The Distributional Effects of Oil Shocks

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Abstract

We study the effects of oil supply shocks across the income distribution using 45 years of high-frequency German administrative data. At the bottom of the distribution, earnings growth two years after the shock falls by 0.75 percentage points; the top of the distribution is affected little. Similarly, the separation probability rises significantly at the low end of the distribution while the top is unaffected. We investigate how the systematic response of monetary policy to oil shocks affects these findings. Monetary tightening to counteract oil-shock-induced inflation generates significant output and employment costs. Across the income distribution, we find that the tightening of the nominal rate in response to oil shocks hurts the bottom of the income distribution disproportionately more than the top.

1 Introduction

Disruptions of supply chains following the COVID-19 pandemic and abrupt changes in commodity prices after the Russian invasion of Ukraine have reminded policymakers and economists of the importance of supply factors for economic performance. We build on the recent literature on the distributional effects of economic fluctuations and policies to study the effects of supply fluctuations for earnings and employment along the income distribution. Supply shocks are notoriously difficult to identify and measure, since they are often one-off events (such as the post-Covid breakdown in supply chains). Further, identifying the distributional implications requires long panels of high-frequency individual-level data. To take a first step towards understanding the distributional effects of supply fluctuations, we focus on exogenous fluctuations in a key input price to western economies, that of oil (Känzig, 2021), and use German administrative data on worker earnings and employment, available since the 1970s at high frequency, to study its distributional implications. In addition to

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furthering our understanding of supply shocks to business cycle fluctuations, our findings will also she light on the distributional implications of the transition to net zero emissions and less reliance on fossil fuels, including oil.

One question of particular interest to policymakers is how the effects of supply shocks on individual earnings and employment relate to those of demand shocks, such as the innovations to monetary policy. For this, we combine the monetary-policy shocks we identified in (Broer et al., 2022) with those from Cloyne et al. (2022), to have a series of monetary-policy innovations that matches that of oil shocks.

Comparing the paths of the economy following these two shocks is interesting also because the response to oil shocks that standard time-series techniques uncover includes the effects from any monetary policy reaction to the oil price shock. Policymakers confronted with a supply disruption, in contrast, would like to know its effect on the economy for any policy-reaction they might choose, including, importantly, none. We therefore use our estimates to take a first step to identifying such effect of oil-shocks in the absence of a monetary reaction. How this is best done depends on the particular policy scenario one is interested in: on the one hand, policymakers might be interested in the path of the economy should they decide to keep delaying their monetary response indefinitely, implying repeated surprises of non-reaction. Alternatively, they might want to know what path the economy would take in case they were to credibly commit to not reacting to oil shocks ex ante. These two policy scenarios correspond, respectively, to those studied in Sims and Zha (2006) and, more recently, McKay and Wolf (2023).

We find significant and substantial contractionary effects of supply increases in oil prices on aggregate economic indicators of the Germany economy since the 1970s. Moreover, we find that such contractions are not just explained by a contractionary monetary response to the oil-price-induced inflation surge. Rather, when we use our estimates of aggregate responses to both shocks to construct the two counterfactual 'monetary non-response' scenarios, we still find substantial contractionary effects of oil price increases. Specifically, because of the delayed response of the economy to monetary policy interventions, the monetary response to oil shocks has very little impact during the first year and a half, but contributes to their contractionary effect after that.

The incidence of oil-price induced contractions on individual German workers shows substantial heterogeneity: income-poor workers suffer substantially more, in particular because the fall in employment hits them disproportionately. These findings are not unlike those we found in our previous paper for monetary contractions, and average business cycles. Although the estimates are particularly uncertain along this dimension, the monetary response seems to have accounted for a substantial part of the fall in employment prospects among the poor. These findings suggest that fiscal policy rather than monetary policy might be a more effective tool for responding to supply shocks.

Related Literature

Our study relates, first, to previous work on the aggregate and individual-level effects of oil shocks. Many studies have tried to overcome the endogeneity problem arising from the response of oil prices to economic conditions, mostly using structural-vector-regression techniques (see Zhou (2020) for a recent contribution and a survey of the literature). Känzig (2021) investigates how news about oil supply, identified form high-frequency price changes around OPEC-announcements, and changes in the price of European carbon emission allowances affect European economies. In response to more restrictive policies, unemployment in the EU rises and industrial production falls. Känzig (2023) shows that carbon-price induced energy-price increases reduce aggregate activity. He also finds that, in UK data, they particularly reduce consumption of poor-income households, whose consumption baskets feature a higher share of energy. Similarly, Pieroni (2023) and Labrousse and Perdereau (2023), among others, study the heterogeneous incidence of post-tax energy price changes in dynamic general-equilibrium models with heterogeneous consumers. Bobasu et al. (2024) study the interplay of energy price shocks and monetary policy in a quantitative HANK model. To our knowledge, we are the first to investigate the interplay between these two forces empirically.

Our study also contributes to a growing literature on the distributional effects of aggregate shocks. Much of this literatures has focused on monetary policy, including our own previous work (Broer et al., 2022). There we use the same SIAB dataset to investigate the incidence of monetary policy along the income distribution in Germany since the ECB took over monetary policy. Three contemporaneous papers—Holm et al. (2021), Andersen et al. (2023), and Amberg et al. (2022) investigate this question for the cases of Norway, Denmark, and Sweden, respectively.

Our results also relate to the literature that aims at separating the direct effects of supply shocks from those due to any monetary response. Following Sims and Zha (2006) (first published as a working paper 10 years earlier), Bernanke et al. (1997) study the effect of oil shocks under a counterfactual scenario where monetary policy repeatedly surprises economic agents by not responding. More recently, Caravello et al. (2024); McKay and Wolf (2023) have shown how one can describe (conditional and unconditional) economic fluctuations under counterfactual policy rules based on VAR evidence. They use the shocks to U.S. monetary policy identified, respectively, by Romer and Romer (2004) and Gertler and Karadi (2015) together with simulated effects of oil shocks on the U.S. economy to estimate their effects under a counterfactual policy. To our knowledge our paper is the first to compare both approaches in an empirical study of the effects of oil price shocks with counterfactual monetary policy.

2 Data

Sample of Integrated Labor Market Biographies

Our source of administrative data on the German labor market is the Sample of Integrated Labor Market Biographies (SIAB), a two-percent subsample of all labor-market biographies in Germany, provided to us by the Research Data Center (FDZ) of the German Federal Employment Agency.[1] It covers the entire labor market history for all individuals included in our dataset, between 1974 and 2021. The data comprises information reported to the German tax authority and social-security administration, and includes information on employment status, job changes, unemployment benefit receipts, and average daily earnings within an ongoing employment relationship. The data do not cover employment spells of civil servants and do not contain self-employed individuals, as both groups are covered by special social security systems.

The data is organized in labor market spells, which can, at most, be one year long, since an employer needs to report information to the German tax authority at least once per year (Schmucker et al., 2023). We convert our data to monthly observations of employment status and average monthly earnings. For individuals who hold multiple jobs during a single month, we keep the one with the highest remuneration. Information on pre-tax earnings is top censored. We impute it by using observable characteristics, using a Tobit regression (Dauth and Eppelsheimer, 2020).

We categorize an individual as unemployed if they receive unemployment benefit payments at the beginning of their non-employment spell. As benefit eligibility has changed over the course of our sample period, especially in terms of duration, this allows us to work with a relatively consistent unemployment definition.

In our main analysis, we restrict attention to individuals who are closely attached to the labor market (i.e., employed or unemployed, according to the definition above), and between the ages of 25 and 60. We deflate pre-tax earnings using the CPI.[2]

Oil shocks and monetary policy surprises

As a measure of surprise changes in the oil price that are not caused by economic conditions, we use the shock series provided in Känzig (2021), identified as price changes in a short window around OPEC announcements. We compare the economic effects of these shocks to those of monetary policy surprises.

[1]We rely on the factually anonymous version of the Sample of Integrated Labour Market Biographies (SIAB-Regionalfile) – Version 7514. Research Data Centre (FDZ) of the Federal Employment Agency (BA) at the Institute for Employment Research (IAB). Data access was provided via a Scientific Use File supplied by the FDZ of the BA at the IAB.

[2]We obtain data on the CPI from FRED, series name $DEUCPALTT01IXNBM$.

In order to be able to investigate the effects of both shocks over an identical, long sample period, we combine two series of monetary shocks. The first series is constructed by Cloyne et al. (2022) for the German Bundesbank, for the period from 1974 until the end of 1998. They use a narrative approach to identify unexpected changes to German monetary policy. The second series comes from Almgren et al. (2022), who use a high-frequency approach to identifying surprises in the ECB's monetary policy actions. The two series are non-overlapping and describe the actions of two different central banks conducting monetary policy in Germany.

The Bundesbank's policy rate was the *discount rate*, at which commercial banks could obtain short term liquidity from the central bank. Starting in 1999, when monetary policy authority shifted to the ECB, the policy rate became the rate for *main refinancing operations*. Crucially, there is a seemless transition between the two monetary policy rates, allowing us to combine the series into a single one for our whole sample.

3 Aggregate effects

3.1 Aggregate effects of oil supply news shocks in Germany

To study the effect of oil shocks on aggregate economic conditions in Germany during our sample period, we use the shock series provided in Känzig (2021). We estimate the following regression equation at the monthly frequency:

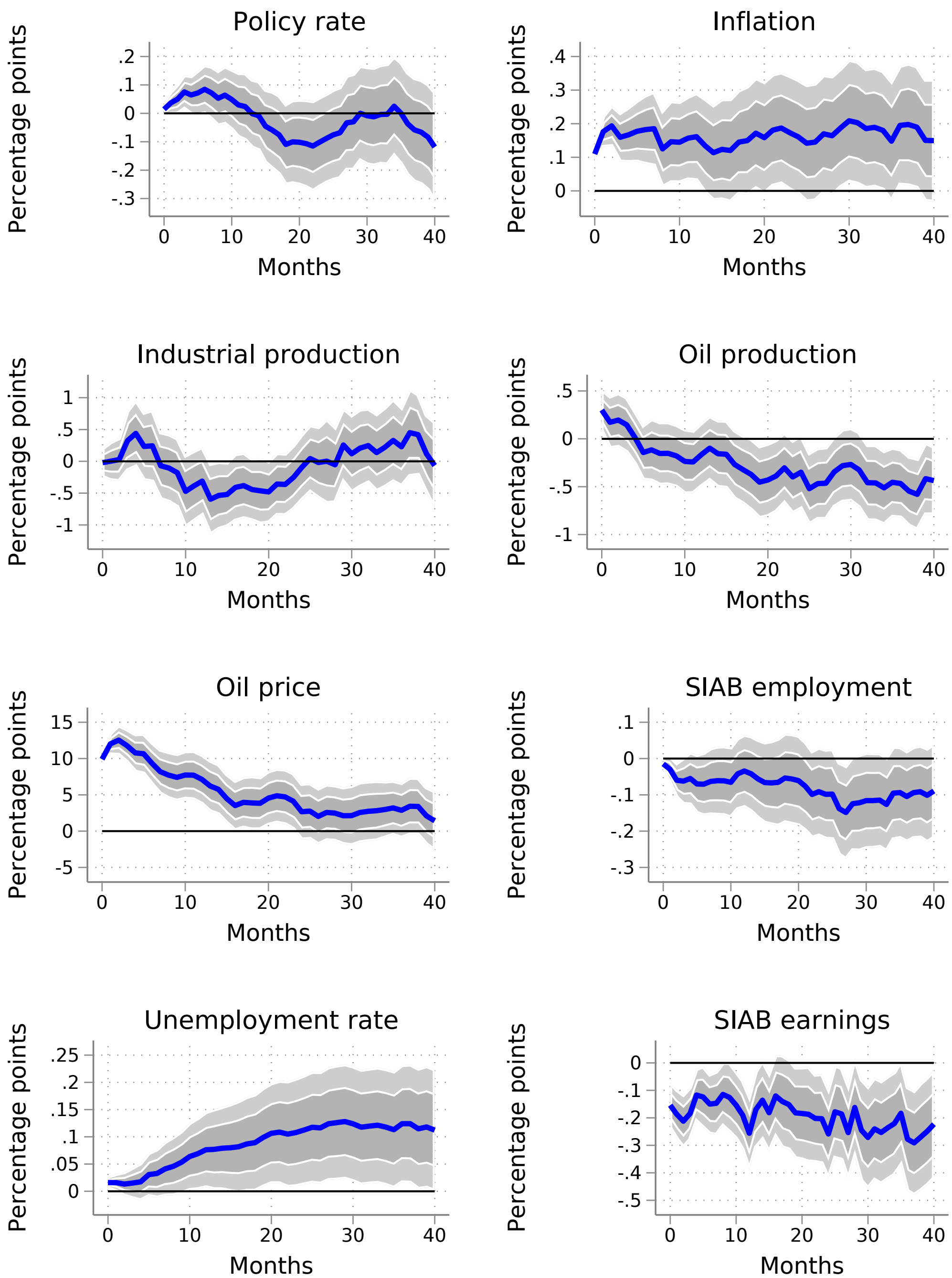
$$\Delta y_{t+h} = \alpha_h + \beta_h Oilnews_t + \sum_{i=1}^{l} \gamma_{i,h} X_{t-i} + \varepsilon_{t,h} \quad \forall h \geq 0 \tag{1}$$

where $\Delta y_{t+h} = y_{t+h} - y_{t-1}$ is the h-period difference in the variable of interest, $Oilnews_t$ represents a negative oil supply news shock, and $X_{t-i}, i = 1, ..., l$ represents control variables equivalent to those in Känzig (2021), but for the German economy, where applicable: the German consumer price index (CPI), German industrial production (IP), the real world crude oil price, world oil inventories and world oil production. In addition, we include two control variables from our administrative data: aggregate (average) earnings of the employed and the employment rate. For our baseline specification, we include $l = 3$ lags.

Figure 1 shows the results from this exercise, which are almost exactly in line with those reported in Känzig (2021) for the U.S. economy.[3] The shock causes world oil production to decrease, in line with the intuition that negative news about oil supply coincides with a fall in realized oil supply. Oil inventories increase significantly and persistently (not shown). The

[3]The original shock series is normalized such that it causes a 10% increase in the real oil price. Despite the fact that the US CPI and industrial production values are replaced with their German equivalents, and controls for aggregate unemployment and earnings were added, the shock still causes a 10% increase in the real oil price in our specification.

Figure 1: The aggregate effects of oil price news in Germany



Note: The Figure shows estimates of Equation (1) for different dependent variables y. Standard errors are heteroskedasticity robust and clustered at the month level. The shaded areas represent 68% and 90% confidence intervals. Impulse responses are scaled to an oil supply news shock which causes a 10% rise in oil prices in Känzig (2021)'s original estimation. Employment and average real earnings are constructed using German administrative data. The sample period is 1974-2020.

shock about oil news also has significant effects on the monetary policy rate of the German monetary policy authority: within the first six months after the shock, the policy rate rises significantly, by about 10 basis points. It then decreases in a protracted cycle over 3.5 years. Our goal in the next sections will be to study a counterfactual with a different policy rate response.

Further, the negative oil supply news shock persistently increases inflation in Germany, by about 0.2 to 0.3 percentage points. Industrial production falls significantly one year after the initial shock, but the effect subsides at longer horizons. Importantly, labor market conditions deteriorate in response to contracting oil supply: the official German unemployment rate rises and the employment rate in our sample population falls. Finally, the real pre-tax earnings growth of the employed in our sample declines significantly, driven, in part, by the higher rate of inflation. Three years after a negative oil supply news shock, earnings growth is 0.3 percentage points lower than in the absence of a shock.

3.2 Aggregate effects of monetary policy in Germany

As described in Section 2, we estimate the effect of monetary policy shocks by combining data for two monetary policy regimes in Germany, corresponding, respectively, to the period before (Bundesbank (Buba) period) and after 1999 (ECB period). Our object of interest is the following regression, estimated for the entire sample period, from 1974 to 2020, at the monthly frequency:

$$\Delta y_{t+h} = \alpha_h + \beta_h i_t + \sum_{i=1}^{l} \gamma_{i,h} X_{t-i} + \varepsilon_{t,h} \quad \forall h \geq 0 \tag{2}$$

where $\Delta y_{t+h} = y_{t+h} - y_{t-1}$, y_t is an outcome variable of interest, i_t is the monetary policy rate in Germany and X_{t-i} is a vector of control variables. Usually (see e.g., Broer et al. (2022)), the policy rate i_t is instrumented using monetary policy shocks z_t. In our special case, however, there is no continuous instrument series for the entire sample period. To conduct our analysis, we estimate two separate first-stage regressions of the German discount interest rate on the instruments and the controls, one for the Bundesbank period using and one for the ECB period. For the former, we use the series provided by Cloyne et al. (2022), who use a narrative method to identify shocks to the monetary policy of the Bundesbank. For the ECB period, we use the shocks estimated by Almgren et al. (2022). This provides us with two series that capture exogenous fluctuations in policy rates, $\hat{i}_{t,BuBa}$ and $\hat{i}_{t,ECB}$. Both are conditional on the controls in X and monetary policy shocks. Combining them yields the series $\hat{i}_t$, plotted in Figure 13. To obtain the coefficient of interest β_h in Equation

(2), we estimate

$$\widetilde{\Delta y_{t+h}} = a_h + \beta_h \hat{i}_t + \varepsilon_{t,h},$$

where $\widetilde{\Delta y_{t+h}}$ are the residuals from a regression of Δy_{t+h} on the control variables in X. This allows us to recover the impact of unexpected monetary policy movements on variables of interest over our entire sample period. In particular, the coefficient β^h in Equation (2) can be interpreted as the effect of a monetary policy surprise in period t on a variable of interest in period $t+h$.

Figure 2 summarizes the results of this exercise, for an unexpected monetary policy tightening of 100 basis points. Over time, the rate change is reversed. After an initial increase, inflation starts to fall in response to the tightening with a considerable lag, by close to 2 percentage points after three years. Economic activity, in contrast responds somewhat faster: the growth rate of industrial production is reduced by close to two percentage points one year after the shock, before returning to baseline towards the end of the estimation period. The official unemployment rate starts to increase after about 6 months, attains a significant plateau of about 0.4 percentage points over year 2, and then falls back towards zero. Accordingly, the employment rate of individuals in our micro-data sample that are closely attached to the labor market experiences a similar percentage-point decrease in response to the shock that is, however, somewhat less persistent. Their earnings response is noisy and never significant.

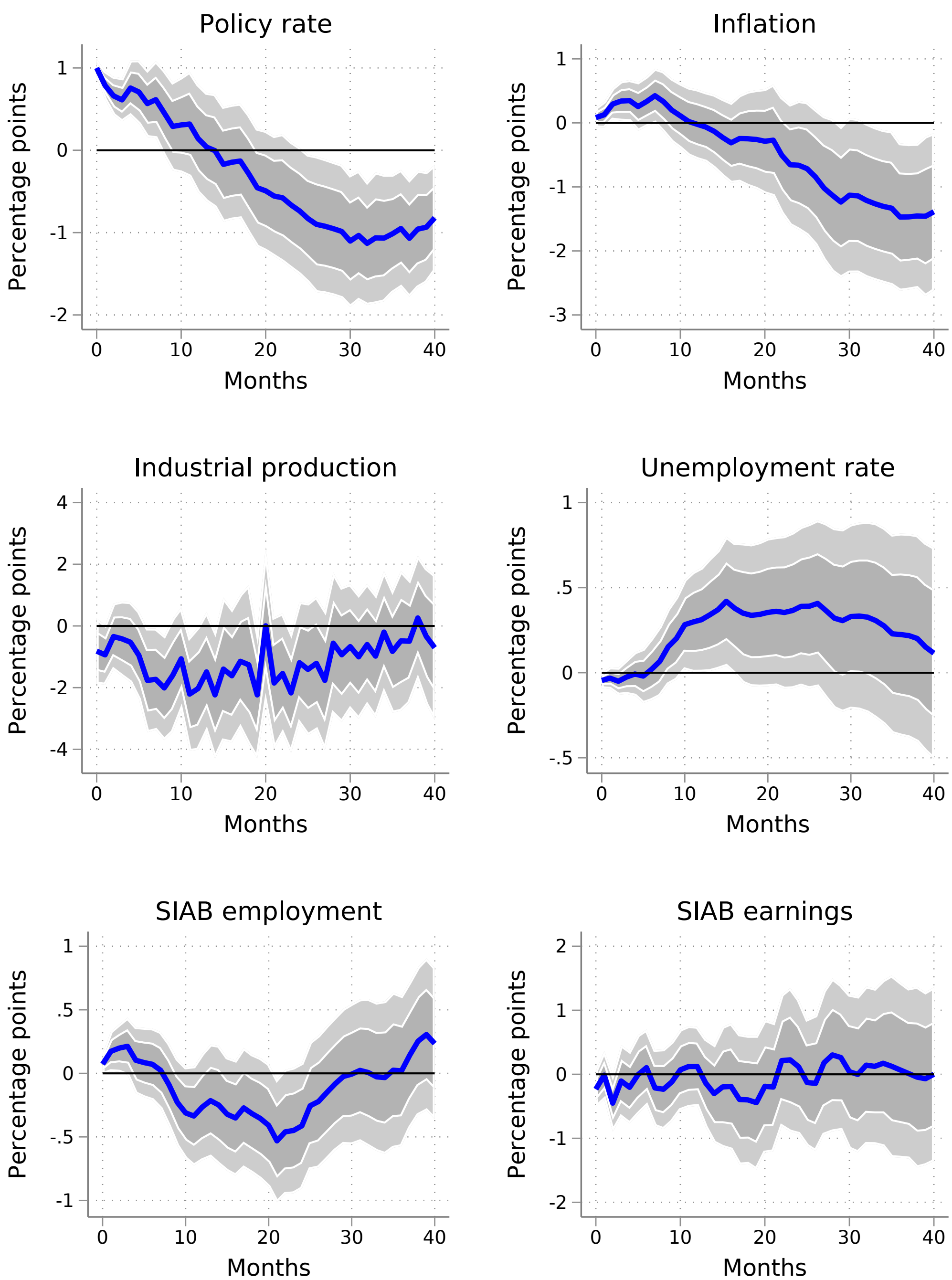
3.3 The effects of oil shocks without a monetary policy reaction

The response of aggregate economic conditions in Germany to a surprise oil supply contraction in Figure 1 includes the consequences of any monetary policy response to rising inflation. In this section, we aim to "clean" the responses from this systematic response using two different approaches.

A sequence of non-response surprises: Sims and Zha (2006)

The first approach relies on a method proposed by Sims and Zha (2006) and applied to oil shocks in Bernanke et al. (1997): each period after the oil price shock, there is a monetary policy surprise such that the policy rate remains at zero. All other variables in the economy evolve according to the combined effect of the oil price news shock *and* the sequence of surprising monetary (non) responses. For this exercise, we use the full-sample estimates presented in Figures 1 and 2. The shock series necessary to achieve a zero-response of the policy rate is reported in Figure 14.

Figure 2: The aggregate effects of monetary policy surprises in Germany



Note: The Figure shows estimates of coefficients β_h in Equation (2) for different dependent variables y. We combine monetary policy shocks from Cloyne et al. (2022) and Almgren et al. (2022). Standard errors are heteroskedasticity robust and clustered at the month level. The shaded areas represent 68% and 90% confidence intervals. Impulse responses are scaled to a monetary policy shock which causes a 1% rise in the policy rate. Employment and average real earnings are constructed using German administrative data. The sample period is 1974-2020.

Figure 3: The aggregate effects of oil price news without a monetary response

Note: The Figure shows estimates of coefficients β_h in Equation (1) for different dependent variables y. The blue lines show the baseline estimates reported in Figure 1, the red lines show the results when we add a sequence of monetary policy shocks such that the monetary policy rate remains at zero. Standard errors are heteroskedasticity robust and clustered at the month level. The shaded areas represent 68% and 90% confidence intervals. Impulse responses are scaled to an oil supply news shock which causes a 10% rise in oil prices in Känzig (2021)'s original estimation. Employment and average real earnings are constructed using German administrative data. The sample period is 1974-2020.

Anticipated non-response: McKay and Wolf (2023)

The second approach follows McKay and Wolf (2023) and Caravello et al. (2024): in period zero, in addition to being hit by an oil supply news shock, the economy is hit by several different monetary policy shocks, calibrated to bring the policy rate's impulse response as close to zero as possible. The appealing feature of this approach is that it does not rely on an economy continuously being surprised, as all unexpected monetary policy actions happen in period zero. For this exercise, we require at least two transitory monetary policy shocks and the economy's response to both. We use the shocks identfied, respectively, in Cloyne et al. (2022) for the Bundesbank from 1974 until 1998, and Almgren et al. (2022), for the ECB period. Like McKay and Wolf (2023), who use the shocks to U.S. monetary policy identified, respectively, by Romer and Romer (2004) and Gertler and Karadi (2015), we thus use shocks identified by two different methods (narrative vs. based on high-frequency asset prices). In contrast to their work, we also consider shocks to the policies of different central banks but for the same economy. Specifically, we estimate Equation (2) for the Bundesbank subsample (before 1999) and the ECB subsample, using local projections as opposed to VARs. The resulting responses to these "Bundesbank shocks" and "ECB shocks" are presented in the Appendix, in Figures 11 and 12. We can use these responses to identify a counterfactual response to oil shocks under an anticipated monetary non-response under two rather strong assumptions: first, the relevant structural features of the German economy are approximately identical over the two sub-samples. Second, the economy reacts to monetary policy only through changes in the current level and expected path of the policy instrument.

Figure 11 shows the responses of aggregate variables to a two-standard-deviation shock during the Bundesbank subsample period. Apart from a different scale, the impulse responses are very similar to those in Figure 2 (where we consider a 100*bp* shock). This is because their variance is substantially higher than that of ECB shocks, such that they dominate the combined series in Figure 2. Figure 12 shows the responses to a two-standard-deviation ECB shock (which, given the more stable interest rates during the ECB sample and smaller variance of shocks, is substantially smaller in magnitude relative to that considered in Figure 11). The monetary policy contraction is estimated to be substantially more short-lived, with interest rates turning negative in the second half of the first year before switching sign again after 30 months. Despite this, inflation falls, if not monotonically, with a peak response in the same order of magnitude as in Figure 2, before rising back towards zero towards the end of the response period. The responses of industrial output and the official unemployment rate are very similar to those in Figure 2.

To identify the effects of oil shocks on the German economy without a monetary reaction, and following McKay and Wolf (2023), we add to the oil shock responses in Figure 1 a weighted sum of the responses to the two monetary policy shocks that attain a policy rate as close to zero as possible over the first 40 months. To undo the contractionary response, the weights of both monetary shocks are negative, but that associated with Bundesbank shocks (equal to -0.04, see Figure 14), substantially exceeds that of ECB shocks (-0.018). This is because (i) the cyclical response of interest rates to ECB shocks in Figure 12 is largely orthogonal to the much more persistent response of interest rates to oil shocks and (ii) the ECB requires smaller interest rate movements to achieve similar changes in aggregate variables to the Bundesbank.

Counterfactual responses

Each of the two methods generates counterfactual impulse responses to those reported in Figure 1. We report these results, together with the original oil supply news shock responses, in Figure 3. The responses of the policy rate in these counterfactual scenarios is substantially less contractionary in the first year, but then becomes more contractionary, as the estimated interest rate response to oil shocks changes sign. The paths of the counterfactual policy rates differ markedly from each other, however: the Sims and Zha (2006)-method by construction delivers a the policy rate at zero throughout the entire horizon. McKay and Wolf (2023), in contrast, only achieves an approximate non-response, with, in particular, slightly negative policy rates upon impact and in year 2 of the response.

Given the delayed response of inflation to monetary shocks, its counterfactual responses only differ meaningfully from the original estimates in the second half of the response horizon, when, in the absence of a contractionary response, inflation is about 10 (15) bp higher under Sims and Zha (2006) (McKay and Wolf (2023)).

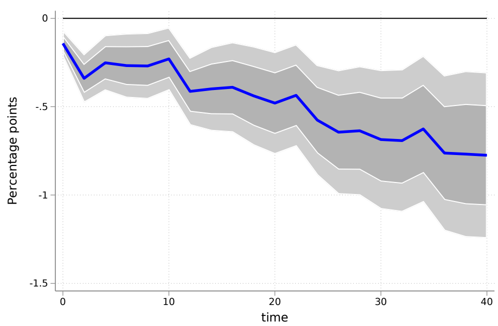
The short-term responses of activity indicators diverge earlier. Industrial production, in a scenario without monetary policy intervention, falls considerably less when using McKay and Wolf (2023)'s method. This gain is short-lived, however, as all series converge again after three years. McKay and Wolf (2023)'s method also indicates a 10bp smaller rise in unemployment without monetary policy intervention. SIAB employment falls less in year 2 under both methods but then converges

Both methods thus suggest that the systematic monetary policy response to oil shocks in Germany has traded off lower short-term activity for lower inflation in the medium term, although the precise magnitude of that trade-off differs.

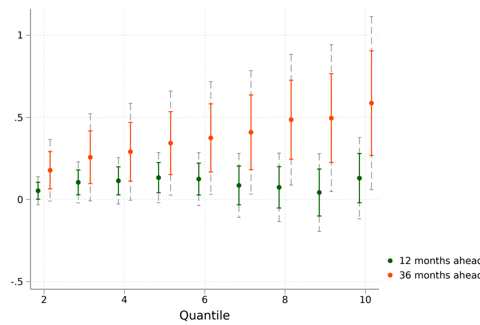
4 Distributional effects

Our primary interest is in the heterogeneous incidence of oil price surprises on earnings and employment along the German income distribution. We focus on three variables at the individual level: (i) the employment status ($\{0, 1\}$) of employed individuals h periods after the shock, $p_{h,ee}$; (ii) the employment status of unemployed individuals h periods after the shock, p_{ue}; and (iii) the individuals' earnings growth over h periods of the shock, $\Delta earn_{i,h}$.

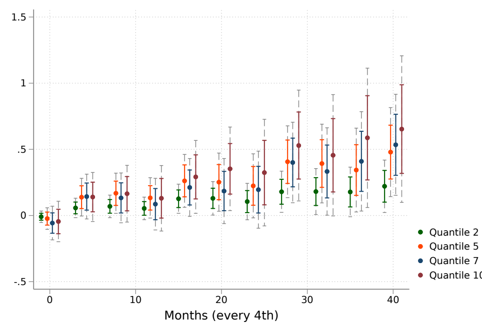
Figure 4: The incidence of oil shocks on earnings growth of the employed



(a) Overall effect (δ_h)



(b) Effect across quantiles (β_h^d) at different horizons h



(c) Effect over time for different quantiles (β_h^d)

Note: The Figure shows estimates of Equation (3) for the earnings of the employed. Standard errors are heteroskedasticity robust and clustered at the month level. The *top left panel* shows the overall effect of negative oil news on earnings. The shaded areas represent 68% and 90% confidence intervals. The *top right panel* shows the effects of the shock on different deciles 12 and 36 months after the shock. The solid and dashed lines represent 68% and 90% confidence bands, respectively. The *bottom panel* shows the effects of the shock on for deciles 2, 5, 7 and 10 at different time horizons. The solid and dashed lines represent 68% and 90% confidence bands, respectively. Impulse responses are scaled to an oil supply news shock which causes a 10% rise in oil prices in Känzig (2021)'s original estimation.

Following Guvenen et al. (2017) we sort individuals according to their average income over a five year period. We then estimate the following regression:

$$y_{i,t+h} - y_{i,t-1} = \alpha_h + \sum_{j=2}^{10} \gamma_h^d \mathbb{I}_{d=j} + \left(\delta_h + \sum_{i=2}^{10} \beta_h^d \mathbb{I}_{d=i}\right) Oilnews_t + \sum_{j=1}^{l} \gamma_{j,h} X_{t-j} + \varepsilon_{i,t,h} \quad (3)$$

where $y_{i,d,t}$ represents either the employment-transitions $p_{h,ee}$ and $p_{h,ue}$, or the pre-tax earnings growth of the employed $\Delta earn_{i,h}$, and $\mathbb{I}_{d=i}$ is an indicator that takes value 1 if individual i's income belongs to decile j, and 0 otherwise. The coefficient δ_h measures the effect of an oil supply news shock on the first decile on the distribution, while the coefficients β_h^d represent the relative effect on all other deciles.

4.1 Incidence of oil shocks across the income distribution

Figure 4 summarizes the effect of oil news shocks on earnings of the employed across quantiles. The response of earnings growth in the first decile of the income distribution is depicted in the top left panel. The shock has a significantly negative impact on real earnings growth that rises in magnitude throughout the estimation horizon.

The top right panel investigates the heterogeneity of this effect across the distribution, by showing the responses of other deciles relative to the first decile after 12 and 36 months. The 12-months responses present a slight inverse-U shape, that is, however, only marginally significant. The relative 36-months responses are increasing in magnitude along the income distribution. Hence, the effect of an oil price news shock on earnings growth above the median is significantly weaker than in the reference bottom decile, and close to zero. Consequently, the brunt of the oil shock's effect of earnings growth appears to be borne by the bottom of the income distribution, especially at longer horizons.

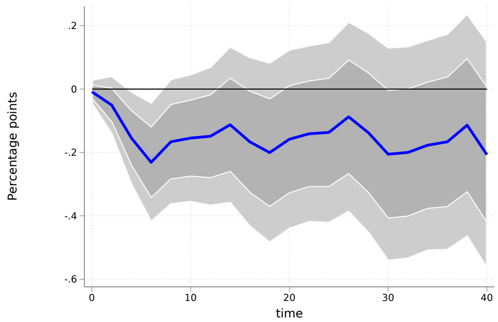
The bottom panel shows the entire relative impulse response, for selected deciles. While income growth differences are initially close to zero and insignificant, at later horizons, a clear pattern emerges: higher deciles experience significantly smaller earnings declines after a negative oil supply shock compared to lower deciles.

Next, we run the regression in Equation (3) with the change in employment status between months $t-1$ and $t+h$ on the left-hand side, restricting the sample to individuals employed in period $t-1$. Hence, the coefficient δ_h measures the impact of an oil supply news shock on the probability that an individual in the first decile of the income distribution will remain employed during the months $t+h$.

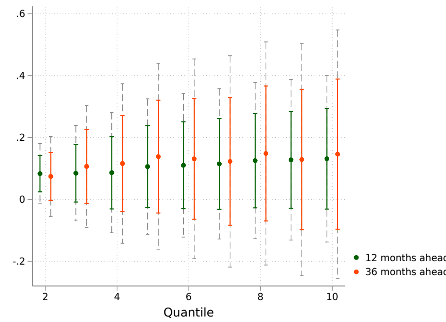
The results of this exercise are reported in Figure 5. For the bottom of the income distribution, an oil supply news shock implies a decrease in the probability of remaining employed. The results are, however, only statistically significant at the 68% confidence level. Individuals are 0.2 percentage points less likely to remain employed for more than three years, after an oil shock. To put this effect into perspective, the baseline probability of remaining employed for this time period is 97%. Hence, the oil supply shock effect is very small.

As the top-right and bottom panel of Figure 5 reveal, there is little heterogeneity as to how different deciles are affected by the shock: confidence bands are large and effects are economically relatively small. The probability of being employed three years after the shock decreases by 0.2 percentage points in the first decile, and is closer to zero for the other deciles, but the difference is not statistically significant. It appears, therefore, that a shock to news about oil supply only marginally affects the employment probabilities of those currently employed.

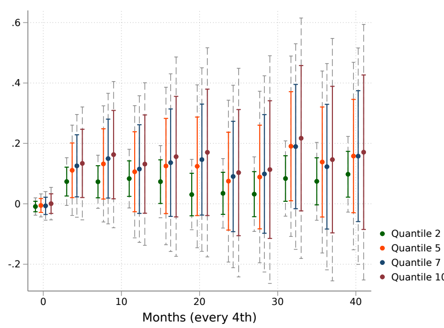
Figure 5: The incidence of oil shocks on the probability of employment for the employed



(a) Overall effect (δ_h)



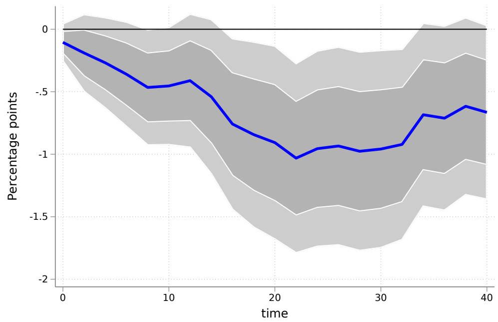
(b) Coefficient β_h^d at different t



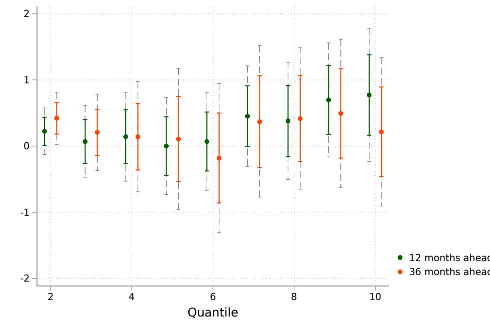
(c) Effect over time for different quantiles (β_h^d)

Note: The Figure shows estimates of Equation (3) for the employment status of the employed in period t. Standard errors are heteroskedasticity robust and clustered at the month level. The *top left panel* shows the effect of negative oil news on the first decile (δ_h). The shaded areas represent 68% and 90% confidence intervals. The *top right panel* shows the effects of the shock on different deciles 12 and 36 months after the shock. The solid and dashed whiskers represent 68% and 90% confidence bands, respectively. The *bottom panel* shows the effects of the shock on for deciles 2, 5, 7 and 10 at different time horizons. The solid and dashed lines represent 68% and 90% confidence bands, respectively. Impulse responses are scaled to an oil supply news shock which causes a 10% rise in oil prices in Känzig (2021)'s original estimation.

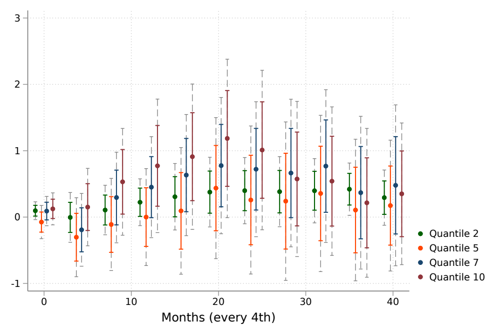
Figure 6: The incidence of oil shocks on the probability of employment for the unemployed



(a) Overall effect (δ_h)



(b) Coefficient β_h^d at different t



(c) Effect over time for different quantiles (β_h^d)

Note: The Figure shows estimates of Equation (3) for the employment status of the unemployed in period t. Standard errors are heteroskedasticity robust and clustered at the month level. The *top left panel* shows the effect of negative oil news on the first decile (δ_h). The shaded areas represent 68% and 90% confidence intervals. The *top right panel* shows the effects of the shock on different deciles 12 and 36 months after the shock. The solid and dashed lines represent 68% and 90% confidence bands, respectively. The *bottom panel* shows the effects of the shock on for deciles 2, 5, 7 and 10 at different time horizons. The solid and dashed lines represent 68% and 90% confidence bands, respectively. Impulse responses are scaled to an oil supply news shock which causes a 10% rise in oil prices in Känzig (2021)'s original estimation.

Finally, Figure 6 presents the coefficient estimates in Equation (3) with the change in employment status between months $t-1$ and $t+h$, but restricting the sample to those unemployed in period $t-1$. The coefficient δ_h thus measures the impact of an oil supply news shock on the probability that an individual in the first decile of the income distribution who is unemployed in $t-1$ is employed in month $t+h$.

The coefficients in the top left panel of Figure 6 follow a hump-shaped pattern, indicating that unemployed individuals at the bottom of the income distribution experience a significant decline in their employment probability, by up to one percentage point. The point estimates of this decline are smaller and insignificant for individuals with above-median incomes. For comparison, in the sample, the unconditional job-finding probability after 12 months is 30%.

This is confirmed in the bottom panel: the relative effects follow an inverted hump shape for higher deciles. This implies that, while individuals at the bottom of the income distribution find it more difficult to find work after a negative oil news shock, this effect is weaker for unemployed workers above the median of the income distribution in the second and third year of the response.

In conclusion, our results indicate that the lower end of the income distribution is most affected by a negative oil supply news shock. The main drivers of this heterogeneity are changes in job-finding and the falling earnings of the employed.

4.2 The incidence of monetary policy shocks along the income distribution

A study of distributional effects of oil shocks under counterfactual monetary policy scenarios (as for aggregate effects in Section 3.3), requires estimates of the distributional effects of monetary-policy shocks. We have studied the curious incidence of monetary policy shocks along the income distribution for the ECB period in our previous paper (Broer et al., 2022). Here we study this incidence in a longer sample similar to that for the incidence of oil shocks, by combining the two shock series for the Bundesbank and ECB periods as in the estimates of Equation (2). Specifically, we estimate the following regression separately for individuals in each decile $d = 1, ..., 10$ of the permanent-income distribution:

$$y_{i,d,t+h} - y_{i,d,t-1} = \alpha_{d,h} + \beta^{y}_{d,h}\hat{i}_t + \sum_{i=1}^{l} \gamma_{i,d,h} X_{t-i} + \varepsilon_{i,d,t+h} \tag{4}$$

where $y_{i,d,t}$ again represents either transition probabilities or the pre-tax earnings growth of employed individuals, and $\hat{i}_t$ denotes, as in Section 3.2, the fitted value from the first-stage regression of policy rates on the monetary policy shocks from Cloyne et al. (2022) and Almgren et al. (2022).

Figures 7 to 9 show estimated responses to a 100 bp contractionary monetary policy shock according to Equation 4. Figure 7 considers earnings growth of the employed as the dependent variable. The responses for the full sample and Bundesbank subsample are very similar, insignificant and small. The ECB shocks, in contrast, are followed by a non-significant but strong rise in earnings of the employed, perhaps due to selection into unemployment of lower-earnings individuals within deciles.

Figure 8 shows the results when estimating Equation 4 with the frequency of transitions from employment to employment between period $t-1$ and $t+h$ as the dependent variable. As in our previous paper, monetary policy affects employment probabilities substantially more below the median. The patterns across subsamples are identical (if again different in magnitude).

In response to amonetary expansion, "U-to-E transitions", depicted in Figure 9, fall for individuals outside of the top tercile. Again, the magnitude is substantially larger for the ECB subsample.

4.3 The incidence of oil shocks in the absence of monetary reaction

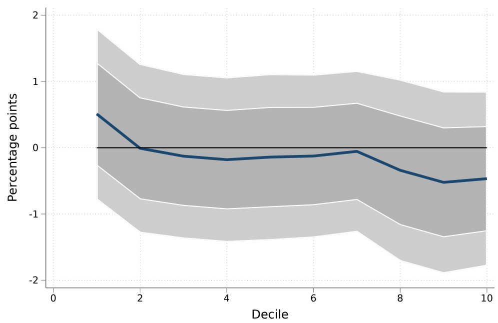
In this section we present counterfactual responses of earnings and employment probabilities to oil shocks across the income distribution when monetary policy keeps interest rates approximately constant. For this, we first estimate Equation (3) substituting the oil price shock $oilnews_t$ for the policy rate.

Having estimated the impulse responses for oil and monetary shocks in this way, we then construct counterfactual responses as discussed in Section 3.3.

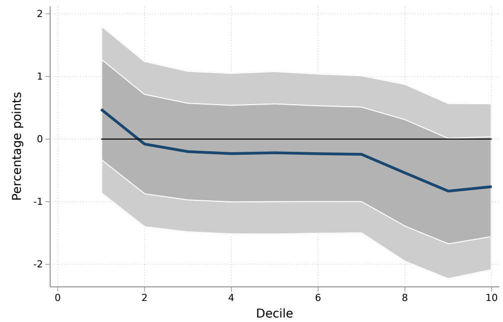
Figure 10 presents the results, across deciles, at horizon $h = 18$. As expected from the near-zero effect of monetary policy on earnings growth in the full sample in Figure 7, when adding to the oil shock response a sequence of responses to monetary policy surprises that keep interest rates at 0 (as in Sims and Zha (2006)), the earnings growth response in panel a) is basically unchanged. Somewhat more surprisingly, the 18-months responses of employment probabilities (panels b) and c)) are similarly unaffected. This is because the series of shocks implied by the Sims and Zha (2006)-method (see Figure 14) turns positive after 7 months, such that stimulative and contractionary effects largely offset each other at the 18-months horizon.

These results contrast with those from the McKay and Wolf (2023)-method, that add a weighted sum of responses to two $t = 0$ expansionary policy shocks (estimated on, respectively, the Bundesbank and ECB subsamples) to the estimated response to oil news. With that counterfactually stimulative monetary policy, earnings of the employed in panel a) of Figure 10 fall by more (reflecting the negative "selection" effect of employment stimulus on average earnings in panel c) of Figure 7). Given the strong response of employment in the ECB subsample, employment probabilities of the employed *rise* under this counterfactual policy (panel b)), in particular at the bottom of the distribution. Similarly, employment probabilities

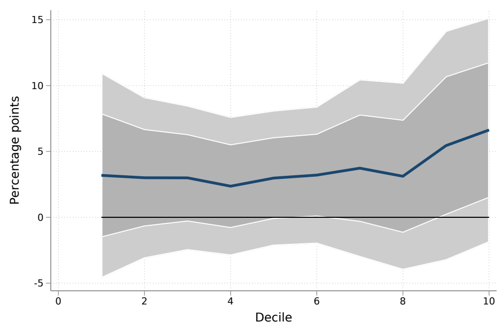
Figure 7: The incidence of monetary shocks on earnings growth of the employed



(a) Full sample



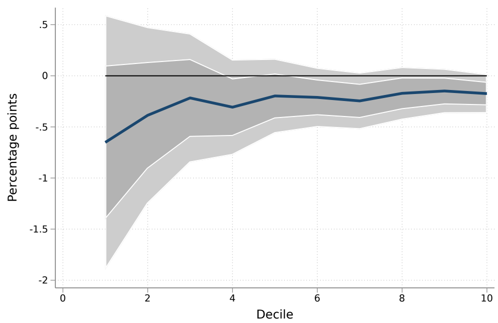
(b) Bundesbank sample, Cloyne et al (2022) shocks



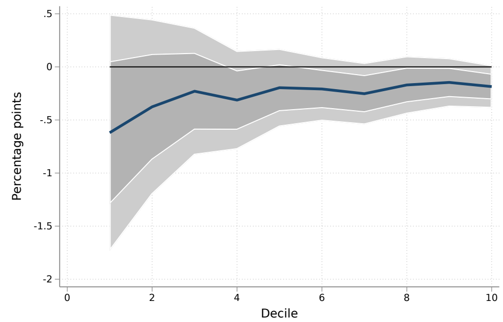
(c) ECB sample, Almgren et al (2022) shocks

Note: The Figure shows, for the case of the earnings growth of the employed, estimates of the coefficients $\beta_{d,18}^{earn}$ in Equation (4). Standard errors are heteroskedasticity robust and clustered at the month level. The shaded areas represent 68% and 90% confidence intervals. Impulse responses are scaled to a monetary policy shock which causes a 1% rise in the policy rate. The *top left panel* shows results for the sample period 1974-2020, the *top right panel* restricts the sample to the Bundesbank subsample (1974-1998), the *bottom panel* restricts the sample to the ECB subsample (1999-2020).

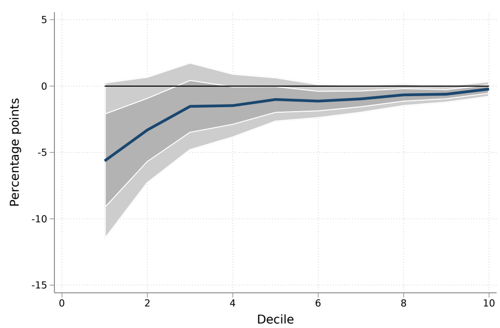
Figure 8: The incidence of monetary shocks on employment probabilities of the employed



(a) Full sample



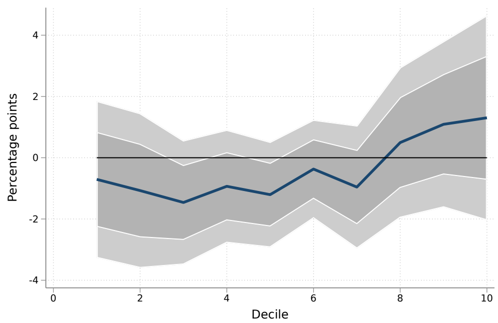
(b) Bundesbank sample, Cloyne et al (2022) shocks



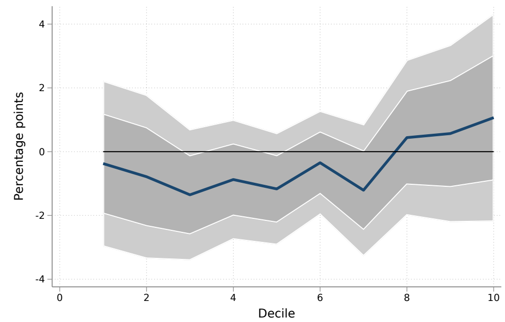
(c) ECB sample, Almgren et al (2022) shocks

Note: Note: The Figure shows, for the future employment status of the employed, estimates of the coefficients $\beta^{ee}_{d,18}$ in Equation (4). Standard errors are heteroskedasticity robust and clustered at the month level. The shaded areas represent 68% and 90% confidence intervals. Impulse responses are scaled to a monetary policy shock which causes a 1% rise in the policy rate. The *top left panel* shows results for the sample period 1974-2020, the *top right panel* restricts the sample to the Bundesbank subsample (1974-1998), the *bottom panel* restricts the sample to the ECB subsample (1999-2020).

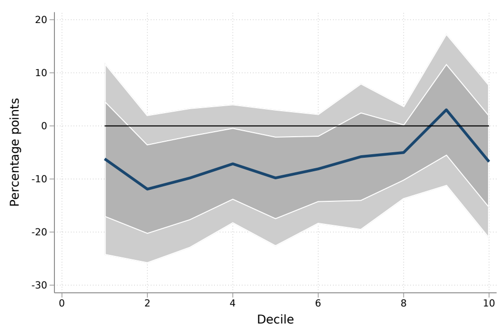
Figure 9: The incidence of monetary shocks on employment probabilities of the unemployed



(a) Full sample



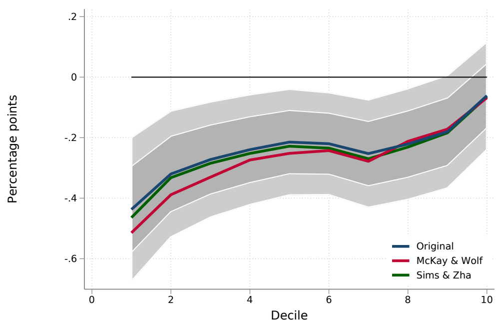
(b) Bundesbank sample, Cloyne et al (2022) shocks



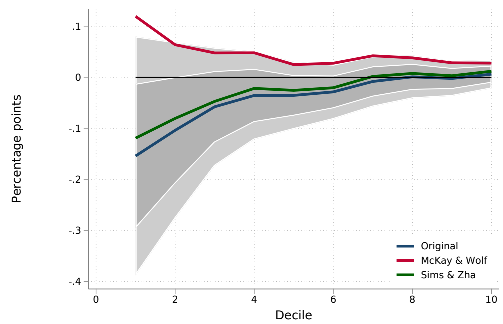
(c) ECB sample, Almgren et al (2022) shocks

Note: Note: The Figure shows, for the future employment status of the unemployed, estimates of the coefficients $\beta^{ue}_{d,18}$ in Equation (4). Standard errors are heteroskedasticity robust and clustered at the month level. The shaded areas represent 68% and 90% confidence intervals. Impulse responses are scaled to a monetary policy shock which causes a 1% rise in the policy rate. The *top left panel* shows results for the sample period 1974-2020, the *top right panel* restricts the sample to the Bundesbank subsample (1974-1998), the *bottom panel* restricts the sample to the ECB subsample (1999-2020).

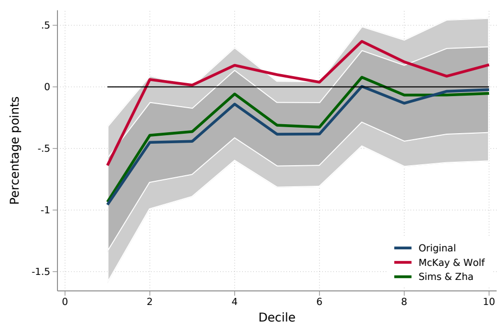
Figure 10: Effect of oil shock across deciles after 18 months



(a) Earnings growth of the employed



(b) Employment probability of the employed



(c) Job-finding probability of the unemployed

Note: The Figure shows estimates of Equation (4) for different variables y at $h = 18$. Standard errors are heteroskedasticity robust and clustered at the month level. The *top left panel* shows the effect of a 100 bp expansionary monetary-policy shock on the employment probability of the employed, across deciles in the permanent income distribution. The *top right panel* shows the effects of the shock on the job-finding probability of the unemployed, across deciles. The *bottom panel* shows the effects of the shock on earnings growth of the employed over $h = 12$. The shaded areas represent 68% and 90% confidence bands.

of the unemployed, in panel c), are substantially improved.

5 Conclusion

Our study sheds light on the impact of oil price shocks and their monetary responses on the German economy. We find that oil price increases trigger significant economic contractions, with heterogeneous impact along the income distribution. Notably, income-poor workers bear the brunt of these shocks, experiencing lower job-finding probabilities and persistently lower earnings growth.

Furthermore, our research underscores the importance of considering distributional consequences when formulating policy interventions. Constructing counterfactual monetary policy non-responses to oil price shocks, we show that, at the aggregate level, inflationary pressures are greater without monetary intervention, while employment and output are higher. These results are robust to different methods of constructing counterfactuals.

Finally, we show that monetary non-intervention after a supply shock benefits the income-poor the most. Their employment probabilities rise considerably, while the top of the distribution is only marginally affected. Job-finding probabilities of the unemployed rise across the whole distribution.

Our findings suggest that policymakers should consider the distributional impacts of monetary interventions and the potential benefits of tailored policy interventions to mitigate adverse effects on vulnerable populations. Future research should further explore the interplay between supply shocks and monetary policy. In particular, the different magnitudes of monetary-policy effects across different periods of our data sample deserve further investigation. Alternative supply shocks also do.

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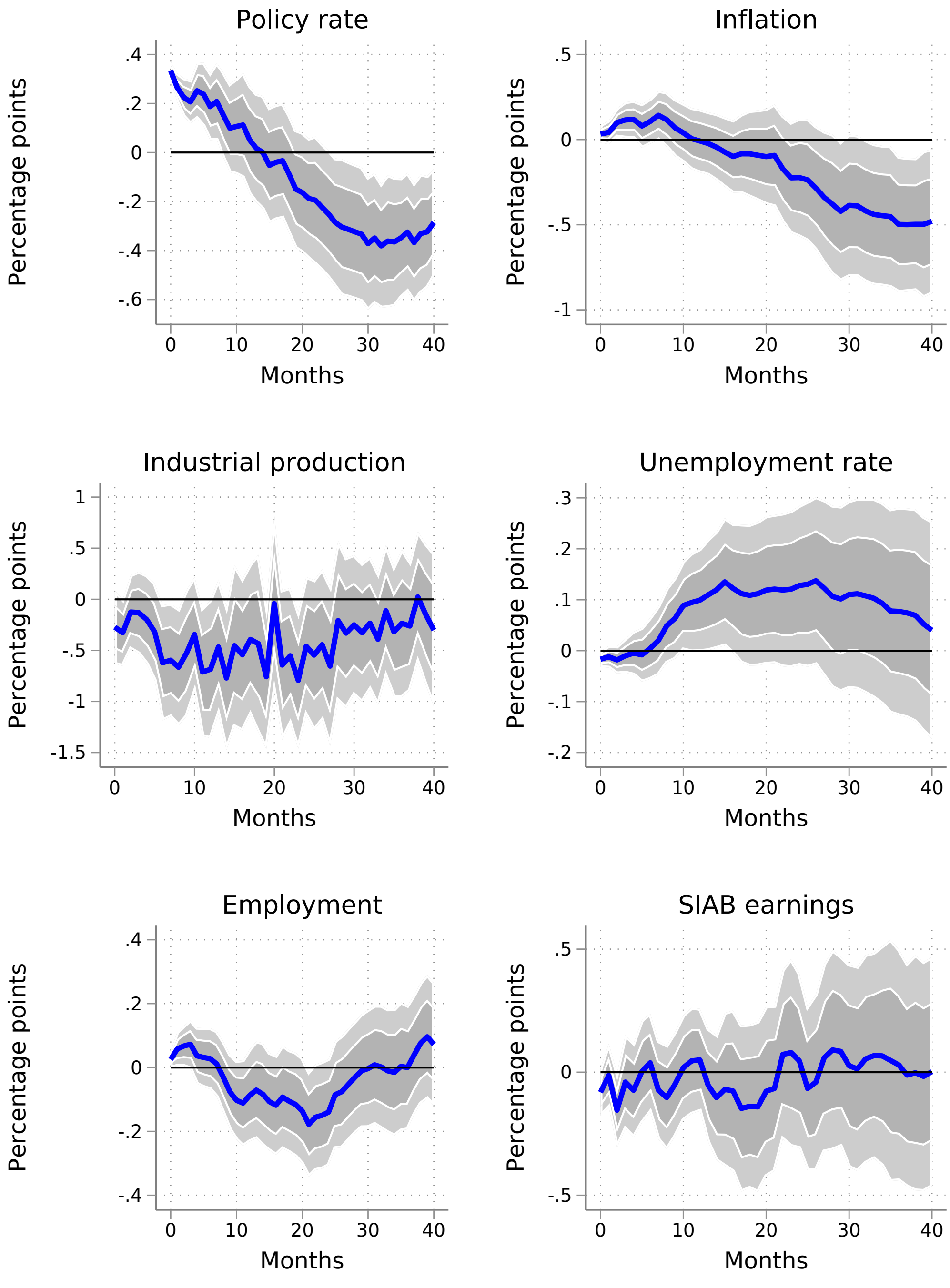
A Additional Figures

Figures 12 and 11 show the aggregate responses to an ECB and Bundesbank monetary policy shock, respectively. In our estimation of Figure 11, we follow Cloyne et al. (2022), including 3 lags of the monetary policy surprise, industrial production, the consumer price index, the discount rate, aggregate employment, aggregate earnings of the employed and the unemployment rate. In our estimation of Figure 12, we follow Broer et al. (2022), including three lags of the monetary policy shock, aggregate earnings of the employed, the discount rate and aggregate employment. We use the high-frequency monetary policy surprises provided in Almgren et al. (2022).

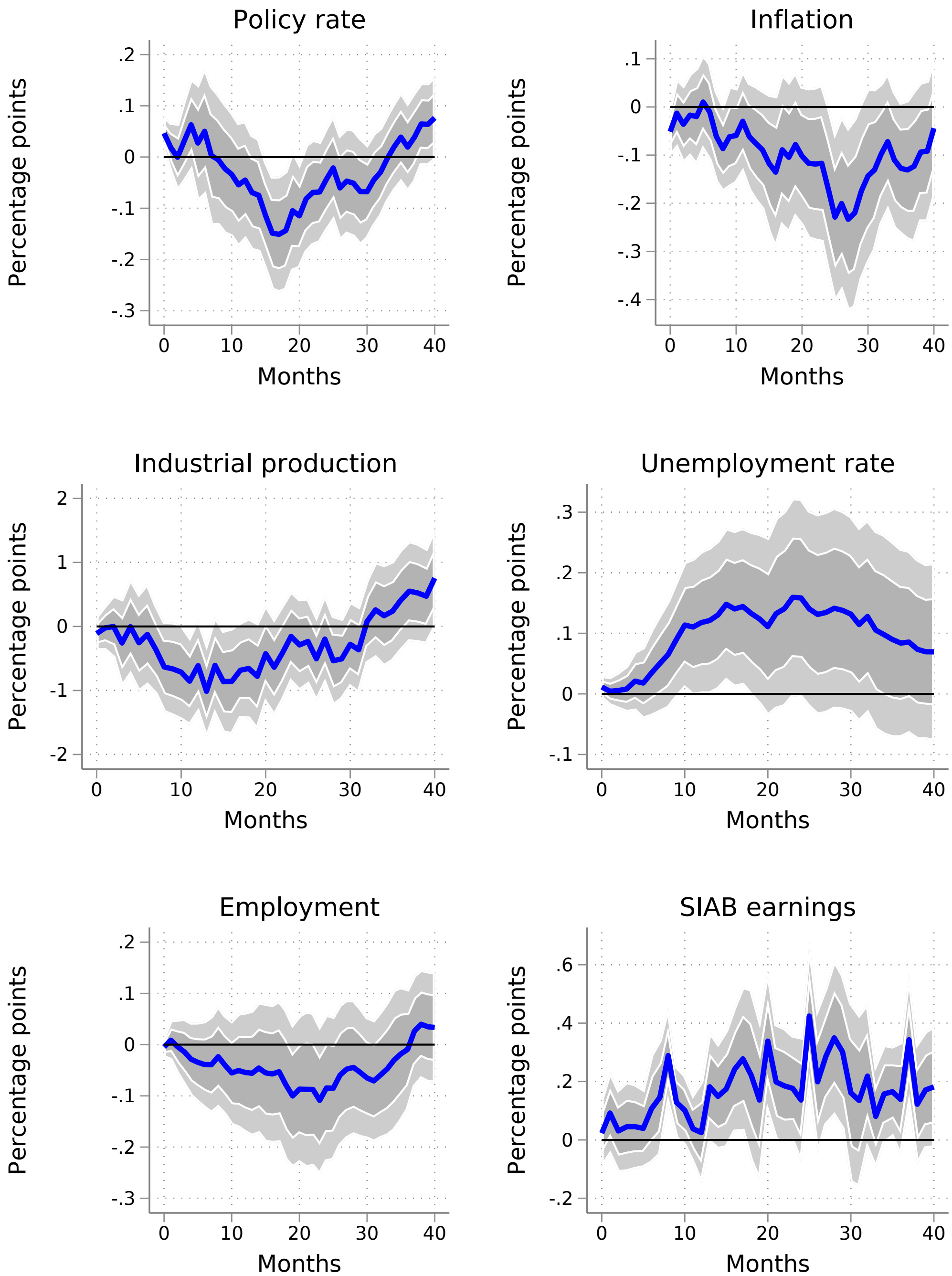
Figure 13 shows the combined first-stage predictions across the whole sample.

Figure 11: The aggregate effects of Bundesbank policy surprises in Germany



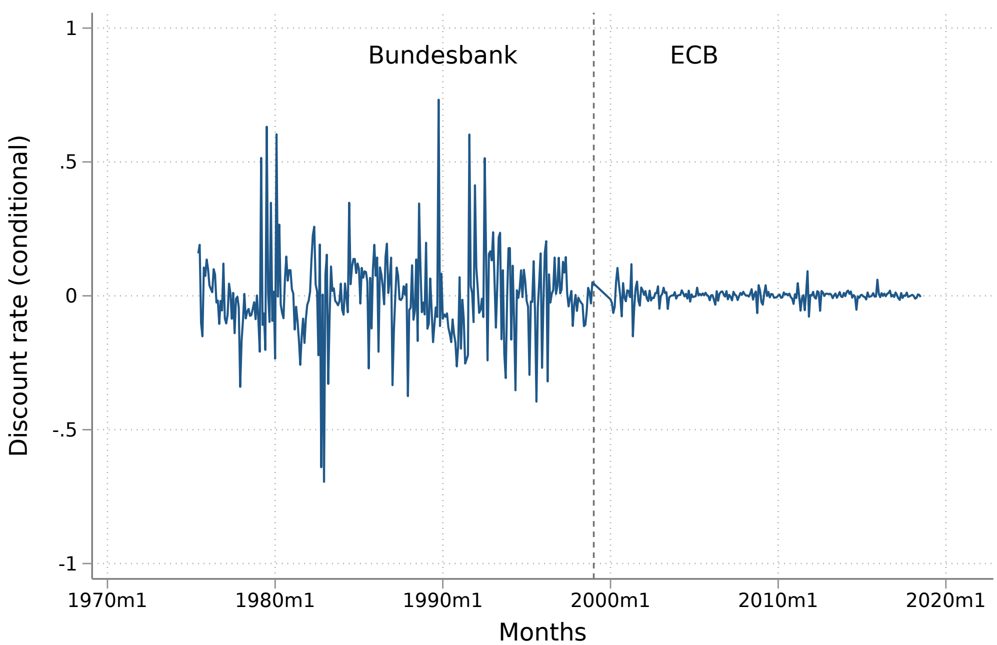
Note: The Figure shows estimates of Equation (2) for different dependent variables y. For this exercise, we use monetary policy shocks from Cloyne et al. (2022) and restrict the sample period to 1974-1998. Standard errors are heteroskedasticity robust and clustered at the month level. The shaded areas represent 68% and 90% confidence intervals. Impulse responses are scaled to a two-standard-deviation monetary policy shock, implying a 33 basis point rise in the policy rate. Employment and average real earnings are constructed using German administrative data.

Figure 12: The aggregate effects of ECB policy surprises in Germany



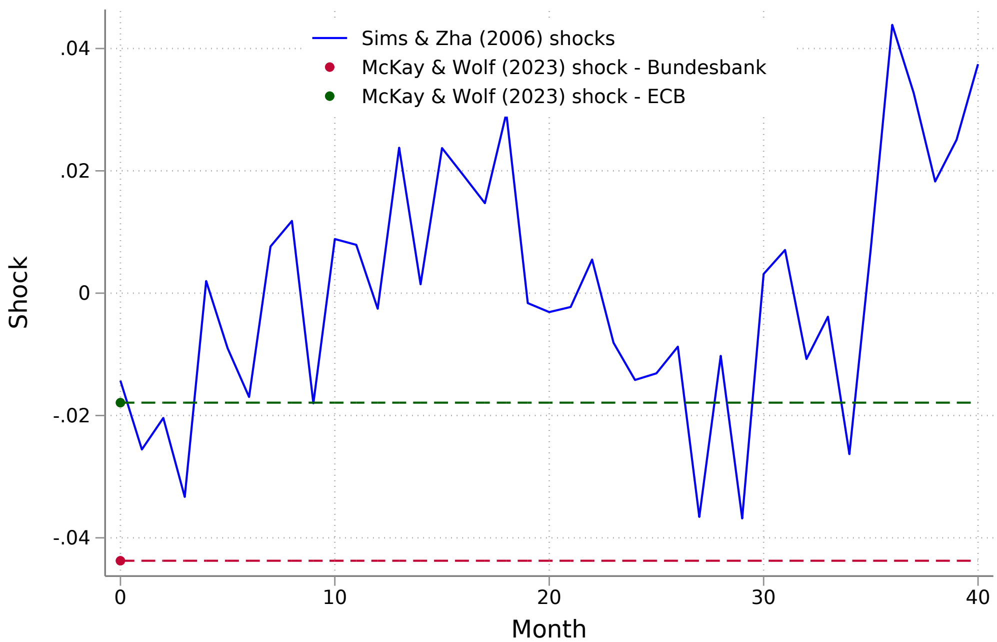
Note: The Figure shows estimates of Equation (2) for different dependent variables y. For this exercise, we use monetary policy shocks from Almgren et al. (2022) and restrict the sample period to 1999-2020. Standard errors are heteroskedasticity robust and clustered at the month level. The shaded areas represent 68% and 90% confidence intervals. Impulse responses are scaled to a two-standard-deviation monetary policy shock, implying a 5 basis point rise in the policy rate. Employment and average real earnings are constructed using German administrative data.

Figure 13: First stage prediction of the combined discount series



Note: The Figure shows the predicted first-stage discount rate series. We estimate two separate first-stage regressions, for the Bundesbank and ECB periods, respectively. For the former, we instrument the discount rate using monetary policy shocks from Cloyne et al. (2022), for the latter, we use shocks from Almgren et al. (2022). Both first stage regressions are conditional on the same control variables. Subsequently, we combined the two first stage predictions into the series shown in the figure. The sample period is 1974-2020.

Figure 14: Implied shock series



Note: The Figure shows the implied monetary policy shock series necessary for a zero response of the policy rate after an oil supply news shock (Sims and Zha, 2006). In addition, it shows the period-0 shocks necessary to keep the policy rate response as small as possible, following McKay and Wolf (2023).