006-06-08	2.75	0.25	
2006-08-03	3.00	0.25		2006-10-05	3.25	0.25	
2006-12-07	3.50	0.25		2007-03-08	3.75	0.25	
2007-06-06	4.00	0.25		2008-07-03	4.25	0.25	
2008-10-08	2.75	-1.50	Lehman crash, excluded	2008-12-04	2.00	-0.75	
2009-01-15	1.00	-1.00		2009-03-05	0.50	-0.50	
2009-04-02	0.25	-0.25		2011-04-07	0.50	0.25	
2011-07-07	0.75	0.25		2011-11-03	0.50	-0.25	
2011-12-08	0.25	-0.25	QE announcement	2012-07-05	0.00	-0.25	
2014-06-05	-0.10	-0.10	QE announcement	2014-09-04	-0.20	-0.10	QE announcement
2015-12-03	-0.30	-0.10		2016-03-10	-0.40	-0.10	QE announcement
2019-09-12	-0.50	-0.10		2022-07-21	0.00	0.50	
2022-09-08	0.75	0.75		2022-10-27	1.50	0.75	
2022-12-15	2.00	0.50	QT announcement	2023-02-02	2.50	0.50	
2023-03-16	3.00	0.50		2023-05-04	3.25	0.25	
2023-06-15	3.50	0.25		2023-07-27	3.75	0.25	
2023-09-14	4.00	0.25					

Note: Policy rate = Diskont rate (1984:M1-1998:M12), Main refinancing operations rate (1999:M1-2008:M9), Deposit facility rate (2008:M10-2023:M12). For a list of all monetary policy meetings (without changes in the policy rate) see the Bundesbank Archive and the EA-MPD by Altavilla et al. (2019).

Table A.3: Summary statistics - Monetary policy surprises

	Min.	1st Quartile	Median	Mean	3rd Quartile	Max.
all MP shocks	-0.3000	0.0000	0.0000	-0.0014	0.0000	0.2300
positive MP shocks	0.0005	0.0083	0.0200	0.0359	0.0355	0.2300
negative MP shocks	0.0001	0.0077	0.0250	0.0391	0.0500	0.3000

Note: Summary statistics of the monetary policy shocks - 3-month Interbank or OIS rate changes, poor man's sign restriction - between 1984 and 2023.

Table A.4: Asymmetric Financial Market Effects

	Dependent variable:						
	Policy Rate	3m Gov bond	1y Gov bond	2y Gov bond	10y Gov bond	DAX	GER-US
MP shock	1.026^{***}	0.384^{***}	0.398^{***}	0.324^{***}	0.144^{**}	-0.097^{***}	0.0003
	(0.218)	(0.106)	(0.101)	(0.097)	(0.069)	(0.020)	(0.020)
MP shock	−0.017	−0.178	0.127	0.235	0.111	-0.067^{**}	−0.023
$\times I(MPshock > 0)$	(0.346)	(0.176)	(0.168)	(0.154)	(0.109)	(0.032)	(0.031)
Constant	0.003	-0.006^{**}	0.0004	−0.003	−0.0001	0.0001	−0.00000
	(0.006)	(0.003)	(0.002)	(0.003)	(0.002)	(0.001)	(0.001)
Observations	664	399	419	664	664	664	664
R^2	0.058	0.039	0.075	0.054	0.023	0.106	0.002

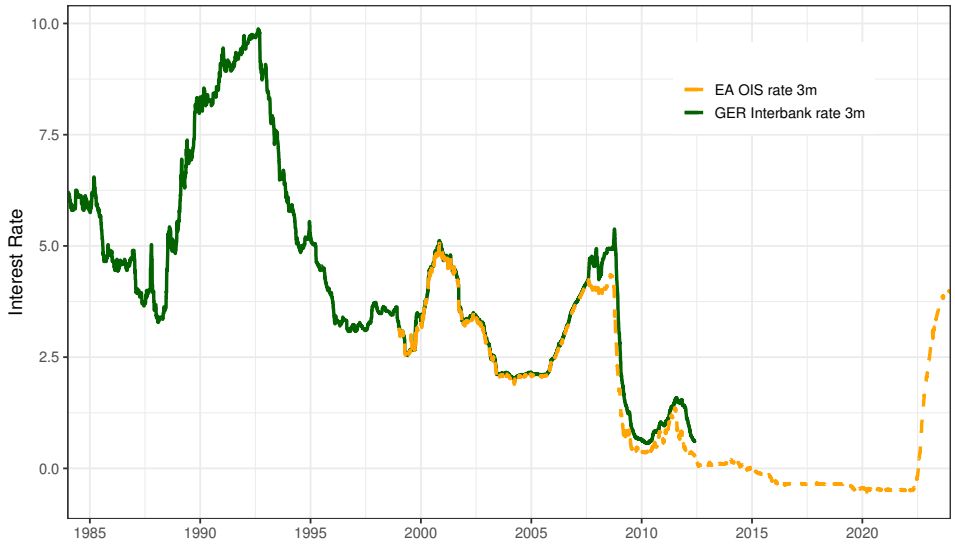
Note: The table presents OLS regressions of the daily changes in the Policy Rate, (3 month, 1 year, 2 year, 10 year) German government bond yields the German stock market index (DAX) and exchange rates (Mark-US or Euro-US) on the monetary policy surprises (1 pp increase). Robust standard errors in the parenthesis. *p<0.1; **p<0.05; ***p<0.01

Table A.5: Exogeneity test - monetary policy shocks

	Dependent variable:							
	Monetary Policy Shock							
	overall	Buba	ECB	overall	Buba	ECB	positive	negative
Monetary Policy Shock, lag	0.034	0.022	0.054	0.022	0.002	0.053	−0.012	0.034
	(0.039)	(0.053)	(0.059)	(0.039)	(0.053)	(0.059)	(0.025)	(0.029)
Δ DAX	0.00005	0.0002	−0.0001	−0.0000	0.0001	−0.0001	-0.0001^{*}	0.0001
	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0001)	(0.0001)
Δ US 3m gov bond yield	0.001	0.001	0.003	0.0003	0.001	0.0005	−0.001	0.002
	(0.002)	(0.003)	(0.003)	(0.002)	(0.004)	(0.003)	(0.001)	(0.002)
Δ German yield curve	0.003	0.002	0.005	−0.003	−0.002	−0.001	−0.006	0.003
	(0.004)	(0.005)	(0.006)	(0.005)	(0.007)	(0.008)	(0.004)	(0.004)
Δ FX GER-US	0.002	−0.007	0.016	−0.001	0.000	−0.002	−0.000	−0.001
	(0.011)	(0.015)	(0.018)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Δ Commodity Price, log				−0.0003	−0.002	0.001	−0.0004	0.0001
				(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Δ Average earnings, log				−0.002	-0.003^{*}	0.000	−0.001	−0.001
				(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Δ Unemployment rate				−0.001	−0.014	0.008	0.002	−0.004
				(0.007)	(0.012)	(0.008)	(0.004)	(0.005)
Δ Consumer price, log				0.001	0.003	0.001	0.005^{**}	−0.004
				(0.004)	(0.006)	(0.004)	(0.002)	(0.003)
Δ Industrial prod., log				0.0005	0.001	0.0003	0.0004	0.0001
				(0.001)	(0.001)	(0.001)	(0.0004)	(0.0004)
Constant	−0.001	−0.003	−0.0003	−0.001	−0.002	−0.001	0.004^{***}	-0.006^{***}
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.003)	(0.001)	(0.002)
Observations	663	363	299	663	363	299	663	663
Frequency	daily	daily	daily	monthly	monthly	monthly	monthly	monthly
R^2	0.002	0.003	0.010	0.012	0.024	0.018	0.025	0.017

Note: Regressions at daily and monthly frequency for each policy meeting, $\Delta = t-1$ to $t-90$ for daily, $\Delta = t-1$ to $t-4$ for monthly *p<0.1; **p<0.05; ***p<0.01

Figure A.1: Development of 3-month Interbank and OIS rates



Note: The graph shows and compares the development of the 3-month German Interbank rate with the 3-month Overnight Index Swap (OIS) rate of the Euro Area.

B Labour market data & inequality

Table B.1: Summary Statistics - SIAB sample

	Mean	Std Dev	10th perc	Median	90th perc
Age	40.07	10.85	25	40	55
Tenure	2,515.46	2,520.57	210	1,672	6,144
Education	1.99	0.51	1	2	3
Real gross daily wage	109.53	68.65	47	97	179
Observations per month	376,888.18	31,111.03	339,428	373,386	428,073
Changers per month	19,828.10	14,680.87	12,756	17,571	29,020
Employed changers per month	4,516.38	7,959.62	1,761	3,031	7,127

Note: The table contains summary statistics of the main sample between January 1975 to December 2023. Wages are in Euro, 2015 prices. Tenure counts the days since the start of the current job. Education takes a value of 1 for individuals without a degree, 2 for vocational training, 3 for high school, 4 for high school and vocational training, 5 for graduates of technical colleges and 6 for university graduates.

B.1 Temporal disaggregation - details

The SIAB data mainly reflect annual average earnings percentiles. Through temporal disaggregation, however, the missing earnings information can be interpolated at a higher frequency, which is particularly useful for monetary policy analysis.

Regression-based interpolation techniques rely on high-frequency indicator series to

inform the dynamics of a low-frequency target series. Well-known examples include the approach proposed by Chow and Lin (1971) and subsequent extensions that have been used, for instance, to interpolate quarterly GDP using monthly industrial production or triennial wealth data using quarterly financial accounts (Batty et al., 2019). As shown by Chen (2007), the Chow–Lin method satisfies the key requirements of an interpolation exercise: it enforces an aggregation constraint, preserves short-run dynamics of the indicator series, mitigates distortions at year boundaries, and reduces end-point distortions.

The method of Chow and Lin (1971) estimates an unobserved high-frequency series Y_h whose averages are consistent with an observed low-frequency series Y. Identification of Y_h requires one or more high-frequency indicator series X. Estimation proceeds via a generalized least squares (GLS) regression of the annual series Y on the annualized high-frequency indicators CX, where C denotes a conversion matrix that aggregates the high-frequency observations to the annual level. In this application, overall *monthly* earnings percentiles are obtained by regressing overall *annual* earnings percentiles on seasonally adjusted *monthly* earnings percentiles from specific *sub-samples*, including an intercept.

$$C = \begin{bmatrix} 1/12 & 1/12 & 1/12 & 1/12 & \cdots & 0 \\ 0 & 0 & 0 & 0 & \cdots & 0 \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & 0 & \cdots & 1/12 \end{bmatrix} \tag{2}$$

The corresponding GLS regression can be written as

$$Y = CX\beta + Cu. \tag{3}$$

Chow and Lin (1971) show that, for a given variance-covariance matrix $V = \mathbb{E}[uu']$, the consistent GLS estimator $\hat{\beta}$ is given by

$$\hat{\beta} = \left[X'C'(CVC')^{-1}CX\right]^{-1} X'C'(CVC')^{-1}Y, \tag{4}$$

and that the linear unbiased estimator of Y_h is

$$\hat{Y_h} = X\hat{\beta} + VC'(CVC')^{-1}\left[Y - CX\hat{\beta}\right]. \tag{5}$$

This expression consists of two parts: the term $X\hat{\beta}$ captures the predicted high-frequency path of Y_h based on the indicator series X, while the second term allocates the low-frequency residuals across months. A key assumption of the approach is that the estimated linear relationship between the annual series CX and Y_h also applies to the monthly relationship between X and Y_h (Sax and Steiner, 2013). Given the high persistence of earnings percentiles and the close alignment between sub-sample and full-sample characteristics, this assumption appears plausible.

Regarding the variance-covariance structure, Chow and Lin (1971) assume that monthly residuals follow an AR(1) process, whereas Litterman (1983) generalise this specification to a random walk in order to accommodate non-cointegrated series:

$$u_t = u_{t-1} + \epsilon_t, \qquad \epsilon_t = \rho\epsilon_{t-1} + \eta_t \qquad (0 < \rho < 1). \tag{6}$$

This latter specification is employed to estimate monthly German earnings deciles. Further details can be found in the original contributions by Chow and Lin (1971) and Litterman (1983).

Due to the two-sided residual allocation in the temporal disaggregation approach and seasonal adjustment, post-policy shock earnings residuals may leak into lagged outcomes if monetary policy affects earnings components that are not adequately captured by the monthly indicator (X). To test for this leakage, I use a lag-exogeneity test to determine the extent to which the lagged interpolated earnings deciles explain monetary policy surprises. Table B.3 shows that there is no evidence that post-policy information is shifted beforehand as the lagged earnings information cannot predict the monetary policy surprises. This also confirms the exogeneity of the monetary policy shocks derived.

B.2 Robustness - interpolation

While the monthly earnings percentiles of the employed changers sub-sample can be used directly in the local projection analysis, the results are highly volatile and subject to significant uncertainty due to the small sample size, particularly when estimating distributional measures (see Figure C.17). At the same time, the overall sample is only available annually, which does not align with the frequency of monetary policy shocks

Table B.2: Additional reports and monetary policy

	Monetary Policy shock effects	
	immediate	12 months ahead
Change of health insurance	0.00026	0.00036
	(0.00040)	(0.00047)
Change of contribution group	-0.00143	-0.00248
	(0.00127)	(0.00220)
Change of accounting system	-0.00200	-0.00093
	(0.00113)	(0.00072)
Other compensation	-0.00013	0.00012
	(0.00011)	(0.00011)
Parental leave/statutory duty	0.00002	-0.00001
	(0.00002)	(0.00002)
Extra payment	-0.00032	-0.00043
	(0.00030)	(0.00031)
Other reasons	-0.00006	0.00039
	(0.00092)	(0.00076)
Observations	17,920,186	15,829,869

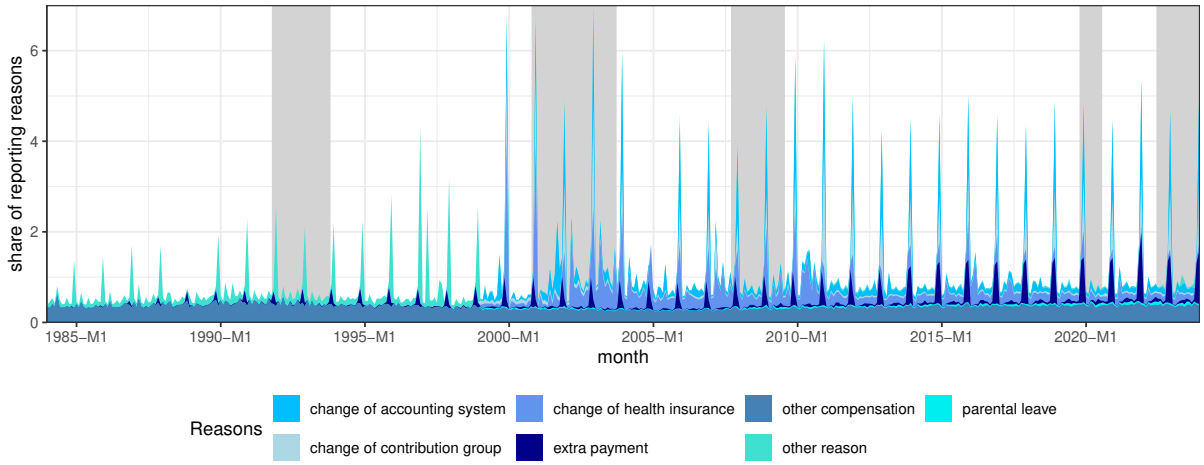
Note: Effects of Monetary Policy shocks (25 bp) on the likelihood to hand-in additional reports to the social security provider due to various reasons. Each regression controls for calendar-month dummies (seasonality), part-time, occupation, German state and individual fixed effects. Two-way (worker and time) cluster robust standard errors in the parenthesis. *p<0.05; **p<0.01; ***p<0.001

Table B.3: Test for lag-exogeneity

	Dependent variable: Monetary Policy Shock			
	(1)	(2)	(3)	(4)
	80-20 ratio	80th wage perc	50th wage perc	20th wage perc
lag 1	−0.084	−0.012	−0.004	−0.008
	(0.306)	(0.009)	(0.011)	(0.010)
lag 2	−0.348	0.020	0.019	0.018
	(0.517)	(0.017)	(0.020)	(0.016)
lag 3	0.804	−0.005	−0.019	−0.022
	(0.491)	(0.017)	(0.019)	(0.015)
lag 4	−0.526	−0.011	0.0002	0.008
	(0.491)	(0.017)	(0.019)	(0.015)
lag 5	0.224	0.009	0.008	−0.004
	(0.515)	(0.017)	(0.020)	(0.016)
lag 6	−0.055	−0.0004	−0.003	0.006
	(0.303)	(0.009)	(0.011)	(0.009)
Constant	−0.038	−0.037	−0.072	0.008
	(0.024)	(0.030)	(0.054)	(0.043)
Observations	474	474	474	474
R^2	0.014	0.014	0.007	0.010

Note: Test for lag-exogeneity of the monetary policy surprises on interpolated earnings deciles. The lagged dependent variables (80-20 ratio, earnings percentile) are tested for their ability to explain the monetary policy shocks (1984:M1-2023:M12). Robust standard errors in the parenthesis. *p<0.05; **p<0.01; ***p<0.001

Figure B.1: Reporting reasons - employed changers

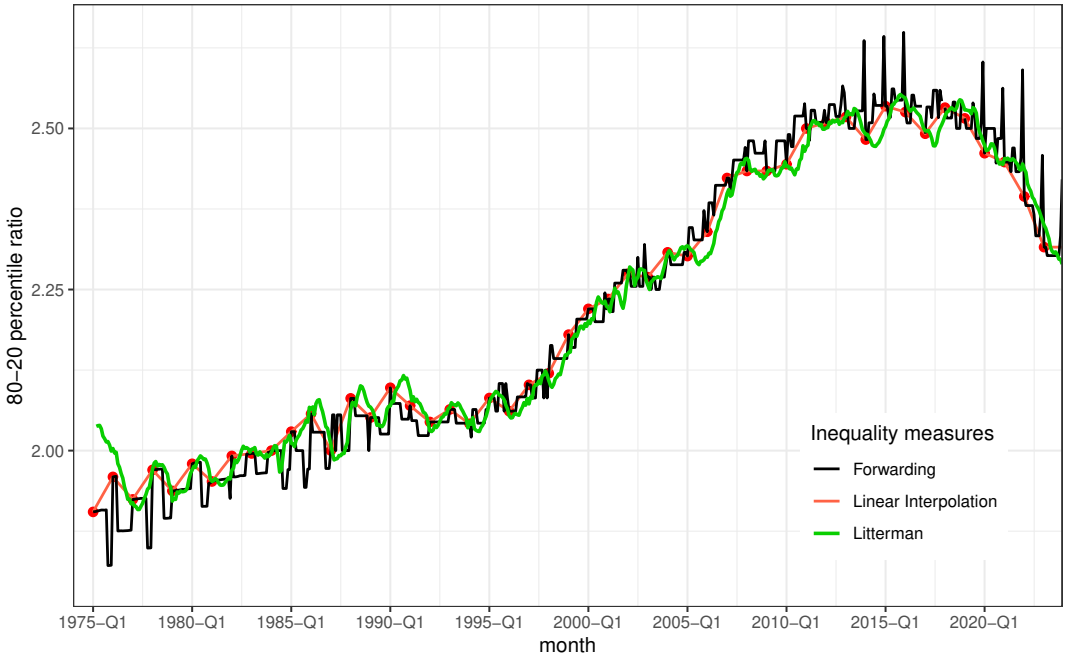


Note: This figure plots the shares of the reporting reasons considered in the "employed changers" sample compared to the overall sample over time. The shaded grey areas depict recessionary phases in Germany.

and would require the aggregation of expansionary and contractionary shocks. Therefore, I follow Groiss (2023) and interpolate the annual earnings deciles of the overall SIAB sample by the monthly earnings deciles of the the sub-sample of "employed changers" by the temporal disaggregation approach of Litterman (1983). Internal and external back-casting exercises confirm the validity of this approach for earnings deciles, and the results are robust whether I apply the approach of Chow and Lin (1971) or seasonally adjust the monthly time series after temporal disaggregation rather than before (Groiss, 2023).

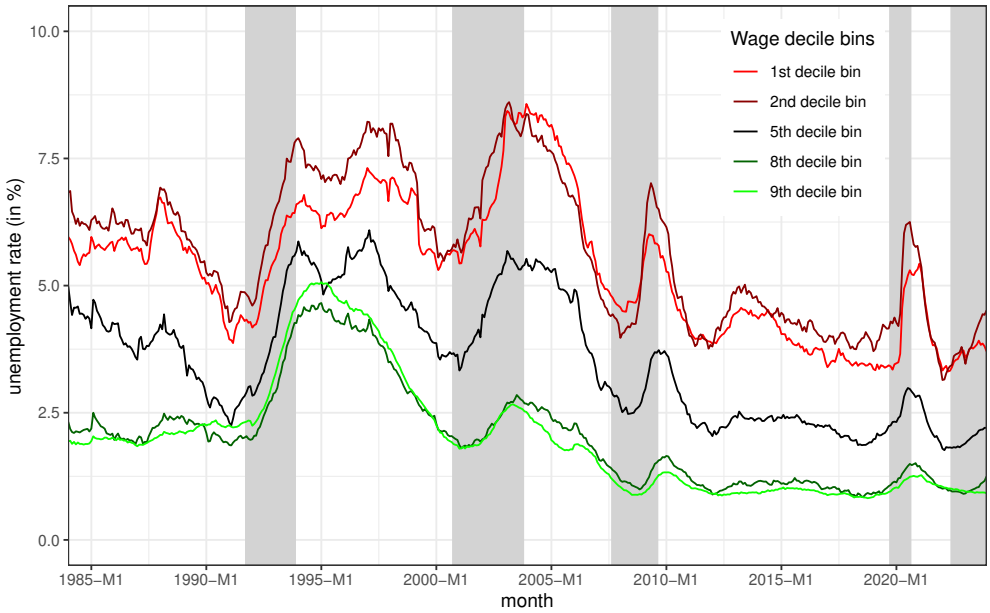
Mitman et al. (2022) suggests forwarding the earnings in the SIAB by up to one year until new earnings are available. However, this assumes that none of the incumbent workers have a change in earnings during the year. Furthermore, these time series exhibit significant shifts at the beginning of the year and plateaus throughout, which could introduce spurious relations. Nevertheless, Figure C.18 shows that the findings in Section 5 are robust to the form of interpolation. Earnings percentiles from forwarded real earnings also point towards asymmetric monetary policy effects on low earnings and earnings inequality.

Figure B.2: Interpolated monthly inequality



Note: This figure shows the development of the 80-20 percentile ratio according to different interpolation methods: linear interpolation (orange), earnings forwarding (black), Litterman regression-based approach (green). The interpolation is applied to the percentiles before the ratio is calculated. The red dots show the values of the first quarters for annual comparisons.

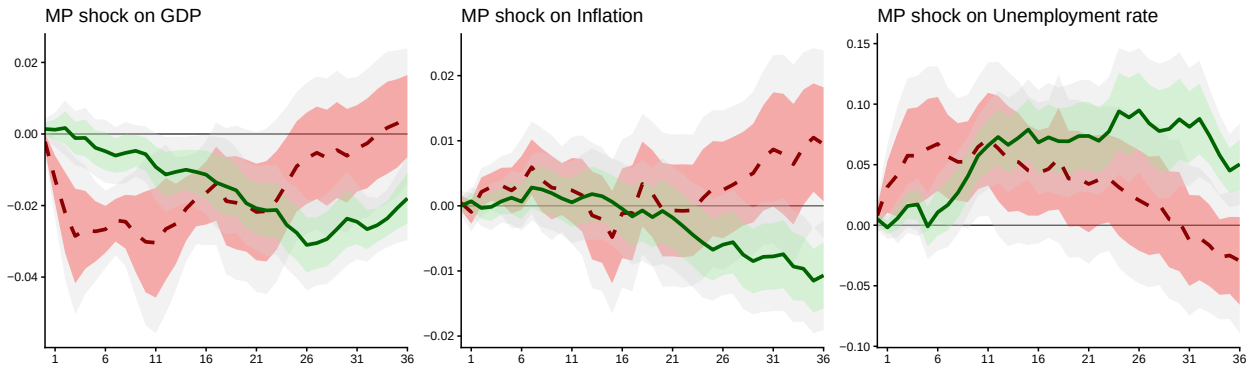
Figure B.3: Monthly unemployment rate per decile



Note: The figure shows the monthly development of the unemployment rate for the 1st, 2nd, 5th, 8th and 9th permanent earnings decile bin. Grey shaded areas depict recessions according to the German council of economic experts.

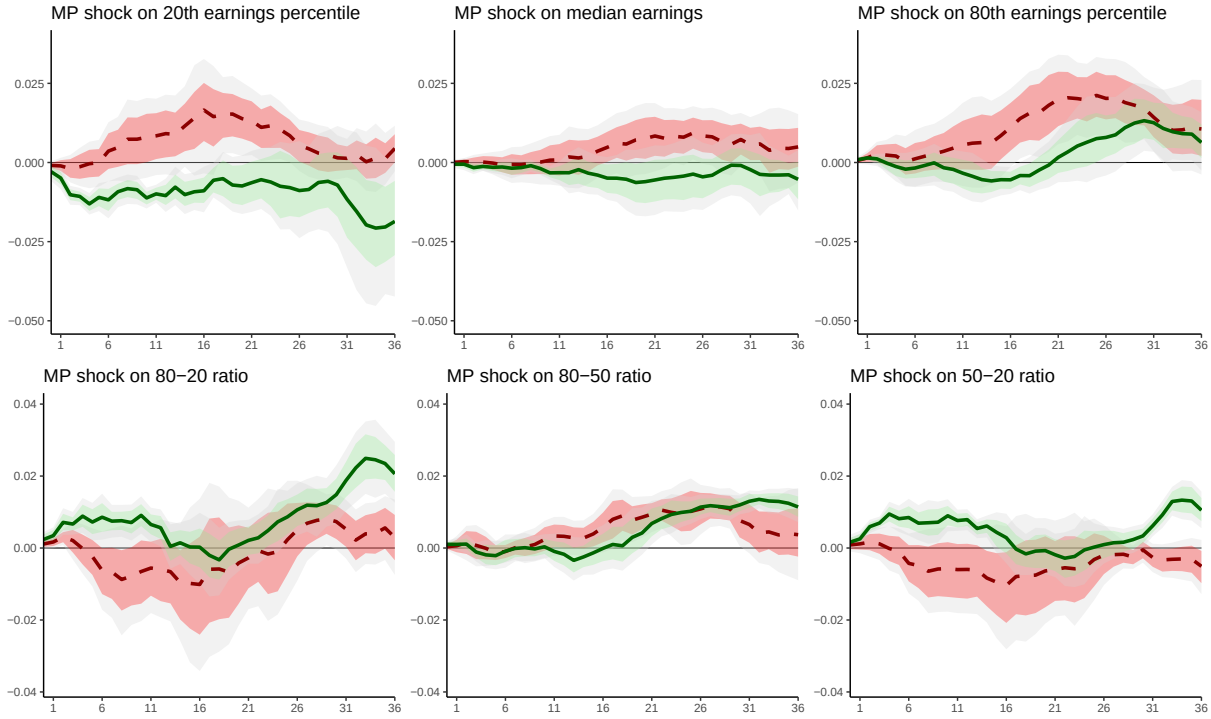
C Monetary policy effects - Robustness

Figure C.1: Asymmetric monetary policy responses - macro indicators



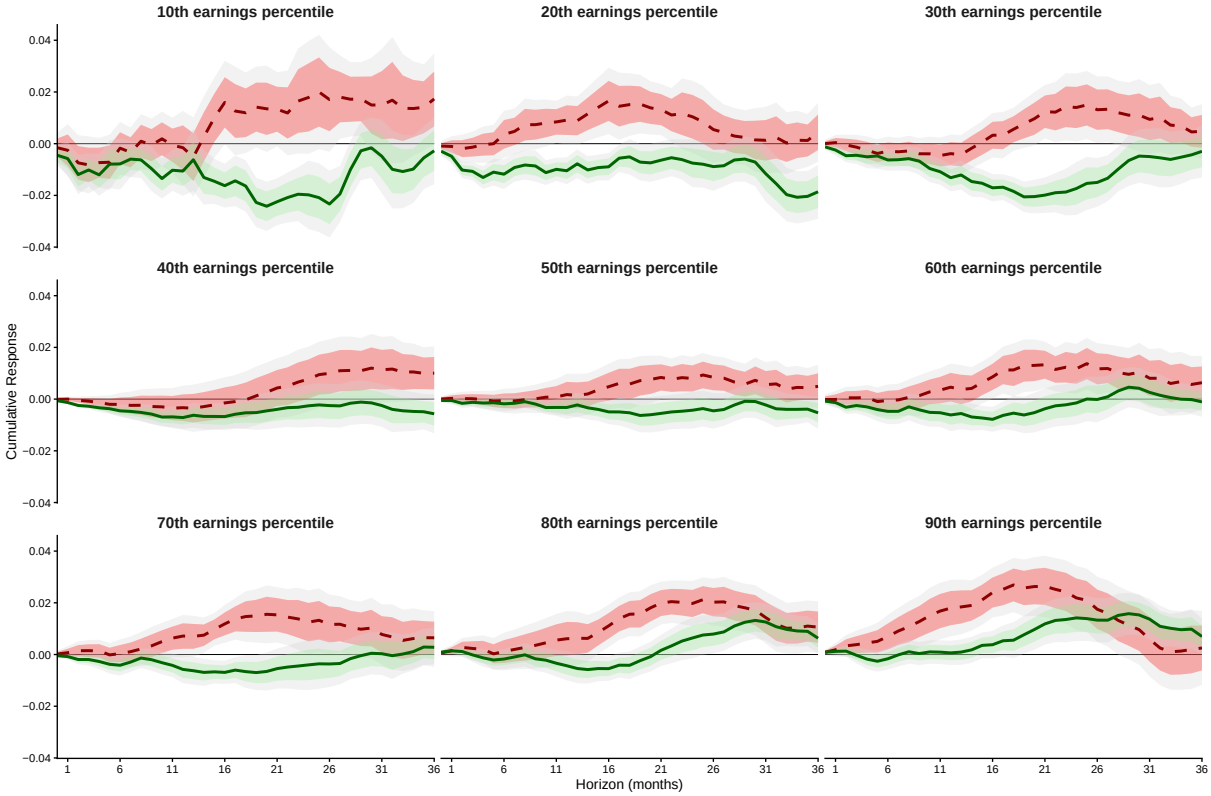
Note: The figure plots the responses of real GDP growth (interpolated with the industrial production index), inflation (y-o-y GDP deflator, interpolated by CPI) and the unemployment rate to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted (for a direct assessment of symmetry). The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure C.2: Asymmetric monetary policy responses - BWB standard errors



Note: The figure plots impulse responses of all earnings deciles to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1984 to December 2023. The graph depicts 68% and 90% confidence intervals based on block wild bootstrapped standard errors (Gadea and Jordà, 2025).

Figure C.3: Asymmetric monetary policy responses - all earnings deciles



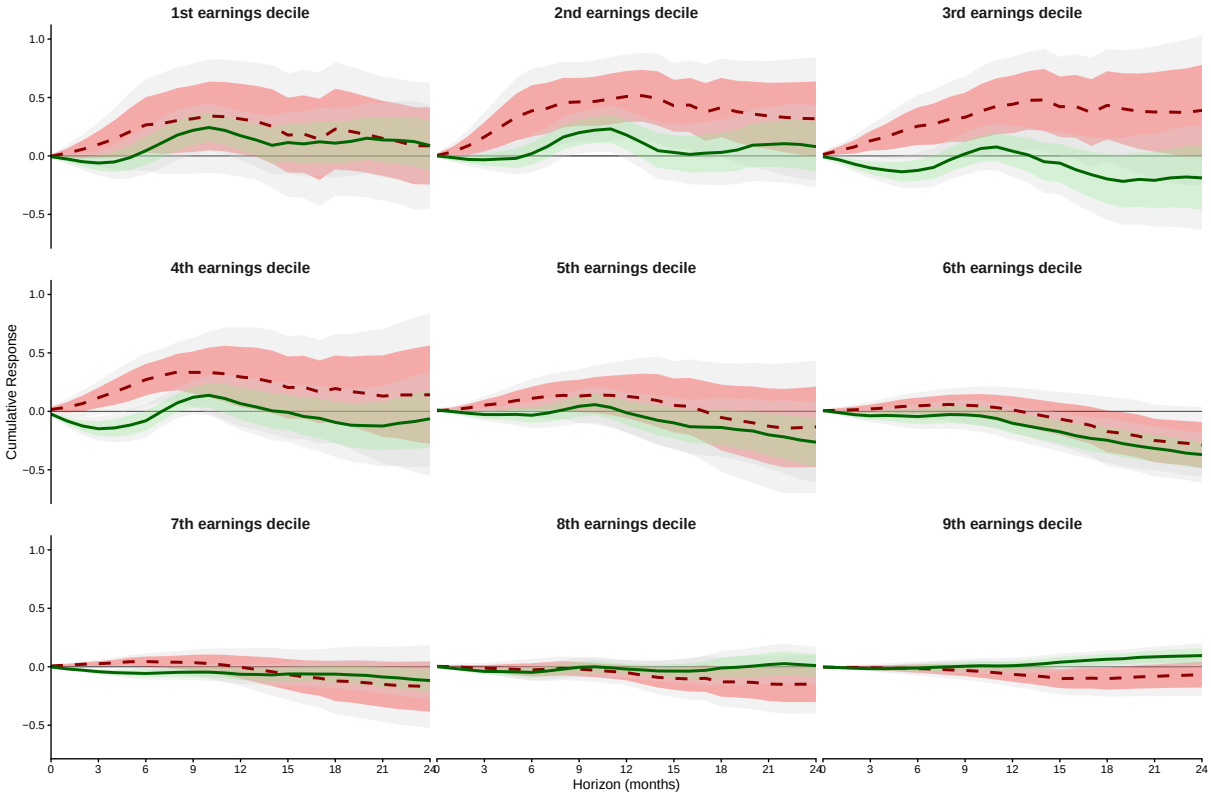
Note: The figure plots impulse responses of all earnings deciles to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1984 to December 2023. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Table C.1: First Stage - PR changes

	Shock coefficient	Standard Error	F-Statistic	p-value
20th earnings percentile	1.24	0.15	72.1	<0.001
50th earnings percentile	1.21	0.14	76.9	<0.001
80th earnings percentile	1.17	0.15	62.0	<0.001
80-20 percentile ratio	1.20	0.14	78.0	<0.001
80-50 percentile ratio	1.12	0.18	39.5	<0.001
50-20 percentile ratio	1.23	0.15	70.4	<0.001

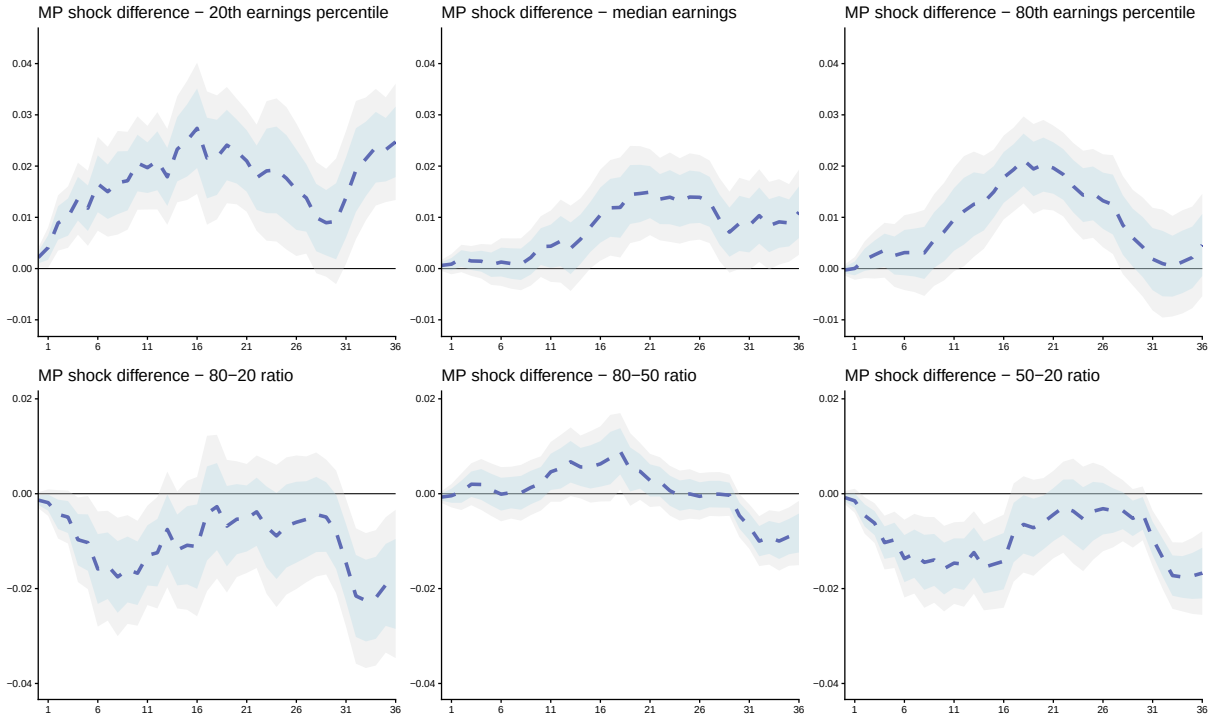
Note: The table lists the first-stage coefficients of the policy rate changes regressed on monetary policy surprises for different earnings percentiles and percentile ratios. The standard errors and partial F-Statistics account for heteroskedasticity and serial correlation (Newey and West, 1987).

Figure C.4: Asymmetric monetary policy responses - unemployment per earnings decile



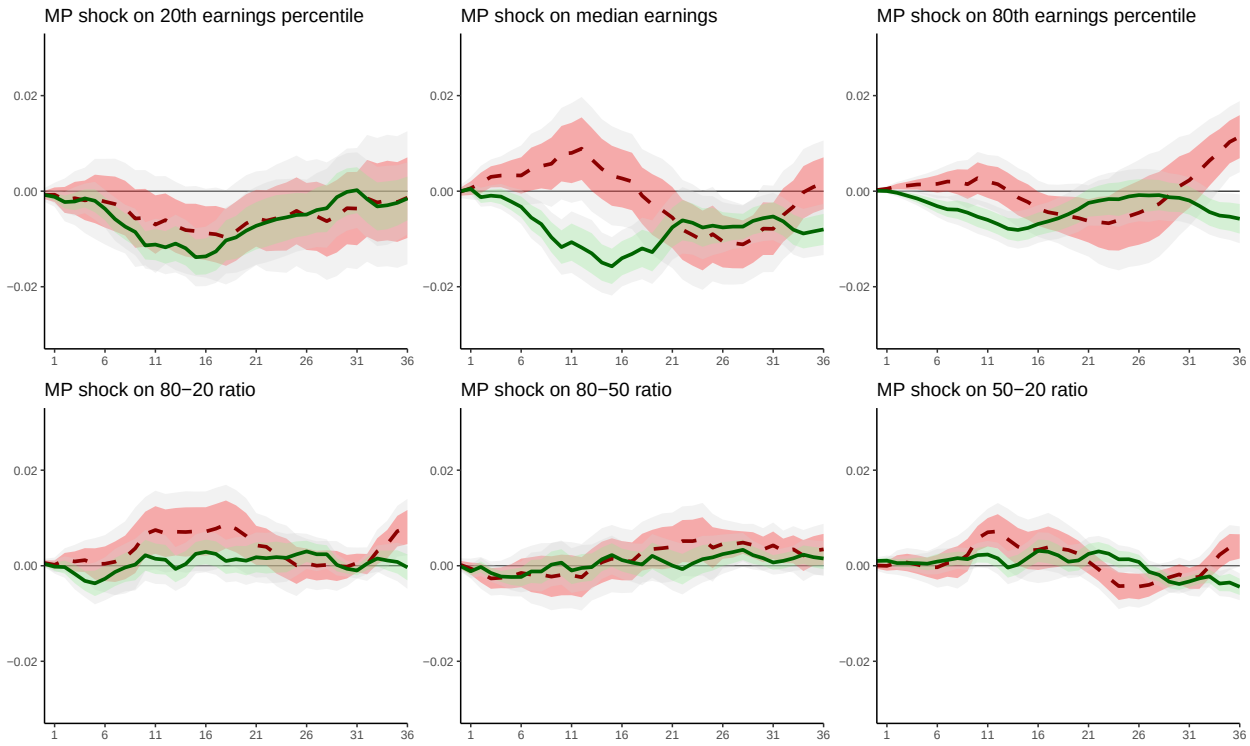
Note: The figure plots impulse responses to the unemployment rate per earnings decile group to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1984 to December 2023. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure C.5: Asymmetry test - Difference Contractionary-Expansionary Monetary Policy



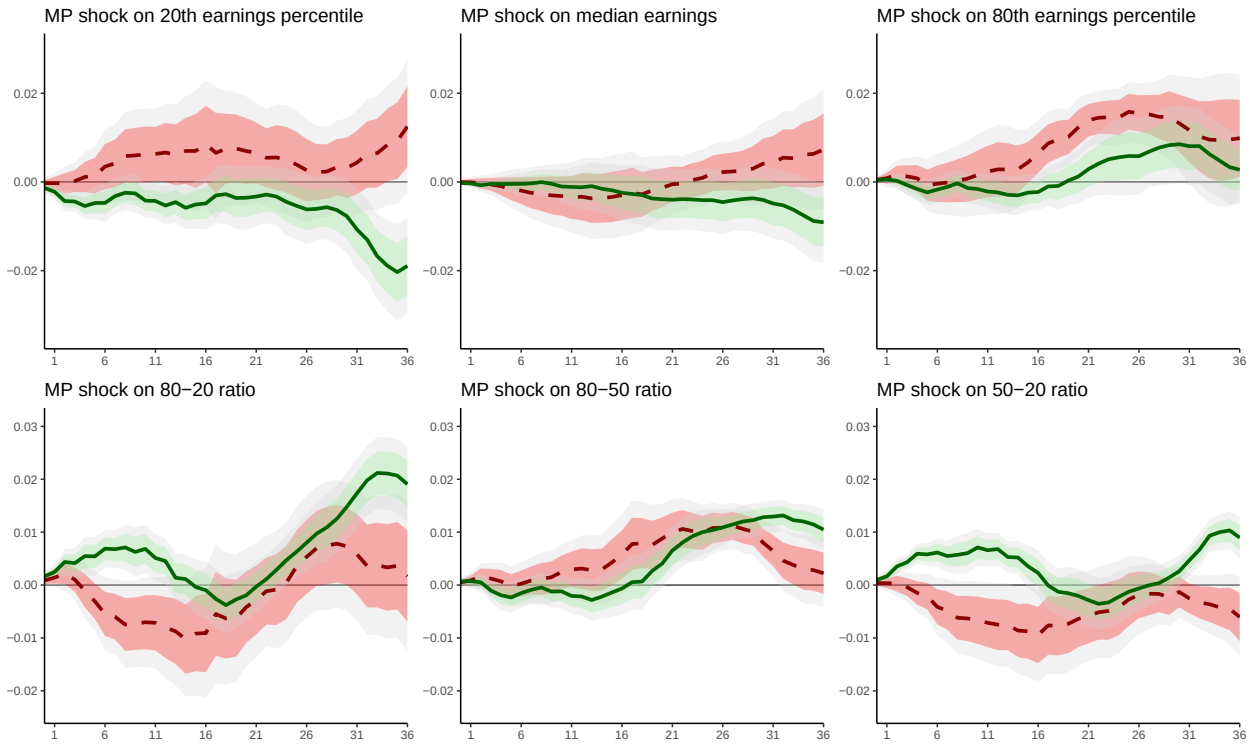
Note: The figure plots the differences in the responses to a contractionary (+0.25pp) versus an expansionary (-0.25 pp) monetary policy surprise. IRF are at the monthly frequency using data from January 1984 to December 2023. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure C.6: Asymmetric monetary policy responses - fixed composition



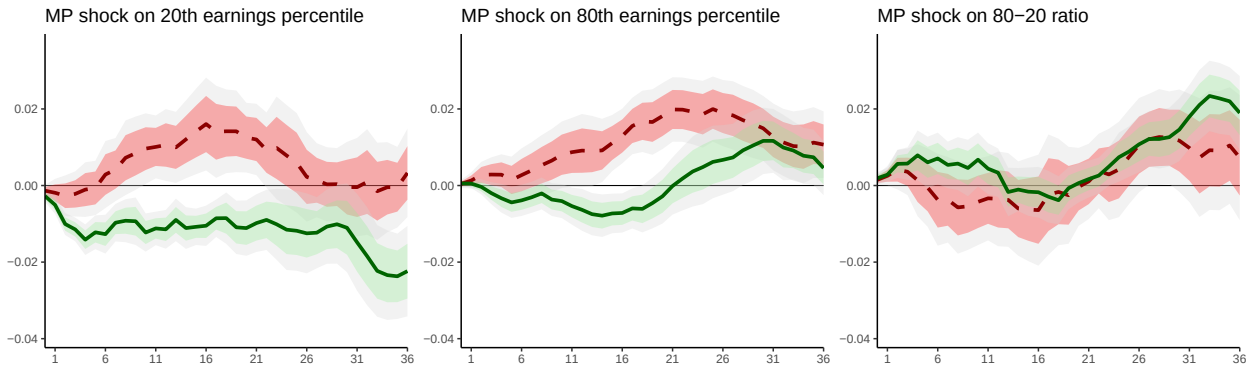
Note: The figure plots impulse responses of earnings deciles and the 80-20 percentile ratio to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1984 to December 2023, excluding workers that have been unemployed around a monetary policy shock ($t-12$ to $t+36$). The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure C.7: Asymmetric monetary policy responses - nominal earnings



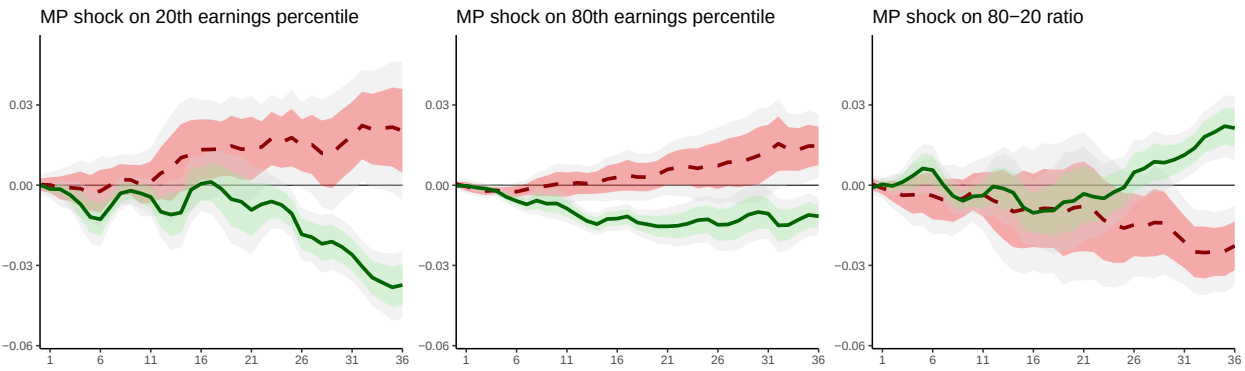
Note: The figure plots impulse responses of *nominal* earnings deciles and the 80-20 percentile ratio to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1984 to December 2023. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure C.8: Asymmetric monetary policy responses - large shocks



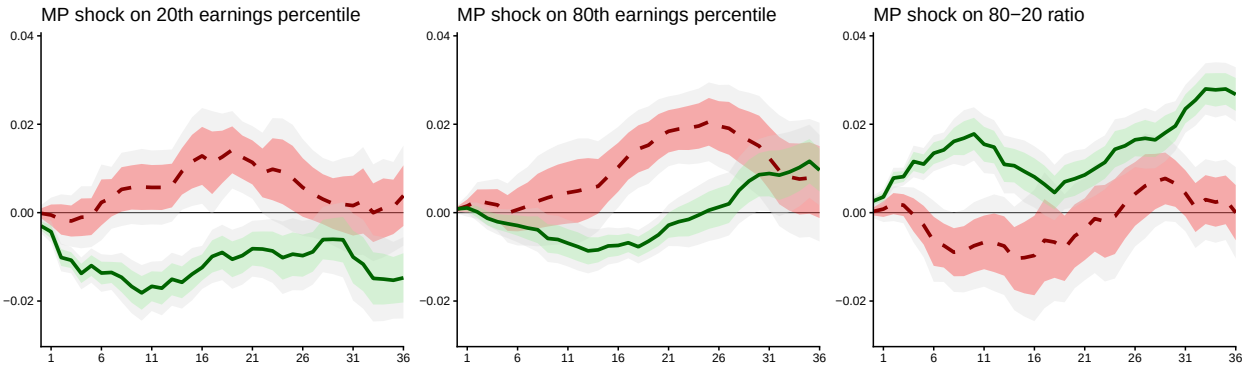
Note: The figure plots impulse responses of earnings deciles and the 80-20 percentile ratio to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1984 to December 2023, excluding small surprises (<1 SD = 4.28 bp). The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure C.9: Asymmetric monetary policy responses - Miranda-Agrippino and Nenova (2022)



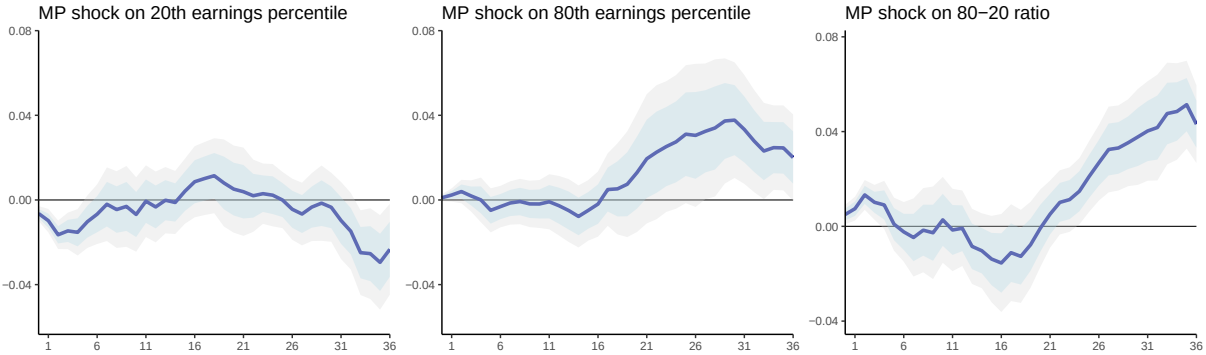
Note: The figure plots impulse responses of earnings deciles and the 80-20 percentile ratio to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1999 to December 2021, shocks are provided by Miranda-Agrippino and Nenova (2022). The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure C.10: Asymmetric monetary policy responses - 2-day window



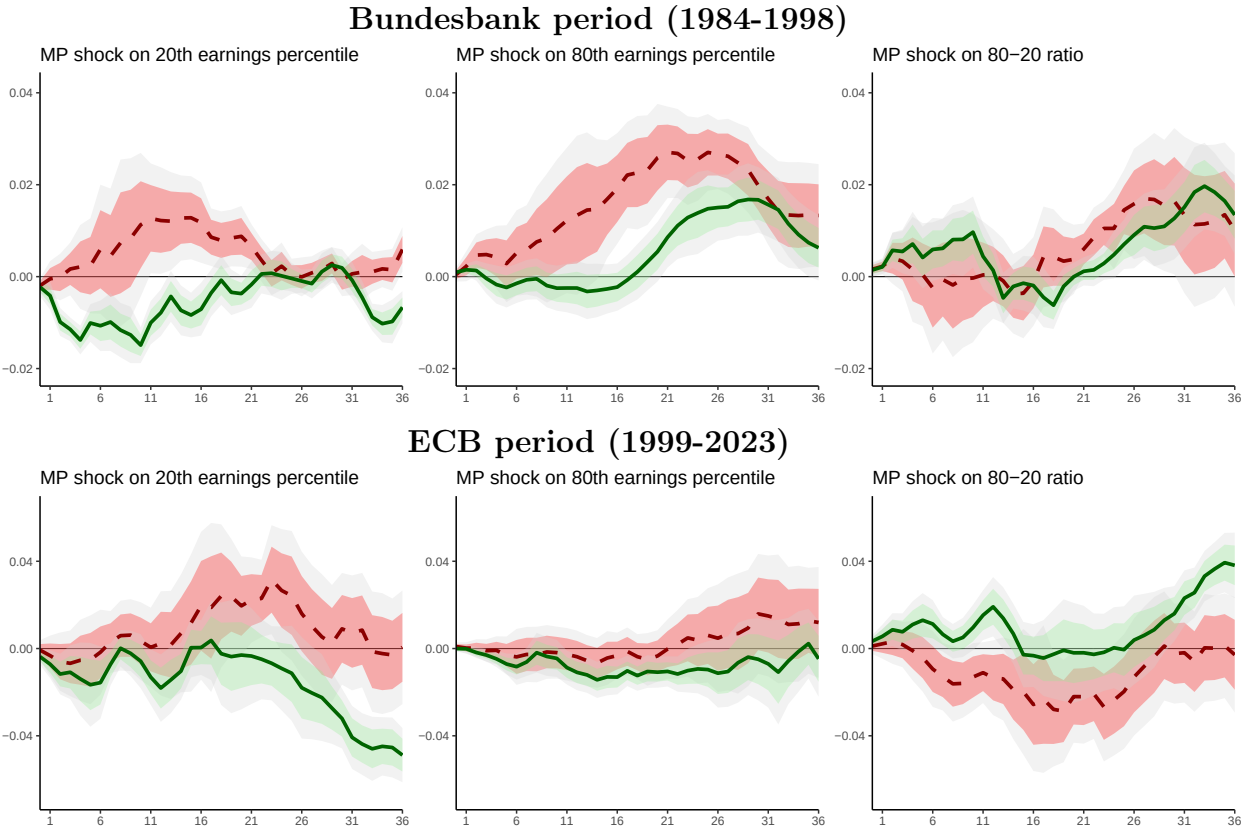
Note: The figure plots impulse responses of earnings deciles and the 80-20 percentile ratio to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1984 to December 2023, 2-day window (t+1 - t-1) for the Bundesbank period. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure C.11: Earnings responses to monetary policy - IV



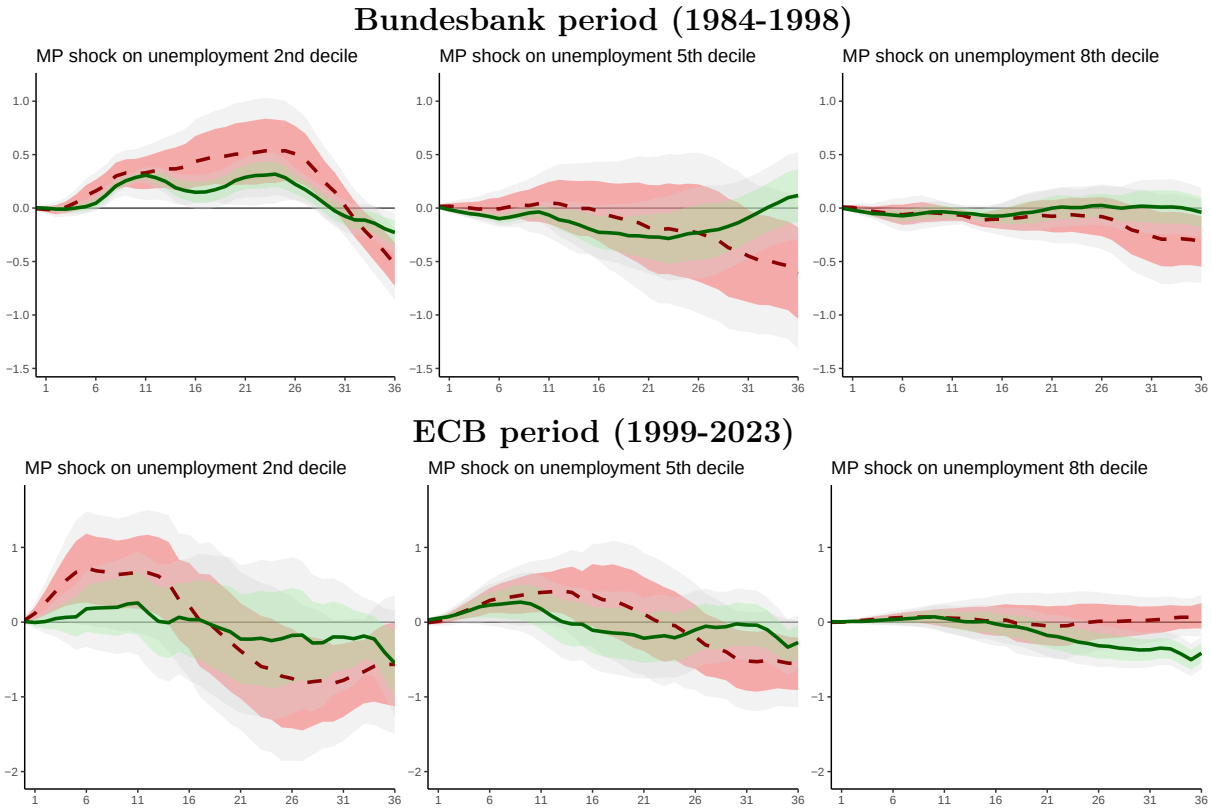
Note: The figure plots impulse responses as well as 68% and 90% confidence intervals (blue and grey shaded areas) of earnings deciles and the 80-20 percentile ratio to a 1 pp change in the policy rate, instrumented by monetary policy surprises. Impulse responses are at the monthly frequency using data from January 1984 to December 2023. The graph depicts Newey-West standard errors.

Figure C.12: Asymmetric monetary policy responses - Bundesbank vs ECB



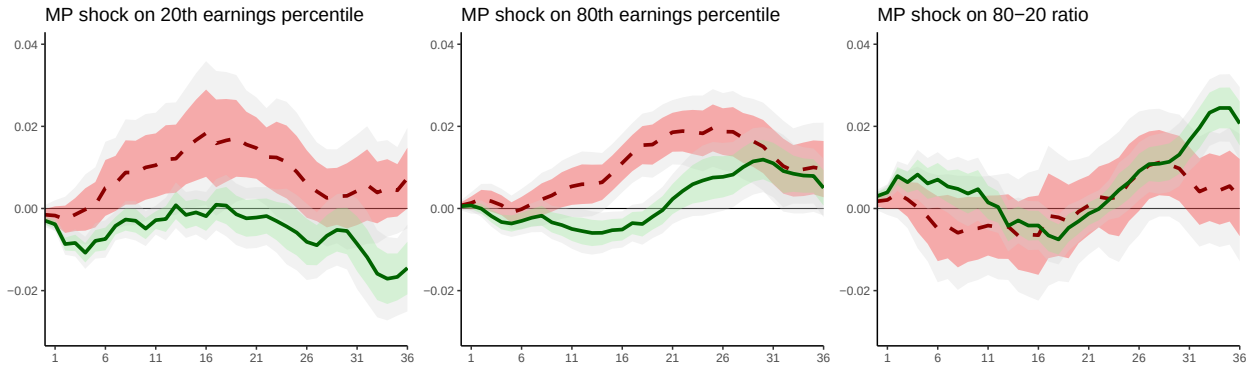
Note: The figure plots impulse responses of earnings deciles and percentile ratios to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. The upper row shows the responses between January 1984 and December 1998 (Bundesbank), while the lower row shows the responses between January 1999 and December 2023 (ECB). The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure C.13: Asymmetric unemployment responses - Bundesbank vs ECB



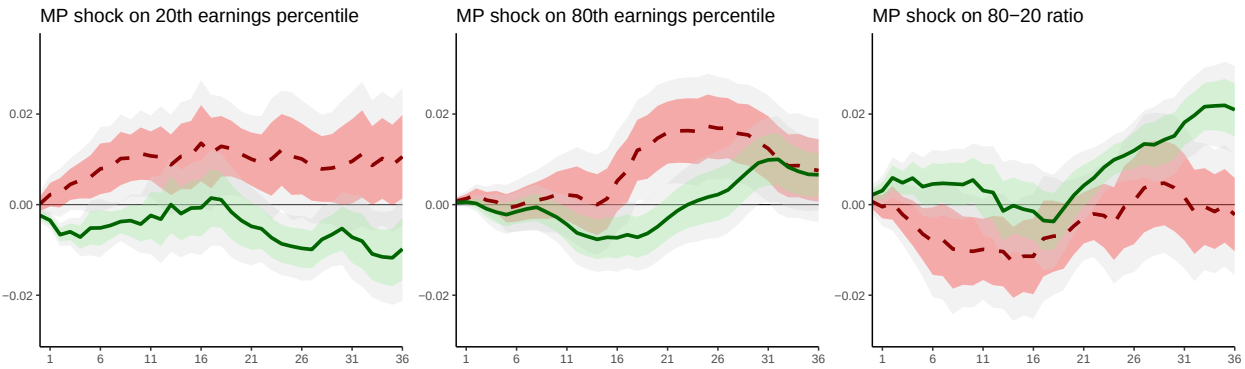
Note: The figure plots impulse responses of the unemployment rate to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. The upper row shows the responses between January 1984 and December 1998 (Bundesbank), while the lower row shows the responses between January 1999 and December 2023 (ECB). The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure C.14: Asymmetric monetary policy responses - Lags dependent variable



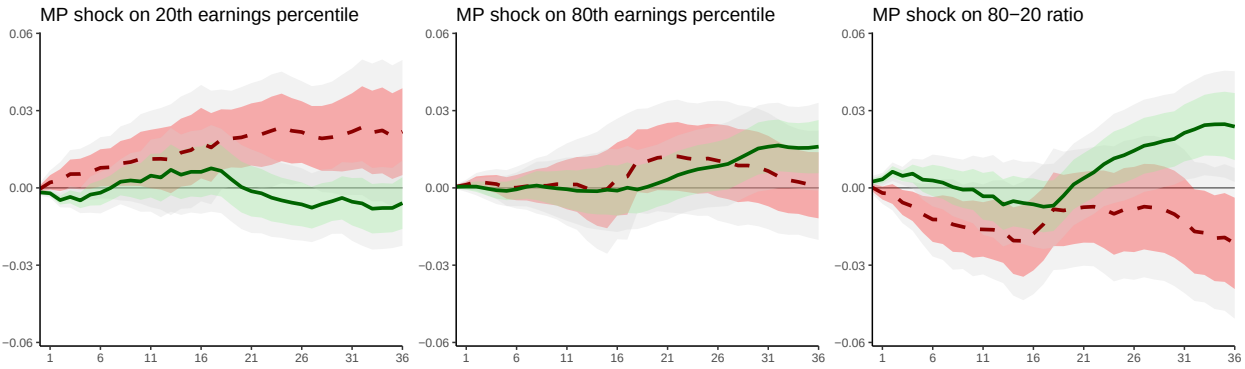
Note: The figure plots impulse responses of earnings deciles and the 80-20 percentile ratio to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1984 to December 2023. Compared to the baseline specification (P=12), only 3 lags of the dependent variables are used. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure C.15: Asymmetric monetary policy responses - Lags control variables



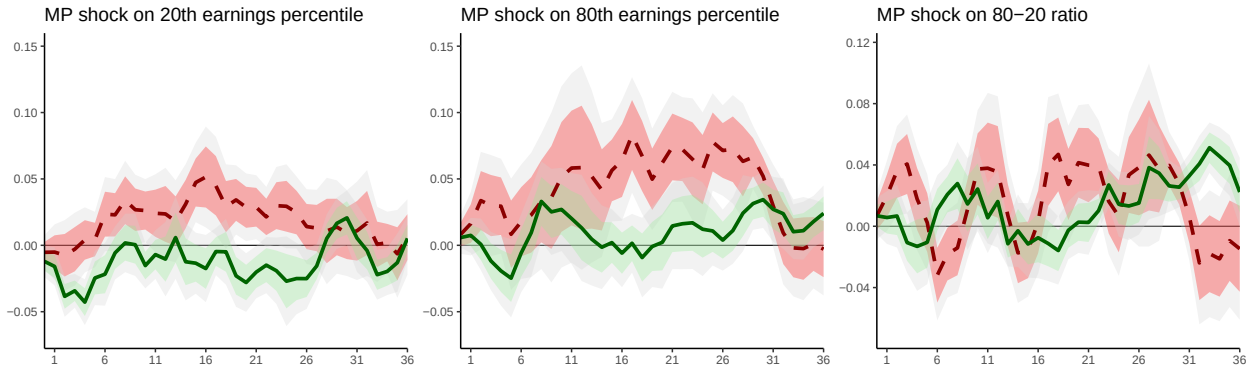
Note: The figure plots impulse responses of earnings deciles and the 80-20 percentile ratio to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1984 to December 2023. Compared to the baseline specification (12 lags), only 3 lags of all control variables are used. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure C.16: Asymmetric monetary policy responses - without control variables



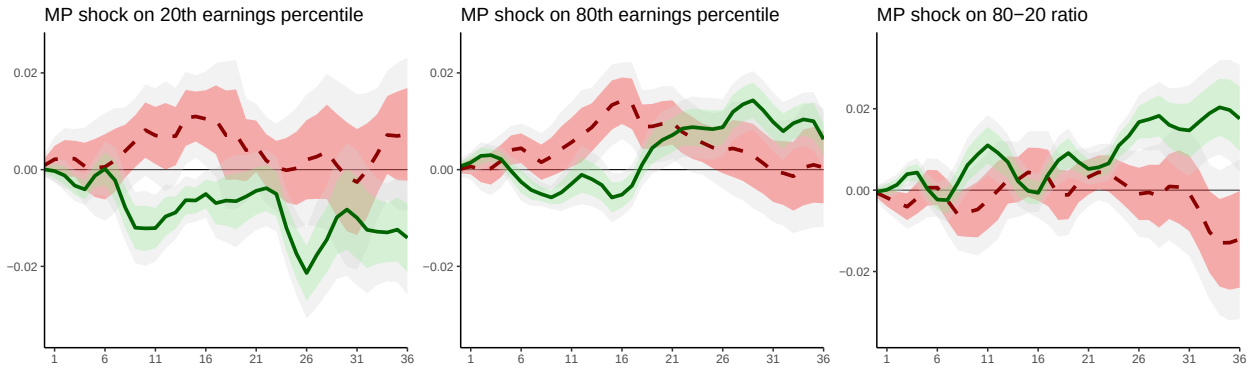
Note: The figure plots impulse responses of earnings deciles and the 80-20 percentile ratio to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1984 to December 2023. Compared to the baseline specification, no controls (except for the lagged dependent variable) are used. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

Figure C.17: Asymmetric monetary policy responses - employed changers sub-sample



Note: The figure plots impulse responses of earnings deciles and the 80-20 percentile ratio from the employed changers sub-sample to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1984 to December 2023. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

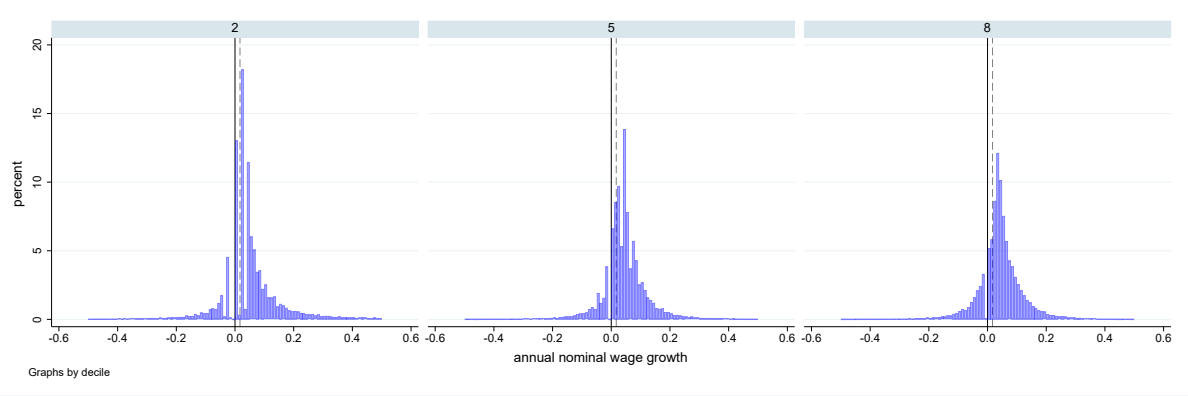
Figure C.18: Asymmetric monetary policy responses - forwarded earnings



Note: The figure plots impulse responses of earnings deciles and the 80-20 percentile ratio with forwarded earnings to a contractionary (+0.25 pp, red, dashed line) and expansionary (-0.25 pp, green, solid line) monetary policy surprise. IRF to expansionary shocks are inverted. IRF are at the monthly frequency using data from January 1984 to December 2023. The graph depicts 68% and 90% confidence intervals based on Newey-West standard errors.

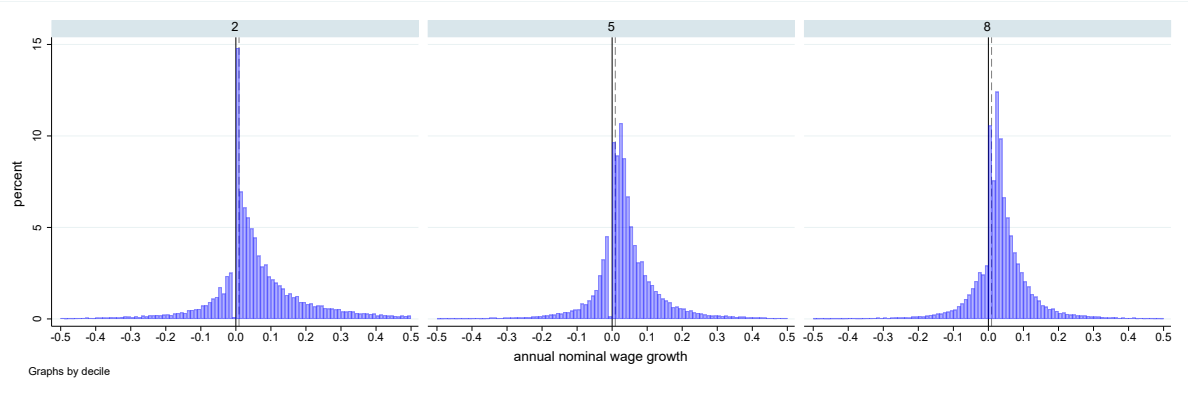
D Downward Wage Rigidity

Figure D.1: Earnings growth distribution across earnings deciles - 1995



Note: The figure plots the distribution of annual nominal earnings growth rate for the 2nd, 5th and 8th earnings decile group in 1995. The dashed lines represent the average inflation rate (1.7%).

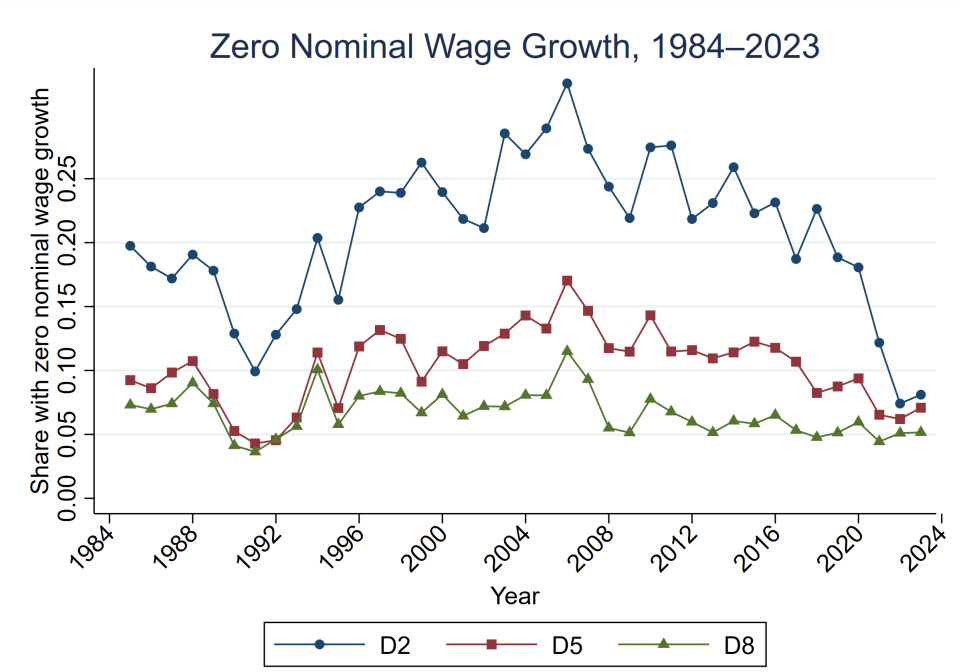
Figure D.2: Earnings growth distribution across earnings deciles - 2015



Note: The figure plots the distribution of annual nominal earnings growth rate for the 2nd, 5th and 8th earnings decile group in 2015. The dashed lines represent the average inflation rate (0.9%).

Earnings function approach. Despite the importance of wage rigidities, the use of microdata to investigate this phenomenon is a relatively recent development. Measurement error has been a pivotal problem in the empirical literature on wage rigidities, since mismeasured individual-level wages may lead to spurious wage changes that could be wrongly interpreted as flexibility. Therefore, I use a model that accounts for measurement error and enables the distinction between real and nominal downward wage rigidity, as described in Goette et al. (2007). To assess the prevalence of downward wage rigidity across the distribution in West Germany, I calculate the proportion of wage changes in the flexible, nominal rigidity and real rigidity regimes for each year and earnings decile group.

Figure D.3: Zero earning growth share across earnings deciles



Note: The figure shows the share of workers who stay at their job (excluding workers with multiple jobs and top-coded wages) with zero nominal earnings growth at the 2nd, 5th and 8th earnings decile group over time (1984-2023).

In the absence of wage rigidity, wage changes $\Delta w^*_{i,t}$ can be described by the simple regression

$$\Delta w^*_{i,t} = \boldsymbol{x_{i,t}}\boldsymbol{\beta} + e_{i,t} \tag{7}$$

the explanatory variables $\boldsymbol{x_{i,t}}$ include tenure, tenure squared, gender, German nationality, 4 education levels, 120 occupational groups, 14 industry dummies, and 10 state (*Bundesländer*) dummies. The residual $e_{i,t}$ is assumed to be distributed normally. In case of nominal downward wage rigidity, the wage changes are governed by:

$$\Delta w_{i,t} = \begin{cases} \Delta w^*_{i,t} & \text{if } \Delta w^*_{i,t} \geq 0 \\ 0 & \text{if } \Delta w^*_{i,t} < 0 \end{cases} \tag{8}$$

In case of real downward wage rigidity, the changes in wages are described by the following equation. Here, $r_{i,t}$ is the inflation-related cut-off below which wage changes

become rigid:[30]

$$\Delta w_{i,t} = \begin{cases} \Delta w^*_{i,t} & \text{if } \Delta w^*_{i,t} \geq r_{i,t} \\ 0 & \text{if } \Delta w^*_{i,t} < r_{i,t} \end{cases} \tag{9}$$

Furthermore, the model considers the possibility of measurement errors in the observed earnings. Observed earnings changes, denoted by $\Delta y_{i,t}$, are generated by the equation:

$$\Delta y_{i,t} = \Delta w_{i,t} + \Delta m_{i,t} \tag{10}$$

The measurement error $m_{i,t}$ is assumed to be a normally distributed shock to the earnings levels. Earnings are measured without error with probability q and with error $m_{i,t}$ with probability $1 - q$.

Using this setup, I can calculate the probability of each observation falling within one of the three regimes and estimate all parameters using the maximum likelihood method. The benchmark for evaluating downward wage rigidity is the estimated notional earnings change distribution for individuals in the fully flexible regime.

Identification of the three rigidity regimes is based on the local asymmetries of the earnings growth distribution, as depicted in Figure 9. Downward nominal wage rigidity is defined by the discrete jump in the density around zero relative to the size of the spike at zero. However, rather than assessing the unconditional distribution depicted in the histogram, I control for various individual characteristics to derive more reliable estimates. Real downward wage rigidity is identified by asymmetries occurring at earnings changes other than zero, with a jump close to the inflation rate. Further details can be found in Goette et al. (2007) and Knoppik and Beissinger (2003).

Sample restriction. Following Bauer et al. (2007), I created a sample suitable for the earnings function approach to detecting downward wage rigidity, which differs from the other exercises in this paper in some respects. To avoid artificial zero wage growth, I remove censored wages at the top of the distribution, and to avoid noise and large earnings changes due to job switching or changes in working hours, I remove job changers.

[30] For tractability reasons, I assume $r_{i,t}$ being normally distributed with finite mean and variance.

Otherwise, I follow the sample cleaning described in Section 4. I do not deflate the earnings to be able to distinguish between real and nominal wage rigidity.

Results. Table D.1 shows the estimated proportions of workers in the German private sector who are in the full flexible regime as well as the nominal and real wage rigidity regimes. As these are mutually exclusive states, the shares of the three regimes add up to 100% for each year and earnings decile group. While the real rigidity regime dominates the nominal rigidity regime in the fifth and eighth deciles for most years, the reverse is true for the second decile. At the bottom of the distribution, around a third of earnings changes can be attributed to the real rigidity regime, with up to two-thirds being assigned to the nominal rigidity regime. This leaves less than ten percent of wages in the flexible regime in most years. In the fifth and eighth decile groups, slightly less than a third of observations are in the flexible regime, making the upper part of the earnings distribution less subject to downward rigidity. The decline in the share of the real rigidity regime observed by Bauer et al. (2007) seems to have been reversed since 2008.

The model also assesses the extent to which the wage setting was constrained in the two rigidity regimes (Table D.2). Starting at 19% in 1985, the proportion of constrained earnings in the second decile increased to reach levels of up to 57% in 2005. This share is much larger than in the higher deciles, ranging from 5% to 37% in the fifth and eighth decile groups. In contrast, the proportion of constrained wages in the real regime remains consistent across the distribution, ranging from 15% to 30% for most years. This demonstrates that downward wage rigidity is significant in Germany, even among high-paid workers. Although the shares across regimes and of constrained wages change over time, this persistently affects the results of the German labour market.

Table D.1: Wage Rigidity Regimes by Decile Group (1985-2023)

Year	2nd Decile			5th Decile			8th Decile		
	Flexible	Nominal Rigidity	Real Rigidity	Flexible	Nominal Rigidity	Real Rigidity	Flexible	Nominal Rigidity	Real Rigidity
1985	0.115	0.425	0.460	0.022	0.361	0.617	0.261	0.335	0.404
1986	0.098	0.482	0.419	0.075	0.346	0.579	0.000	0.534	0.466
1987	0.055	0.487	0.458	0.114	0.286	0.600	0.227	0.360	0.414
1988	0.000	0.536	0.464	0.024	0.348	0.628	0.155	0.343	0.502
1989	0.008	0.525	0.467	0.023	0.322	0.655	0.092	0.304	0.604
1990	0.000	0.588	0.412	0.000	0.251	0.749	0.000	0.265	0.735
1991	0.000	0.752	0.248	0.050	0.251	0.699	0.147	0.186	0.667
1992	0.025	0.722	0.253	0.077	0.202	0.721	0.202	0.162	0.637
1993	0.072	0.468	0.460	0.219	0.222	0.559	0.337	0.202	0.460
1994	0.052	0.540	0.408	0.163	0.372	0.465	0.319	0.326	0.355
1995	0.009	0.558	0.433	0.167	0.258	0.576	0.235	0.213	0.552
1996	0.000	0.580	0.420	0.288	0.301	0.411	0.384	0.265	0.352
1997	0.002	0.598	0.400	0.308	0.307	0.385	0.388	0.252	0.360
1998	0.001	0.638	0.361	0.234	0.327	0.439	0.304	0.283	0.413
1999	0.008	0.631	0.362	0.186	0.363	0.451	0.270	0.227	0.504
2000	0.000	0.630	0.370	0.282	0.315	0.403	0.325	0.260	0.415
2001	0.000	0.612	0.388	0.253	0.303	0.444	0.352	0.210	0.438
2002	0.000	0.628	0.372	0.339	0.128	0.168	0.372	0.256	0.372
2003	0.000	0.689	0.311	0.367	0.348	0.285	0.413	0.223	0.364
2004	0.176	0.535	0.289	0.411	0.309	0.280	0.454	0.266	0.280
2005	0.124	0.574	0.302	0.422	0.302	0.276	0.506	0.307	0.187
2006	0.017	0.727	0.256	0.047	0.558	0.396	0.326	0.394	0.280
2007	0.246	0.550	0.204	0.284	0.393	0.323	0.334	0.361	0.304
2008	0.000	0.723	0.277	0.384	0.417	0.198	0.470	0.261	0.269
2009	0.000	0.658	0.342	0.486	0.296	0.219	0.569	0.168	0.263
2010	0.000	0.720	0.280	0.291	0.412	0.297	0.327	0.349	0.323
2011	0.104	0.642	0.254	0.234	0.432	0.335	0.000	0.367	0.633
2012	0.000	0.703	0.297	0.044	0.432	0.523	0.434	0.204	0.363
2013	0.319	0.447	0.234	0.236	0.375	0.389	0.343	0.194	0.462
2014	0.000	0.716	0.284	0.233	0.397	0.370	0.267	0.214	0.519
2015	0.000	0.683	0.317	0.248	0.414	0.338	0.304	0.213	0.483
2016	0.001	0.749	0.249	0.388	0.398	0.215	0.424	0.206	0.370
2017	0.073	0.589	0.338	0.232	0.375	0.393	0.077	0.167	0.756
2018	0.000	0.699	0.301	0.097	0.327	0.575	0.127	0.221	0.652
2019	0.002	0.674	0.325	0.282	0.362	0.356	0.076	0.187	0.737
2020	0.572	0.305	0.123	0.659	0.211	0.131	0.663	0.205	0.132
2021	0.426	0.339	0.235	0.286	0.376	0.339	0.408	0.218	0.374
2022	0.061	0.672	0.267	0.119	0.281	0.600	0.153	0.359	0.488
2023	0.236	0.748	0.016	0.093	0.313	0.593	0.163	0.366	0.471

Note: The values represent the share of workers in each wage setting regime (Flexible, Nominal Rigidity, Real Rigidity) for each decile group for the years 1985 to 2023.

Table D.2: Share of Constrained Wages by Decile Group (1985-2023)

Year	2nd Decile		5th Decile		8th Decile	
	Nominal Regime	Real Regime	Nominal Regime	Real Regime	Nominal Regime	Real Regime
1985	0.190	0.269	0.101	0.266	0.096	0.206
1986	0.196	0.228	0.094	0.278	0.102	0.209
1987	0.199	0.250	0.107	0.345	0.104	0.224
1988	0.244	0.270	0.132	0.320	0.117	0.231
1989	0.194	0.233	0.104	0.328	0.093	0.290
1990	0.144	0.151	0.063	0.380	0.066	0.363
1991	0.133	0.103	0.051	0.351	0.046	0.366
1992	0.153	0.116	0.061	0.429	0.053	0.383
1993	0.186	0.271	0.083	0.335	0.081	0.290
1994	0.269	0.248	0.151	0.240	0.135	0.177
1995	0.222	0.228	0.086	0.323	0.071	0.305
1996	0.378	0.309	0.129	0.219	0.129	0.219
1997	0.428	0.314	0.146	0.222	0.146	0.222
1998	0.453	0.281	0.138	0.230	0.138	0.230
1999	0.380	0.248	0.127	0.255	0.127	0.255
2000	0.436	0.281	0.122	0.198	0.122	0.198
2001	0.362	0.265	0.122	0.244	0.122	0.244
2002	0.441	0.285	0.122	0.244	0.122	0.244
2003	0.569	0.269	0.150	0.152	0.150	0.152
2004	0.535	0.289	0.160	0.171	0.160	0.171
2005	0.574	0.302	0.153	0.166	0.153	0.166
2006	0.559	0.209	0.372	0.284	0.372	0.284
2007	0.293	0.124	0.167	0.166	0.167	0.166
2008	0.507	0.210	0.152	0.111	0.152	0.111
2009	0.541	0.300	0.146	0.126	0.146	0.126
2010	0.494	0.209	0.176	0.152	0.176	0.152
2011	0.349	0.157	0.156	0.150	0.156	0.150
2012	0.436	0.205	0.280	0.384	0.280	0.384
2013	0.208	0.127	0.139	0.212	0.139	0.212
2014	0.396	0.179	0.147	0.203	0.147	0.203
2015	0.316	0.171	0.156	0.180	0.156	0.180
2016	0.339	0.078	0.141	0.114	0.141	0.114
2017	0.226	0.163	0.128	0.197	0.128	0.197
2018	0.356	0.177	0.167	0.359	0.167	0.359
2019	0.287	0.168	0.119	0.174	0.119	0.174
2020	0.163	0.053	0.102	0.055	0.102	0.055
2021	0.139	0.114	0.101	0.115	0.101	0.115
2022	0.115	0.088	0.136	0.379	0.136	0.379
2023	0.112	0.005	0.157	0.378	0.157	0.378

Note: The values represent the share of workers whose earnings are constrained by nominal and real rigidity for each decile group.