Reduced labor market dynamism?
Monetary Policy and the Ins and Outs of Firm Employment*

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Abstract

This paper examines labor market dynamism in response to contractionary monetary policy. Using a new dataset linking German firms, banks, and administrative labor market data, the analysis decomposes firms' labor adjustment into worker flows across labor market states. We find that labor market reallocation increases from firms more exposed to the bank-lending channel of monetary policy to those less exposed. This reallocation happens through unemployment, while hirings and separations between employers drop sharply. As a consequence, overall dynamism decreases after contractionary monetary policy with important consequences for wage growth and productive reallocation. We further document pronounced distributional consequences: low-wage workers face higher unemployment risk, whereas high-wage workers remain employed but experience reduced outside opportunities.

Keywords: monetary policy, labor market flows, heterogeneous firms, bank-lending channel

JEL-Classification: E52, J63, D22, E51

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1 Introduction

Labor market dynamism captures the extent of worker turnover across firms, reflecting the intensity of hiring and separations for a given net change in employment. Higher dynamism is associated not only with flows into and out of unemployment but also with the reallocation of labor across heterogeneous firms. Both processes are central to aggregate productivity through the underlying quality of worker-firm matching. Higher dynamism fosters stronger wage growth, benefiting workers, whereas lower dynamism provides greater employment security at the cost of forgone outside opportunities and weaker wage progression.

It is well-established in the literature that firm heterogeneity is important for the transmission of monetary policy. However, little is known about how monetary policy affects labor market dynamism, beyond the stylized fact that contractionary policy reduces employment. This gap is consequential: if contractionary monetary policy increases dynamism, productivity losses may be mitigated through reallocation effects, wage growth may remain more resilient, and disinflationary pressures may be dampened. Conversely, if contractionary policy suppresses dynamism, productivity and wage growth may decline more sharply, amplifying downward pressure on inflation.

We estimate how firms adjust labor input in response to monetary policy shocks focusing on the bank-lending channel of monetary policy. Doing so, we explore the heterogeneous effects of monetary policy on firms' financial conditions, which are exogenously driven by the exposure of the banks that lend to these firms. Firms linked to banks with weak balance sheets are exposed more strongly to monetary tightening than firms linked to banks with strong balance sheets. We document that firms reduce employment in response to contractionary monetary policy shocks, and that this reduction more than doubles for firms that are linked to weak banks compared to firms linked to strong banks.

We find that the reduction in employment primarily operates through a decrease in hiring (inflows of workers), while separations (outflows of workers) remain largely stable at the firm level. Hence, labor market dynamism strongly decreases after a contractionary monetary policy shock. The decrease in hiring is primarily driven by a fall in hiring from other employers, in particular for those transitions associated with wage increases. As a mirror image, separations to other employers also fall. Hence, the reduction in labor market dynamism is potentially accompanied by suppressed wage growth and productive reallocation. The reduction in hiring is particularly pronounced for firms exposed to the

monetary policy contraction. For these firms, separations to unemployment increase, i.e. firms fire workers. Firms less exposed to monetary policy benefit as they hire more from the unemployment pool. Hence, labor reallocates from more to less exposed firms, but only indirectly through unemployment. This effect is not strong enough to compensate the overall reduction in transitions between employers, however.

We also address the distributional implications of reduced dynamism by accounting for the relative position of a worker flow in the within-firm wage distribution: outflows to unemployment increase primarily among low-wage workers, while high-wage workers are more likely to remain employed within firms. As a result, low-wage workers in exposed firms are particularly hit by contractionary monetary policy as they face elevated employment risk. The decline in labor market dynamism reduces outside opportunities for workers across the wage distribution, particularly for those in exposed firms.

For our analysis, we merge three micro-level databases to compile a new firm-level dataset for Germany. We start from historical vintages of Dafne and establish a dynamic firm-bank link. We then merge firms to their respective banks in Bankfocus (formerly Bankscope). Bankfocus contains balance sheet information for banks, which, together with the firm-bank link, allows us to construct an exogenous measure of a firm's exposure to the bank-lending channel of monetary policy. Banks with different equity-to-asset ratios vary in their sensitivity to lending following monetary policy contractions (Gambacorta and Marques-Ibanez, 2011; Jiménez, Ongena, Peydró and Saurina, 2012; Berger and Bouwman, 2013; Gomez, Landier, Sraer and Thesmar, 2021). We show that links between firms and banks are relatively stable over time, reflecting the traditional "Hausbank" relationship. As a result, firms whose banks have a low equity ratio are more exposed to monetary contractions than firms whose banks maintain higher equity ratio levels.

We further merge firms in Dafne to the Integrated Labor Market Biographies (IEB), which include i) employee-level administrative data on all jobs covered by social security, and ii) information on the respective employers at the establishment level. Our data allow us to compute inflows and outflows of workers at the firm-level as we observe whether workers transition to or from employment, unemployment, or out of the labor force. Based on the annual income information from the IEB, we construct daily gross wages (base wage plus extra pay) for each job of every worker within each firm. This enables us to calculate wage changes for job-to-job transitions and firm-specific wage distributions. Our final sample consists of 240,262 unique firms linked to 1,789 banks, covering the years 2005 to 2019. This results in a total of 7,776,954 firm-quarter observations.

We estimate the dynamic effect of monetary policy on firm-level employment adjustment using state-dependent local projections as introduced by Jordà (2005). We aggregate high-frequency, identified monetary policy shocks for the Euro area provided by Jarocinski and Karadi (2020) and use these as exogenous movements in monetary policy at the quarterly level. Our analysis focuses on a balanced panel of firms over an estimation horizon of eight quarters. We exclude firms with fewer than 10 employees at the time of the shock to ensure meaningful measurement of the within-firm wage distribution.

Our paper is located at the intersection of two strands in the literature. First, it connects to the studies investigating the role of firm-level financial constraints for the propagation of monetary policy shocks. This literature mostly focuses on firm-level decisions on investment (e.g. Jeenas (2019), Ottonello and Winberry (2020), Jungherr, Meier, Reinelt and Schott (2022), or Cloyne, Ferreira, Froemel and Surico (2023))). Meier and Reinelt (2024) and Albrizio, González and Khametshin (2024) address capital misallocation. Bahaj, Foulis, Pinter and Surico (2022) and Jasova, Mendicino, Panetti, Peydró and Supera (2021) investigate employment adjustment at the firm level and document that financially constrained firms adjust employment more in response to monetary policy shocks. Our study addresses the mechanisms underlying the employment adjustments using worker flows at the firm level. Our study also deviates from the aforementioned literature by examining the transmission of monetary policy shocks through firm exposure to the bank-lending channel rather than financial conditions at the firm level.

Second, our study is related to the literature addressing the effects of monetary policy on aggregate labor market flows, e.g., White (2018), Coglianese, Olsson and Patterson (2023), or Graves, Huckfeldt and Swanson (2023). Bergman, Matsa and Weber (2022) and Faia, Shabalina and Wiczer (2024) address worker-level characteristics in these flows. Gulyas, Meier and Ryzhenkov (2024) utilize Austrian administrative data to study worker reallocation after monetary policy shocks interacting the monetary policy shock with person-firm fixed effects (AKMs) estimated from wage data. They document that employment losses are concentrated among low-paid workers in high-paying firms. Different to these studies, our analysis centers around firm decisions, decomposes firm-level employment adjustment into the relative importance of inflows and outflows and can relate worker flows to firm characteristics, in particular firm exposure to monetary policy shocks. Our study therefore abstracts from labor supply dynamics as investigated in Cantore, Ferroni, Mumtaz and Theophilopoulou (2022) or Graves *et al.* (2023).

A growing body of literature addresses the distributional aspects of monetary policy trans-

mission. Again, most of the literature considers wage inequality across workers without investigating the role of firms. Examples are Coibion, Gorodnichenko, Kueng and Silvia (2017), Broer, Kramer and Mitman (2020), Amberg, Jansson, Klein and Picco (2022), Andersen, Johannsen, Jorgensen and Peydro (2023), Hubert and Savignac (2023), Groiss (2025), or Cantore *et al.* (2022). Closest to our approach are the contributions by Moser, Saidi, Wirth and Wolter (2021) and Jasova *et al.* (2021), who also investigate firm-level distributions. Moser *et al.* (2021) study the specific episode of negative interest rates as a one-time monetary policy-induced credit shock in Germany, while Jasova *et al.* (2021) examine the importance of the credit channel for average wages and employment. A common finding in this literature is that the response of wages to monetary policy is stronger at the lower end of the permanent income distribution. This is in line with the results that we document.

Our study more generally connects to the literature that investigates employment adjustment due to financial constraints (e.g., Chodorow-Reich (2014), Giroud and Mueller (2017) or Bäurle, Lein and Steiner (2021)), and to the literature addressing the role of firm characteristics for the propagation of monetary policy shocks (e.g., Cloyne *et al.* (2023); Krusell, Thürwächter and Weiss (2023) who focus on firm age, Popov and Steininger (2023) who focus on firm size, and Steininger and Matzner (2025) who focus on firm capital). Relevant are also studies that more generally address labor market reallocation over the business cycle such as Haltiwanger, Hyatt, McEntarfer and Staiger (2025) or Bachmann, Bayer, Merkl, Seth, Stüber and Wellschmied (2021). Bachmann *et al.* (2021) use related data from the same source to highlight the role of worker churn for aggregate wage and productivity dynamics.

The remainder of the paper is organized as follows. Section 2 describes our data sources, the construction of our sample and the key variables and discusses descriptive statistics. Section 3 describes the specification and identification of firm-level exposure to the bank-lending channel. Section 4 presents the results. Section 5 concludes.

2 Data, measurement and descriptive statistics

2.1 Data construction

We construct a panel of German firms, their banks and their employees between 2005 to 2021 from three different datasets. First, we use Dafne, which compiles yearly financial

accounts for about 1.5 million public and private firms in Germany. Second, we utilize data from Bankfocus (previously Bankscope), which provides yearly balance sheet information for banks worldwide. Third, we use administrative data on the universe of employment biographies in Germany, the Integrated Labor Market Biographies (IEB) provided by the Institute for Employment Research (IAB).

Dafne provides balance sheet information of firms (e.g. total assets, long and short-term debt, cash holdings etc.). Income statements (e.g. sales, profits, interest expenses etc.) are available for larger firms only. Important for our analysis, in partnership with the credit-rating agency Creditreform, Dafne collects the name of the bank(s) that each firm maintains a relationship with, indicating the main bank ("Hausbank" relationship, see Dwenger, Fossen and Simmler (2020) and Bersch, Degryse, Kick and Stein (2020).).

To compile our firm-level panel dataset, we utilize a recent record linkage that allows to merge the establishments in the IEB data with firms in Dafne. This record linkage has been assembled by the Research Data Center (FDZ) of the IAB, in collaboration with ZEW using the firm name, legal form and address (Diegmann, Doherr, Hälbig and Wolter, 2024).[1] To merge firms with their banks, we establish a dynamic firm-bank link using historical vintages of Dafne. We use bank identification and swift codes as identifiers to match the firm and bank data sets at annual frequency. We further support the link by string matching of bank names and manual inspection for consistency. We also take into account changing bank-firm relationships and adjust to bank-level mergers and acquisitions. We draw our final sample by focusing on firms that report positive assets information in Dafne between the years 2005 and 2019.

We then compile the universe of individual employment information for the firms in our sample. Here, we use the administrative employment biographies in the IEB which contain information on all jobs covered by social security in Germany excluding civil servants and self-employed. As such, the IEB covers about 80% of the German workforce. Employers are required to report the exact start and end dates of an employment relationship and to annually confirm an existing relationship so that workers' careers can be tracked on a daily basis. The IEB also contains information about workers receiving unemployment benefits. This allows to observe whether an employee transitions to or from employment, unemployment or out of the labor force when joining or leaving a particular firm. The

[1]The linkage uses firm information from Mannheim Enterprise Panel between the years 2000 and 2020. BvD products such as Dafne use the same firm identifier. The data covers about 80 percent of establishments and 90 percent of total employment in IEB data.

IEB provides information on average daily gross wages (base wage plus extra pay) for each employment spell of a worker in a given establishment. Based on this, we can observe wage changes of workers switching firms (job-to-job transitions) and can compute average wages as well as the within-firm wage distribution at any point in time. We can also link worker flows to their respective position in the within-firm wage distribution.

While the employment data includes any change in the employment relationship, the wage data only provide the average wage in a given spell, e.g., the average yearly wage for an annual spell. The wage information is subject to a cap due to top-coding of high earners' wages in the social security data. Since we are interested in the effect of monetary policy over the business cycle, we transform the worker-firm job relationship into quarterly frequency of firm-level worker stocks and flows. We focus on the end month of a quarter to obtain quarterly dataset. We classify employment flows as existing employment (stayer), new employment (inflow) and terminating employment (outflow) based on the mobility of workers in a given firm between consecutive quarters. For constructing firm-level employment, firm-level wage outcomes and firm-level worker flows, we focus on full-time employees who are subject to regular social security notification. Our approach follows Stüber and Seth (2019) for creating the Administrative Wage and Labor Market Flow Panel (AWFP) data. Exact definitions of these measures and further details data construction are described in the Appendix.

Our sample relies on several filters which are the linkage between active establishments in IEB data and firms in Dafne, availability of firm-bank link in Dafne and balance sheet information in Bankscope (Bankfocus) over the years of interest. Moreover, we drop firms in the financial sector and in public administration and defense. Finally, Our empirical analysis further restricts on employment size and availability over the impulse horizon.[2] After these filters, our final sample consists of 7,776,954 firm-year-quarter observations from 240,262 unique firms that are linked with 1,789 banks.

2.2 Coverage and descriptive statistics

Our dataset covers about 20 percent of the employment reported in the national accounts. This is shown in the left panel of Figure 1. Note that the national accounts figures include part-time workers, civil servants and all sectors of the economy, while we focus only on full-time employment as described above. Note that the increasing coverage is due to a better

[2]This will be described in more detail when we introduce the model.

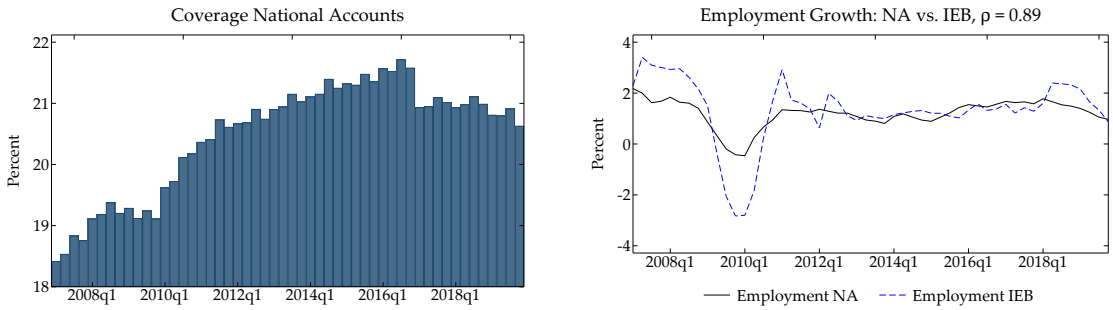


FIGURE 1: Employment Comparison: Coverage and year-on-year growth. Source: IEB, Destatis.

firm-bank link in our data. The right panel of figure 1 shows that we capture the aggregate employment dynamics from the national accounts well. The black solid line plots year-on-year growth rates calculated from the national accounts, the blue dashed line shows aggregated growth-rates from our firm-sample.[3] Overall, the dynamics in our firm-level dataset and the national accounts are very similar, reflected in a correlation coefficient of 0.89. The flow dynamics and industry coverage compare well to the IAB benchmark flow dataset AWFP (Stüber and Seth (2019) and Bachmann *et al.* (2021)).

Table 1 presents descriptive statistics on the firms in our sample. The median (mean) firm in our sample has 22 (56) employees. In the AWFP, which covers the universe of German establishments, the median (mean) establishment has 3 (12) employees (Table A.1).[4] This comparison illustrates that our sample covers mostly large firms and misses some small firms compared to the population. This is due to the coverage in Dafne and the subsequent filters. Nevertheless, our sample still covers a sizable share of small and medium-sized firms. Moreover, our data also has decent variation with regard to firm age, size in terms of assets, and financial leverage. We also observe that the share of firms available in manufacturing and (slightly) in construction is higher in our final sample compared to the AWFP, though our data has a decent coverage for other industries too (Table A.2).

As for firm-bank relationships, Table 1 reports that the median firm is in a relationship with about two banks, while the firms with single-bank relationship and firms with multiple-

[3] Aggregated growth rates from the firm-level data are calculated as $\frac{\sum_i^N E_{i,t+4} - E_{i,t}}{\sum_i^N E_{i,t}}$, where $E_{i,t}$ is employment in firm i in quarter t.

[4] The AWFP reports at the establishment level while our data is at the firm level. For better comparison, in Table A.1, we also report the establishment-level employment and wage distribution using our IEB sample. In this case, the median (mean) establishment in our sample has 18 (44) employees.

	Mean	Min	p10	p50	p90	Max	Observations
Firm employment	56.099	1.00	11.00	22.00	103.00	55256.00	7766281
Mean daily wage	96.121	0.93	58.97	91.09	139.49	396.18	7766281
Wage sum	6373.348	1.85	852.25	2060.30	10725.75	12498928.00	7766281
Firm age	29.670	0.00	7.00	23.00	58.00	804.00	7766281
Firm total assets	7025.560	56.90	398.50	1755.00	14531.33	135844.33	6614703
Firm leverage	0.326	0.00	0.00	0.26	0.75	1.41	6500440
No. of banks	1.821	1.00	1.00	2.00	3.00	16.00	7766281
Bank equity ratio	0.061	0.00	0.03	0.06	0.09	0.16	7766281
Inflow rate	0.067	0.00	0.00	0.04	0.16	196.82	7766281
EE Inflow	0.022	0.00	0.00	0.00	0.07	189.00	7766281
UE Inflow	0.009	0.00	0.00	0.00	0.03	6.20	7766281
OE Inflow	0.007	0.00	0.00	0.00	0.02	29.77	7766281
PE Inflow	0.013	0.00	0.00	0.00	0.05	11.40	7766281
EE Inflow, wage $\uparrow$	0.012	0.00	0.00	0.00	0.04	54.91	7766281
EE Inflow, wage $\downarrow$	0.006	0.00	0.00	0.00	0.02	43.27	7766281
Outflow rate	0.063	0.00	0.00	0.04	0.15	1.00	7766281
EE Outflow	0.021	0.00	0.00	0.00	0.07	1.00	7766281
EU Outflow	0.011	0.00	0.00	0.00	0.04	1.00	7766281
EO Outflow	0.004	0.00	0.00	0.00	0.00	0.92	7766281
EP Outflow	0.009	0.00	0.00	0.00	0.03	1.00	7766281
EE Outflow, wage $\uparrow$	0.011	0.00	0.00	0.00	0.04	0.96	7766281
EE Outflow, wage $\downarrow$	0.006	0.00	0.00	0.00	0.02	0.92	7766281

TABLE 1: Summary statistics at the firm level, 2005-2019. Employment is defined as full-time employment subject to regular social security notification. Mean daily wage is the average imputed wages of full-time regular employees (in Euros). Firm age is calculated as the difference between the year of observation and the year of incorporation. Firm total assets are reported in thousand Euros. Firm leverage is defined as the ratio of long-term and short term debt liabilities to total assets. Firm total assets and firm leverage are calculated as a 3-year backward-looking moving average.
Number of banks are the sum of unique bank relationships with balance sheet information. Bank equity ratio is the total equity to total assets ratio. In case of multiple bank firms, we take the average at the firm level.
Inflow is calculated as the share of new full-time employees between consecutive quarters. Outflow is calculated as the share of full-time employees that leave the firm between consecutive quarters. Source: IEB, Dafne, Bankscope-Bankfocus.

(percent)	1 year	2 years
Main (house) bank	1.83	3.78
Single vs. multiple	1.95	3.61
Number of banks	4.07	7.45

TABLE 2: Changes in firm-bank links. Main bank change represents the likelihood that a firm changes its main bank over 1 year (2 years). Single vs. multiple change measures the likelihood that a firm switches from single (multiple) to multiple (single) bank links. Number of banks reports the likelihood that a firm reduces or increases the number of its banks. Source: Dafne, Bankscope-Bankfocus.

bank relationships roughly split the sample in half. The bank equity ratio has considerable variation over the firm sample: high-equity banks (90th percentile) have 10 percentage points higher equity ratio than low-equity banks (10th percentile).

Table 2 reports on the stickiness of firm-bank relationships. We compute the probability to change the main bank to be about 1.8 percent within one year and 3.8 percent in two years. Hence, the main bank linked to a firm does not change very frequently. We can also assess whether firms switch from having single to multiple bank relationships and vice versa. This probability is also low with about 2 percent within one year and 3.6 percent within two years. Only 4 percent of firms change the number of banks within one year and about 8 percent within two years altogether. Hence, in line with the findings in Dwenger *et al.* (2020), firm-bank relationships are fairly stable over the horizon of two years.

2.3 Employment decomposition

Our data allow to assess employment N at firm i in period t to be determined by employment in the previous period $t-1$ plus employment inflows I into the firm less outflows O out of firm i in t:

$$N_{i,t} = N_{i,t-1} + I_{i,t} - O_{i,t}. \tag{1}$$

Below, we will estimate impulse-responses which means that we will consider the dynamics of employment changes over a specific time horizon. The employment change N in firm i between periods $t+h$ and $t-1$ can then be understood as the difference of cumulative

employment inflows I_i less cumulative employment outflows O_i between these two periods

$$\frac{N_{i,t+h} - N_{i,t-1}}{N_{i,t-1}} = \frac{\sum_{s=0}^{h} I_{i,t+s}}{N_{i,t-1}} - \frac{\sum_{s=0}^{h} O_{i,t+s}\cdot}{N_{i,t-1}}. \tag{2}$$

We consider growth rates to normalize by the last period's employment N_{t-1} in a given firm. Table 1 documents inflow and outflow rates a the firm-level for $h = 0$. Firms hire on average 6.7 percent of new workers as a share of their current employment each quarter. 6.3 percent of workers leave firms each quarter. This means that firms experience a net increase in employment of about 0.4 percent each quarter. A large share of firms does not experience any change in employment, while inflow and outflow rates are very high for some firms.

We can further decompose inflows and outflows of workers by worker characteristics. One such characteristic is the labor force status of the worker before the inflow or after the outflow. Table 1 shows the decomposition of inflows of workers into a firm from employment (EE), from unemployment (UE), from out of the labor force (OE) and from part-time employment (PE). We also report outflows of workers out of a firm to employment (EE), to unemployment (EU), to out of the labor force (EO) and to part-time employment (EP). The remaining inflows and outflows relate to workers who join or drop out of the sample. Notably, the majority of inflows and outflows, about one third each, are hires from or separations to other employers (job-to-job transitions). Hiring from unemployment or out of the labor force happens at a lower rate. Equally, firings (EU transitions) and quits (EO transitions) take place at a lower rate.

For job-to-job transitions, we observe wage changes for workers and report EE inflows and EE outflows separately for workers that increase and decrease their wage. As expected, most job-to-job transitions are related to an increase in the wage and, hence, an income improvement for the worker. The higher wage might also reflect a better firm-worker match and, hence, an increase in productivity from the viewpoint of the worker.

We can decompose Equation (1) across the within-firm wage distribution. This allows us to assess at which parts of the distribution hiring and separation takes place, i.e., which workers are affected the most when employment changes. Doing so, we compute employment changes referring to the firm's wage distribution in the previous period. This reflects the idea that firms consider a given wage distribution (and hence, cost structure of the work force) at the beginning of any period and then decide whom to hire and fire. Between any two time periods, employment changes of workers referring to wages in

quartile Q_{t-1} of the previous period's wage distribution are given by

$$N_{i,t}^{Q_{t-1}} - N_{i,t-1}^{Q_{t-2}} = I_{i,t}^{Q_{t-1}} - O_{i,t}^{Q_{t-1}} + S_{i,t|t-1}^{Q_{t-1}^{+}} - S_{i,t|t-1}^{Q_{t-1}^{-}}. \tag{3}$$

Different to Equation (1), employment changes now not only consist of inflows less outflows of the workers into the particular quartile, but also workers that stayed in the firm S between $t-1$ and t who now sort into the respective quartile Q^+ or out of the respective quartile Q^-. Since we refer to last periods' quantiles, the distribution will not be affected by this periods' employment decisions. It is possible, however, that decisions in t lead to a different sorting of workers with respect to the previous distribution. Here, stayers that do not change their wage will not move between quantiles. Stayers that are relevant in equation (1) are only those whose wage increases or decreases in t such that they would have sorted into different quantiles previously. Due to the reference to the previous periods wage distribution, employment changes by quartile do not encompass an equal number of observations across quantiles. They still add up to firm-level employment changes.

The firm decisions on separations and hiring as well as potentially unobserved firm decisions on wages of existing workers will affect the wage distribution that the firm faces in the beginning of the next period. We do not consider the effect of these decisions on the wage distribution itself, but need to take this into account when computing employment changes by wage quartile between periods $t+h$ and $t-1$:

$$\frac{N_{i,t+h}^{Q_{t+h-1}} - N_{i,t-1}^{Q_{t-2}}}{N_{i,t-1}} = \frac{\sum_{s=0}^{h} I_{i,t+s}^{Q_{t+s-1}}}{N_{i,t-1}} - \frac{\sum_{s=0}^{h} O_{i,t+s}^{Q_{t+s-1}}}{N_{i,t-1}} + \frac{\sum_{s=0}^{h} \left[S_{i,t+h|t+h-1}^{Q_{t+h-1}^{+}} - S_{i,t+h|t+h-1}^{Q_{t+h-1}^{-}} \right]}{N_{i,t-1}} \tag{4}$$

In line with Equation (3), employment changes now not only consist of cumulative employment inflows I_i^Q out of minus employment outflows O_i^Q of the workers into the particular quartile, but also workers that stayed in the firm in consecutive periods in the horizon $t-1$ to $t+h$ and resort into or out of the respective quartile.

Our approach is different to contributions which study the implications of monetary policy for inequality using micro-data at the individual worker level (Amberg *et al.*, 2022; Andersen *et al.*, 2023; Broer *et al.*, 2020). In these studies, workers are categorized according to their permanent income distribution and this distribution is kept constant over the impulse horizon. These papers therefore answer the question of whether the wage gains or losses in response to monetary policy are smaller or greater for workers who were in a specific

part of the aggregate distribution before the shock hit. Instead, we show how firms adjust their labor costs dynamically in response to monetary policy, taking into account their firm-specific distribution.

3 Specification and Identification

3.1 Identified monetary policy shocks

Our firm data covers German firms between 2005 and 2021. During this period, monetary policy was conducted by the ECB. Nevertheless, ECB monetary policy is likely to react to the German economy and is not exogenous. Therefore, we use high-frequency identified monetary surprises for the Euro-area to address endogeneity concerns. We use pure monetary policy shocks that are purged from central bank information effects following Jarocinski and Karadi (2020) as implemented in Jarociński (2022).[5] In particular, we focus on interest rate surprises defined as the first principal component of surprises in Overnight Index Swaps (OIS) with maturities of 1-, 3-, and 6-months and 1-year in half-hour windows around press releases of monetary policy decisions. The surprises are scaled such that they have the standard deviation of the 1-year OIS swap. Central bank information effects are removed by purging the surprises from any stock market comovements. We aggregate these daily shocks by summing them to a quarterly level to match the frequency of our firm data.

At monthly frequency these shocks have been shown to provide reasonable aggregate and micro-level dynamics for Germany, see e.g. Broer *et al.* (2020) for worker dynamics and Balleer and Noeller (2023) for firm dynamics. In Figure **??** in Appendix B, we show that these shocks also provide standard aggregate dynamics at quarterly frequency. Both German real GDP and the German Consumer Price Index decline in response to a contractionary shock.

3.2 Empirical specification

In this section, we describe how we estimate our firm-level local projections. To estimate the effect of monetary policy surprises on firms' labor demand, we run firm-level local

[5]The updated shocks are available here.

projections following Jordà (2005). Formally, we estimate

$$Y_{i,t+h} = \alpha_i^h + \alpha_q^h + \beta^h \; MP_t + \gamma^h Z_{i,t-1} + \varepsilon_{i,t+h} \tag{5}$$

for $h = 0, \ldots, 8$ quarters. As the dependent variable $Y_{i,t+h}$, we will use various firm-level outcomes outlined in more detail below. MP_t is the monetary policy shock. We include firm-level (α_i^h) and quarter (α_q^h) fixed effects to control for unobserved firm heterogeneity and seasonality, respectively. $Z_{i,t-1}$ is a vector of aggregate and firm-level control variables, which include the aggregate unemployment rate, firm-size categories and firm age. Our coefficients of interest are β_h, which describe the response of the dependent variable to the identified monetary policy shock. $\varepsilon_{i,t+h}$ is the error term. We cluster standard errors by time following the suggestions by Almuzara and Sancibrián (2024).

We estimate the local projections over the period 2005 to 2019 excluding Covid-19. Moreover, we restrict the sample such that we have a balanced sample across impulse horizons. Moreover, we focus on firms that have at least 10 employees when the shock hits. We do so to obtain meaningful measures and changes of the within-firm wage distributions and to have a sufficient number of observations in each part of the distribution. Over the impulse horizon, the number of employees is restricted to be positive, i.e., we exclude firms that leave the market, but employment may fall below 10.

To capture the role of the bank lending channel, we estimate the following firm-level local projections conditional on bank exposure:

$$\begin{aligned} Y_{i,t+h} = \alpha_i^h + \alpha_q^h + \beta_1^h \; MP_t + \sum_{g=2}^{5} \beta_g^h \; I\left[X_{ibt-1} \in g\right] \; MP_t \\ + \sum_{g=2}^{5} \psi_g^h \; I\left[X_{ibt-1} \in g\right] + \gamma^h Z_{i,t-1} + \varepsilon_{i,t+h} \end{aligned} \tag{6}$$

All variables are defined as in Section 3.2. The new variable X denotes equity of firm i's relationship bank b at time $t-1$. In particular, $I[.]$ takes the value 1 if X_{ibt-1} is in quintile g of the bank-equity distribution. We create quintiles of bank equity based on (average) bank equity ratios over the firm distribution for each year.[6] We will interpret the coefficients β_g^h as the firm responses to monetary policy across firms that are exposed

[6]The bank equity ratio has increased substantially over our sample period. Yearly split of quintiles ensure that at the time of the monetary policy shock there are equal number of firms that belong to each bank equity quintile.

to the bank lending channel to different degrees. In particular, we interpret firms in the highest bank-equity quintile as having a low exposure (β_5^h), whereas firms in the lowest quintile have a high exposure (β_1^h).

In the following, we mainly focus on firms with multiple bank relationships. This is due to two reasons: first, our firm-bank relationships do not necessarily imply that there is a loan relationship between the bank and the firm. It is possible that firms use the relationship bank to have a deposits account and for other services. In the case of firms that have multiple bank relationships, the relationship(s) are more likely to reflect a loan relationship, as firms begin with a single lender and establish more links over time (Farinha and Santos (2002)). As a matter of fact, based on bank loan information from firms balance sheets, we observe that close to 50 percent of multiple bank firms reported a non-zero bank loan amount during the sample period. For single bank firms this share is only 31 percent.[7] Moreover, averaging across bank equity ratios would reduce measurement error of classifying a firm borrowing from high versus low equity banks. This is one of main arguments in the previous literature which almost exclusively use multiple bank firms to investigate the real effects of the bank lending channel.

Table A.3 shows that single bank firms are smaller on average, both in terms of employment and assets. They are also younger. They are similarly leveraged than multiple banks, however. Interestingly, single bank firms exhibit much more labor turnover with substantially higher inflow and outflow rates.

Finally, we support our benchmark results with industry-time and location-time fixed effects. On the one hand, these time-fixed effects have the advantage of controlling for various aggregate conditions, e.g., demand factors. On the other hand, they absorb part of the general equilibrium effects of monetary policy that we aim to measure. For this reason, we present both specifications next to each other.

3.3 Identification of the bank-lending channel

The core of the bank-lending channel is the effect of monetary policy on the loan supply of banks, which in turn determines the financial position of a firm. In particular, weak banks reduce their credit supply more in response to contractionary monetary policy as documented in a vast empirical literature (e.g., Kashyap and Stein (1995), Kishan and

[7] It is highly likely that single bank firms will turn to their relationship banks if they need a loan. This may be more relevant during times of crisis.

Opiela (2000), Kashyap and Stein (2000), Jiménez *et al.* (2012), Gomez *et al.* (2021)). As a result, firms related to these banks become financially constrained.

We focus on the bank equity ratio as our preferred measure for bank conditions. The bank equity ratio is a measure of bank health, as it allows banks to withstand negative cash flows (due to unpaid credit or asset devaluations). For example, Gambacorta and Shin (2018) demonstrate that high bank equity is associated with higher debt funding, lower cost of debt and ultimately higher lending. Empirical studies confirm that well-capitalized banks can better shield their lending from monetary policy shocks and financial crises, as they have a larger buffer against shocks and easier access to external funds (Gambacorta and Marques-Ibanez (2011), Jiménez *et al.* (2012), Berger and Bouwman (2013), Gomez *et al.* (2021)). The role of bank equity on lending has been further reinforced by bank capital regulations introduced since 2008 financial crisis. Recent studies point out that bank equity also plays a role in the transmission of negative interest rates (Bittner, Bonfim, Heider, Saidi, Schepens and Soares (2022), Arce, García-Posada, Mayordomo and Ongena (2023)). We follow the approaches by De Santis and Surico (2013) and List and Metiu (2025) to show that banks with lower equity-ratios reduce lending more in response to contractionary monetary policy. We consider two regression models. First, we regression the loan-to-asset ratio on the simple interaction of the monetary policy shock and the equity ratio

$$y_{bt} = \alpha MP_t + \beta EquityRatio_{bt} + \gamma MP_t \times EquityRatio_{bt} + \alpha_b + \varepsilon_{bt}. \tag{7}$$

Next, we interact monetary policy with the bank equity ratio quintiles.

$$y_{bt} = \alpha MP_t + \sum_{g=2}^{G} \beta_g \, I\left[\mathbf{X_{bt-1}} \in g\right] \, \mathbf{MP_t} + \sum_{g=2}^{G} \psi_g \, I\left[\mathbf{X_{bt-1}} \in g\right] + \varepsilon_{bt} \tag{8}$$

Note that these are not identical to the bank quintiles used in our baseline regression. Here, we just sort the banks into quintiles, while our baseline regression relates to quintiles at the bank-firm level (hence weighting banks with many firm links higher). Table XX documents that contractionary monetary policy shocks decrease the loan to assets ratio, and significantly less so the higher the equity ratio of a bank.

We sort firms according to the bank equity distribution over time. As long as firms i) do not change their bank relationship after a monetary policy shock and ii) firms do not sort themselves to weak banks if they are already constrained themselves, for example due to a weak balance sheet, the bank relationship serves as an exogenous source of variation to

firms' financial constraints. Both conditions are fulfilled in our setting. First, as argued by, for example, Dwenger *et al.* (2020) firms in Germany typically have long-term bank relationships. In fact, we observe in our data that less than 4 percent of firms change their main relationship bank within 2 years (Table 2). Relationships can hence be considered constant during the transmission horizon of monetary policy. However, typical measures of financial constraints such as size, age, and leverage could still be correlated with bank equity which would confound the interpretation of the bank lending channel of monetary policy. Table A.5 provides summary statistics of these measures for firms that have relationships with banks in the lowest and highest quintile of the bank equity distribution. We observe that firms that are linked with low equity banks are, on average, substantially larger (both in terms of employment and total assets), older and have lower leverage. Therefore, financially-constrained firms, as proxied by size, age and leverage, sort into strongly capitalized banks. This is in line with Schwert (2018) who finds that firms that do not have access to the bond market are linked with banks with higher equity. In addition, Grandi, Darriet, Guille and Belin (2021) use a sample of French SMEs and show that opaque firms are more likely to borrow from banks with high capital which decreases their cost of borrowing. This means that financially constrained firms try to insure themselves against shocks by sorting into financially unconstrained banks. Therefore, our proposed mechanism of monetary policy transmission works not through but despite this sorting.

4 Labor adjustment in response to monetary policy

Next, we discuss our results on how firms adjust employment in response to monetary policy shocks. We proceed in four steps. First, we show responses of the wage bill, employment and the average wage based on aggregate German data as a benchmark. Second, we show results on the wage bill, employment and the average wage at the firm level and add firm heterogeneity and discuss how firm exposure to the bank-lending channel of monetary policy drives the results. Third, we disaggregate the employment results further into inflows and outflows, distinguishing by labor market states. Fourth, we consider distributional aspects by differentiating the results across the within-firm wage distribution.

4.1 Aggregate dynamics

Here, we show aggregate responses of GDP, the CPI and aggregate productivity as well as of the wage bill, employment and the average wage from German national accounts to monetary policy shocks. This implies that we modify Equation (5) such that we remove the firm index i and remove all firm-level controls and fixed effects. Figure 2 shows the responses to a 2-standard deviation contractionary monetary policy shock. This corresponds to a 10 basis point reduction in the interest rate. Solid lines show the point estimates for the series of β_h. The x-axis plots the impulse horizon in quarters, $h = 0, \ldots, 8$ and the y-axis describes the change in the dependent variable in percent. Dark and light-shaded areas correspond to one and two standard deviation confidence bands.

We find that contractionary monetary policy significantly reduces GDP and the CPI in line with conventional knowledge. Output per capita also falls significantly and so does productivity measures as output per hour (not shown). The wage bill falls which is primarily driven by employment which falls by around 0.5 percent at the maximum. Average wages fall slightly, but the response is not significantly different from zero. This indicates a dominant role of employment changes for the reduction in wage costs in the aggregate. The employment decline in Germany is overall similar to comparable responses in other countries (see e.g., Graves *et al.*, 2023 for the US or Gulyas *et al.*, 2024 for Austria).

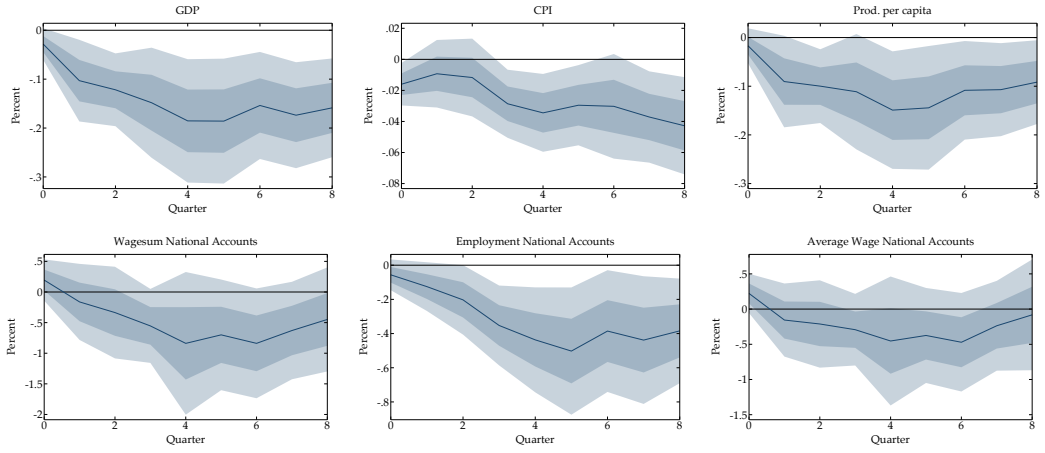


FIGURE 2: Aggregate responses to a 2-standard deviation contractionary monetary policy shock over the period 2005 to 2019. Data is from the national accounts, employment is total dependent employment (excluding self-employed).

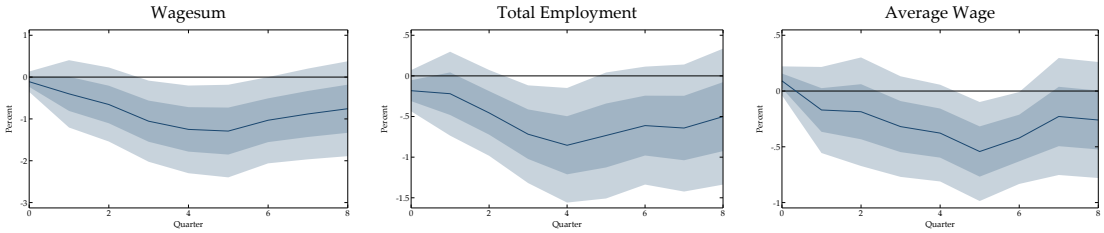


FIGURE 3: Wage and employment responses to a 10 basis points contractionary monetary policy shock at the firm level. The bands represent 68 and 95 percent confidence bands.

4.2 Firm-level labor adjustment

Figure 3 illustrates how the wage bill, employment and the average wage react to the same 2-standard deviation contractionary monetary policy shock at the firm level. According to the left panel, firms reduce their wage bill by around 1.5 percent by quarter 5 after the shock at maximum. This is intuitive, as firms need to cut expenses (internal finance) as credit (external finance) becomes more expensive due to the monetary policy tightening. Expenses can be cut either through less investment or by reducing the wage bill (their current costs). As documented in the middle and the right panel, they do so by reducing employment (by around 1 percent), rather than average wages (by around 0.5 percent). The effect on employment is relatively large and consistent with the aggregate evidence. The reduction in employment and the wage bill is also a response to lower demand due to contractionary monetary policy.

In Table 3, we show the firm responses to monetary policy across the different bank-equity quintiles at impulse horizon $h = 6$. As argued above, we focus on a subsample of firms that have multiple-bank relationships. The first three columns show our baseline specification; the second three columns add a rich set of fixed effects. The variable *shock* refers to the average effect of the monetary policy shock on the dependent variable for our baseline group of firms that have relationships with low equity banks. The interactions then show the relative difference to this effect for firms that have relationships with banks that are in higher quintiles of the bank-equity distribution. Higher quintiles indicate higher bank equity, that is, less restrictive bank lending.

Employment decreases strongly by 1.2 percent after a 10 basis point contractionary monetary policy shock for firms that are related to low equity banks (column 1). This response gradually decreases when we move along the bank-equity distribution. The effect is more than halved for firms in the highest bank-equity quintile with a 0.7 percentage points

smaller decrease of employment. A similar picture emerges when we compare the response of the wage-sum across the quintiles (column 2). However, there is no significant difference in terms of the average wage adjustment (column 3). This documents that firms with less exposure to the bank-lending channel respond less to the monetary policy shock. Moreover, we confirm the result from above that firms adjust their wage costs in response to monetary policy contractions primarily by changing employment. The differences for employment and the wage sum hold and are statistically significant when controlling for industry-time fixed effects, although the size of the effect is reduced by almost half (columns 4 and 5). Note that due to the time fixed-effects the average effect for our baseline group is not identified anymore and we can only report the relative effects. For completeness, Table B.1 shows the same results for the full sample of firms and for the sample of firms that only have relationships with a single bank. We obtain similar results for the full sample, but do not observe significant differences in the responses for firms that are related to high and low equity banks when focusing on single bank relationships. This underpins our argument from above that firms are more likely to have a loan relationship and are therefore more likely to be exposed to the bank-lending channel if they have relationships with multiple banks.

4.3 Firm-level inflows and outflows

Having established that firms adjust their wage-sum primarily by adjusting employment, we want to understand the employment response in more detail. To this end, Figure 4 decomposes the employment responses into inflows and outflows following our decomposition in equation (2). Inflows (middle panel) decline significantly in response to the shock by 1.5 percent after six quarters. By contrast, outflows (right panel) hardly react to the shock initially, if anything, they tend to decline in the long run towards the end of the impulse horizon. The results are clearly stronger for firms which are exposed more to the bank-lending channel. In exposed firms, inflows fall more and outflows decline less.

These results offer a new insight into the labor adjustment of firms in response to monetary policy. As conventional wisdom would suggest, we show that firms reduce their employment in response to a drop in demand and a credit tightening as induced by monetary policy. However, firms reduce employment by hiring significantly less, while outflows hardly change. As a result, the employment reduction is predominantly driven by a decline in inflows relative to employment. A monetary policy tightening therefore reduces labor

				Multiple Bank Firms		
	(1) Employment	(2) Wage sum	(3) Wage	(4) Employment	(5) Wage sum	(6) Wage
shock	-1.19***	-1.62***	-0.42***			
	(0.18)	(0.22)	(0.08)			
equity Q2× shock	0.39**	0.44***	0.04	0.18	0.16	0.16
	(0.15)	(0.16)	(0.05)	(0.13)	(0.11)	(0.11)
equity Q3× shock	0.43**	0.45**	0.00	0.21*	0.20*	0.20*
	(0.17)	(0.20)	(0.07)	(0.11)	(0.10)	(0.10)
equity Q4× shock	0.54***	0.57***	0.01	0.24**	0.24**	0.24**
	(0.18)	(0.22)	(0.08)	(0.11)	(0.10)	(0.10)
equity Q5× shock	0.67***	0.75***	0.05	0.33***	0.34***	0.34***
	(0.19)	(0.23)	(0.08)	(0.13)	(0.12)	(0.12)
N	4,153,019	4,153,019	4,153,019	4,153,018	4,153,018	4,153,018
Benchmark controls	Y	Y	Y	Y	Y	Y
county-time, industry-time FE				Y	Y	Y

TABLE 3: Effects of monetary policy on employment and wage sum by bank-lending channel. Effects at horizon $h = 6$. Benchmark controls include, unemployment rate, quarter fixed effects and firm-main bank fixed effects. Multiple bank sample includes firms that are linked with more than one bank 1 year before the monetary policy shock. Standard errors (in parentheses) are clustered at the main bank-time level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

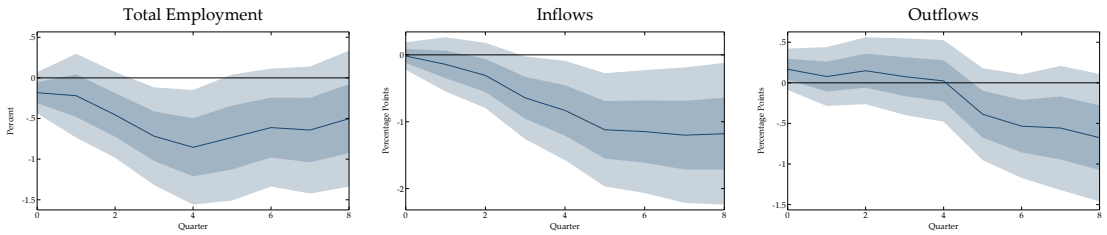


FIGURE 4: Employment and inflow and outflow responses to a 10 basis points contractionary monetary policy shock at the firm level. The bands represent 68 and 95 percent confidence bands.

turnover (defined as the sum of inflows and outflows). A concept related to turnover is churning (see, e.g., Bachmann *et al.* (2021) who document the cyclical properties of churning in German establishments). Churning is defined as net turnover, i.e., turnover in excess of job flows (hiring plus separations less the change in employment). Even though not computed explicitly, our results imply that churn falls in response to contractionary monetary policy shocks. Note that our data excludes entering and exiting firms by construction, so the reduction of reallocation happens between existing firms.

We can further decompose inflows by previous labor market state and outflows by subsequent labor market state of the worker. Table 4 shows the results for horizon $h = 6$ and also reports the response to contractionary monetary policy by bank equity quintiles. One can see that the decline in inflows is mostly driven by a decline in inflows from employment. Inflows from unemployment do not significantly increase. Inflows from out of the labor force also decrease, but to a smaller degree. Inflows from non-regular employment do not react. While outflows of workers from firms do not react to contractionary monetary policy shocks overall, outflows to employment significantly fall. Contrary to employment outflows, firms do fire after a contractionary shock as outflows to unemployment increase. Outflows to out of the labor force or non-regular employment do not react to monetary policy. Within inflows from employment, those with wage increases dominate the overall effect. Mirroring the inflows, the fall in EE outflows is mostly driven by outflows of workers which experience wage increases. Hence, outside opportunities of the currently employed significantly fall after a monetary policy shock.

Graves *et al.* (2023) argue that labor supply increases after contractionary monetary policy, i.e. more people look for employment (OU increases). We do not measure this, as we focus on firms, not workers. However, if labor supply increases, these people are not hired at a

	(1) Inflows	(2) Inflows EE	(3) Inflows UE	(4) Inflows OE	(5) Inflows PE	(6) In EE W ↑	(7) In EE W ↓
shock	-1.53***	-0.83***	0.02	-0.21***	-0.19***	-0.54***	-0.17***
	(0.21)	(0.12)	(0.03)	(0.03)	(0.05)	(0.09)	(0.03)
2.equity × shock	0.30*	0.23*	0.02	0.02	0.03	0.13*	0.07*
	(0.18)	(0.12)	(0.03)	(0.03)	(0.04)	(0.07)	(0.04)
3.equity × shock	0.26	0.16	0.07*	0.05*	0.01	0.11	0.03
	(0.19)	(0.11)	(0.03)	(0.03)	(0.05)	(0.08)	(0.03)
4.equity × shock	0.30	0.20*	0.08*	0.01	0.02	0.14*	0.03
	(0.21)	(0.12)	(0.04)	(0.03)	(0.05)	(0.08)	(0.03)
5.equity × shock	0.45**	0.25**	0.10**	0.01	0.05	0.18**	0.05
	(0.22)	(0.13)	(0.04)	(0.03)	(0.06)	(0.09)	(0.03)
	Outflows	Outflows EE	Outflows EU	Outflows EO	Outflows EP	Out EE W↑	Out EE W↓
shock	-0.40***	-0.65***	0.56***	-0.01	-0.04	-0.43***	-0.12***
	(0.11)	(0.08)	(0.07)	(0.01)	(0.07)	(0.05)	(0.02)
2.equity × shock	-0.09	-0.03	-0.07	0.01	-0.01	-0.01	-0.01
	(0.07)	(0.05)	(0.04)	(0.01)	(0.03)	(0.03)	(0.01)
3.equity × shock	-0.13	-0.05	-0.07	0.01	-0.03	-0.02	-0.04*
	(0.10)	(0.07)	(0.06)	(0.02)	(0.05)	(0.04)	(0.02)
4.equity × shock	-0.20*	-0.12	-0.06	-0.00	-0.01	-0.05	-0.06***
	(0.11)	(0.08)	(0.07)	(0.02)	(0.06)	(0.05)	(0.02)
5.equity × shock	-0.27**	-0.11	-0.12*	-0.01	-0.03	-0.04	-0.06***
	(0.12)	(0.08)	(0.07)	(0.02)	(0.06)	(0.05)	(0.02)
N	4146400	4146400	4146400	4146400	4146400	4146400	4146400

TABLE 4: Employment decomposition in response to contractionary monetary policy shocks. Effects at horizon $h = 6$. Benchmark controls include, unemployment rate, quarter fixed effects and firm-main bank fixed effects. Multiple bank sample including firms that are linked with more than one bank 1 year before the monetary policy shock. Standard errors (in parentheses) are clustered at the main bank-time level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

larger rate according to our results. Also, we do not observe a fall in outflows to out of the labor force which would be consistent with an increase in labor supply.

Table 4 shows that the reduction in inflows is primarily driven by firms related to low equity banks (first row). For these firms, inflows fall by 1.5 percent, while the corresponding drop in firms related to high equity banks is substantially smaller and amounts to only two thirds of the effect. Notably, firms less exposed to monetary policy are those firms that hire from unemployment. Together with the smaller drop in hiring from employment of these firms, this suggests a reallocation of labor from more to less exposed firms, primarily through unemployment. While overall outflows decrease, this effect is substantially stronger for firms less exposed to monetary policy. Firing, i.e., outflows to unemployment happen significantly less in these firms. Outflows to employment decrease similarly for all firms, unrelated to the exposure to monetary policy shocks.

4.4 Inflows and outflows across the within-firm wage distribution

Last, we apply the decomposition of workers flows into different wage quartiles of the firm as derived in Section 2.3, Equation (4). As discussed in Section 2.3, we refer to the wage distribution of the previous period, or the beginning of the period before employment decisions are taken. For readability, we decompose only the response after six quarters, i.e., at $h = 6$, and plot the quartiles on the x-axis in Figure 5. The change in employment can be decomposed into inflows into and outflows out of the firm as well as stayers in the firm for the quartiles of the within-firm wage distribution. Red indicates firms with banks in the lowest quintile and blue indicates firms in the highest bank equity quintile.

The upper-left panel shows a clear difference in employment changes for the different wage quartiles. While employment is reduced at the lowest wage quartile, no significant change is observed for the two upper quartiles. Figure 5 shows that relative inflows to the firm decline significantly across the entire distribution but more so at the lower end of the wage distribution. For example, in the lowest quartile inflows decline by on average 0.75 percent in response to the shock after six quarters, while the corresponding number in the highest quartile is close to zero and not statistically significant. The response of outflows is negative for high-wage workers as shown in the bottom-left panel of Figure 5 with a decline of roughly 0.2 percent. The outflow response in the lower quartile is zero.

Stayers reflect the part of the previous periods wage distribution that is composed of workers who have stayed in the firm between any two time periods up to horizon $h = 6$ and resort into or out of the respective quartile. Stayers overall do not matter substantially in order to understand the employment changes across quartiles. Recall that this does not imply that the wage distribution itself does not change. Hence, we do not consider the reshuffling of stayers due to changes in the distribution. Here, stayers refer to workers with wage changes between two periods that would have sorted differently into the last periods' distribution. These are very few workers, since most quarterly wage changes in ongoing jobs cannot be observed in our data.

Our results imply that firms cut costs in response to the contractionary monetary policy shock by hiring less low wage (potentially less-skilled) workers. This changes their employment decomposition towards more costly high-wage workers. All else equal, a higher share of high-wage workers would increase the average wage in the firm. But as documented in Figure 3, average wages react very little, if anything they slightly fall. This implies that firms must have actually decreased some wages of the remaining or newly hired employ-

ees. Our data do not allow us to measure this adjustment, however, as individual wage information is not available at a high frequency.

Taking into account the role of the bank-lending channel for the results, we see that firms in the highest bank-equity quintile (blue) reduce their employment by less compared to firms in the lowest bank-equity quintile (red) for all wage quartiles but the highest. This suggests that firms that face financial constraints hire less, while outflows are higher. Only for very high-wage workers, we find no significant difference suggesting that all firms equally hold on to their high-wage workers. This becomes apparent by comparing inflows (top right panel) and outflows (bottom left panel). Constrained firms reduce their inflows more than unconstrained firms. The difference is almost symmetrical along the wage quartiles. In contrast, the outflows of low-wage workers do not react to the monetary policy shock for constrained firms, but they fall by almost the same amount for high-wage workers as for unconstrained firms. This is surprising given that these workers are particularly expensive to these firms. One interpretation may be that labor markets are particularly tight for these workers. Moreover, firms tend to save expenses for workers in the lowest quartile of the wage distribution, suggesting that they perceive low-wage workers as easier to replace. Finally, the response of stayers in the firm is not very different between constrained and unconstrained firms.

The lower part of Figure 3 shows inflows and outflows to and from employment and unemployment. The reduction in inflows from employment (and OLF which is not shown) is driven by low-wage workers. Inflows from unemployment increase in less exposed firms. Again, these inflows relate to workers at the lower end of the respective wage distribution. Hence, the difference in inflows from employment and unemployment is particularly large for low-wage workers and suggests substantial replacement of these workers especially at less exposed firms. Outflows to employment fall for all workers, while outflows to unemployment increase for low-wage workers. The difference in outflows to employment and unemployment between more and less exposed firms is slightly larger for low-wage workers.

5 Conclusion

TBC

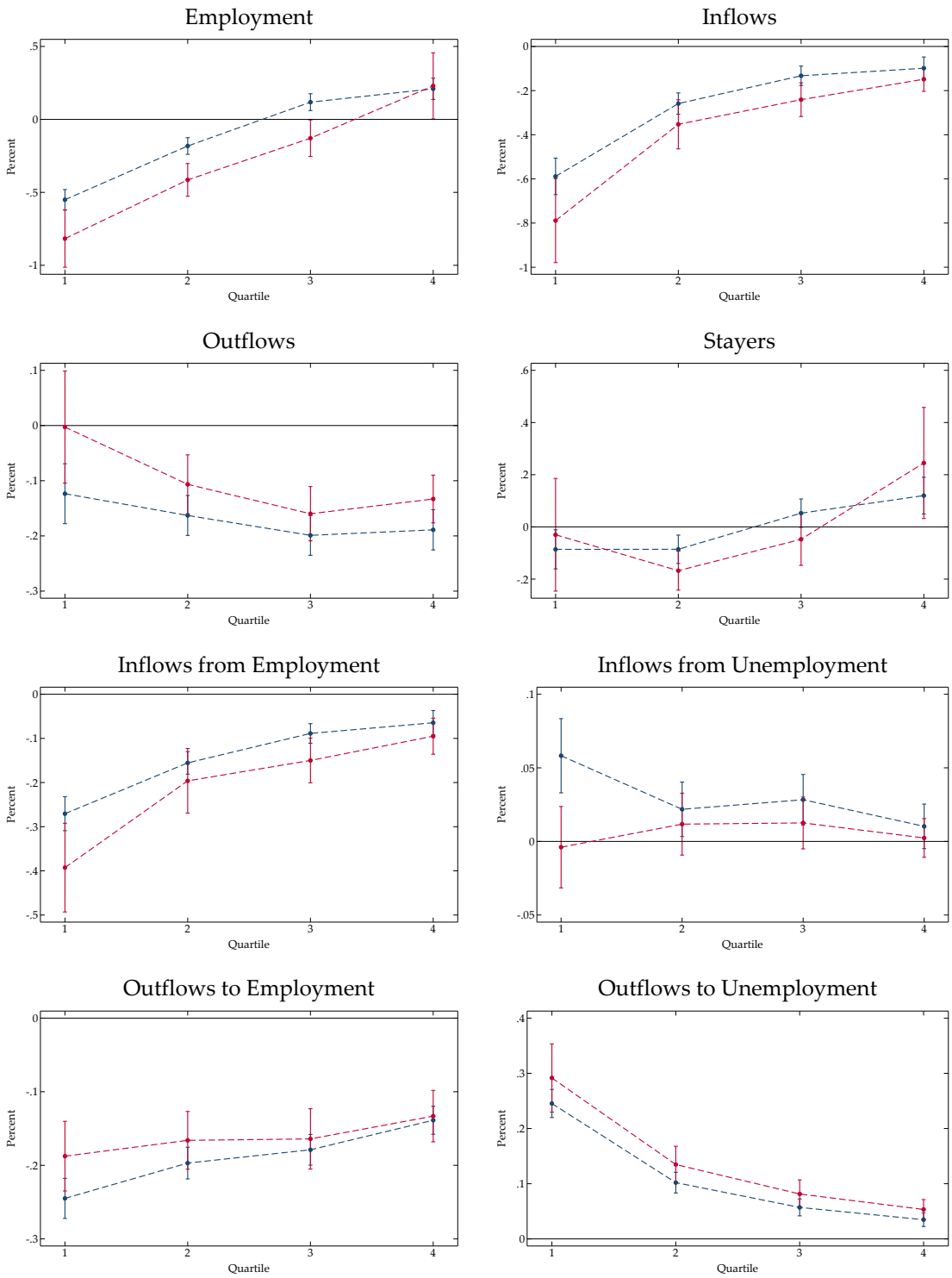


FIGURE 5: Employment decomposition across the firm wage distribution. Red: lowest bank-equity quintile, blue: highest bank-equity quintile. The x-axis shows wage quartiles. Multiple-bank firms.

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Appendix

A Data preparation, data description and first descriptives

A.1 Data preparation

IEB We use the job spells of full-time employees that are subject to regular social security notification. These include person group 101 (employees subject to social security without special features), 140 (seamen) or 143 (maritime pilots). For a given quarter, we pick one spell from a firm-worker pair by using the spell with the highest (imputed) wage.
The wage information in IEB data is subject to censoring above the upper earnings limit for statutory pension insurance contributions. This applies to about 10% of the individual data. We use the imputed daily wages from Beschaeftigten-Historik (BeH) as described in Drechsler, Ludsteck and Moczall (2023). This procedure also distributes special payment transaction for a person, (notification reason 54 in the IEB coding) proportionally to the regular firm-worker job spells of that year.
We construct firm-level quarterly employment and wage aggregates using the definitions above. Accordingly, total employment at a given quarter refers to the number of regular full time employees, mean daily wage is calculated by the average of (imputed) daily wages of the same group of employees. Wagesum is the total of daily wages at a given firm stemming from full time employment.
The flow definitions closely follow the ones introduced in AWFP, such that inflows of a firm for a quarter equals the number of employees who were regularly employed in the current quarter but were not in the previous quarter. Outflows of a firm for a quarter equals the number of employees who were regularly employed in the previous quarter but are not in the current quarter.
In the case of employment (flows) within-firm wage distribution, we group workers into wage quartiles based on the previous quarters' wage distribution. The change in employment for a given wage quartile and quarter means the difference between the number of full-time employees whose wages fall within that wage quartile in the current quarter and the number of full-time employees whose wages fell within that wage quartile in the previous quarter. Outflows of a firm in that wage quartile for a quarter equals the number of employees who were regularly employed in the previous quarter with wages within the wage quartile, but are not employed in the current quarter. Inflows of a firm in that wage quartile for

a quarter equals the number of new employees in the current quarter whose wages fall within the wage quartile. Finally, for those employees that stayed in the firm between the previous quarter and the current quarter, the change in number of stayers means the difference between the number of full-time employees whose wages fall within that wage quartile in the current quarter and the number of full-time employees whose wages fell within that wage quartile in the previous quarter.

Dafne Firm-Bank Link(s) We compile historical vintages of the Dafne database between 2007 and 2020, and construct a time-series of bank-firm relationships. We use bank identification and swift codes as identifiers to match the firm and bank data sets at annual frequency. We further support the link by string matching of bank names and manual inspection for consistency. We also take into account changing bank-firm relationships and adjust to bank-level mergers and acquisitions (M&A).
As in Kazakov, Koetter, Titze and Tonzer (2024) we apply a three-year rolling window approach (forward and backward) to fill the breaks in bank relationship data between historical vintages. We match these yearly firm-bank relationship with bank balance sheet information from Bankscope until 2013 and Bankfocus afterwards. We drop all bank relationships that are not linked with a bank identifier and that the bank does not have balance sheet information in the bank data. In the case of an M&A, we use the balance sheet information of the new entity after target bank's balance sheet ceases to exits. We are able to cover more than 99 percent of all the reported linkages which correspond to a sample of around $800,000$ firms.
To strengthen our identification, we only keep banks with non-zero assets, loans and equity information at all times. Moreover, we winsorize bank equity to assets ratio and loans to assets ratio at the 0.5 and 99.5 percentiles and drop the outlier bank-year observations based on this cut-off. After this cleaning, we create measures such as multiple bank relationship, number of bank relationships, average bank equity to assets ratio at the firm-year level.

A.2 Variable descriptions

- **employment:** full-time employment subject to regular social security notification. Source: IEB
- **inflow:** the number (share) of workers who are full-time employees in the current quarter but were not in previous quarter. Source: IEB

- **outflow:** the number (share) of workers who were full-time employees in the previous quarter but are not in the current quarter. Source: IEB
- **stayer:** the number of workers who are full-time employees in the previous quarter and in the current quarter. Source: IEB
- **mean daily wage:** average (imputed) daily wage in Euros. Source: IEB
- **wage sum:** total (imputed) daily nominal wages in a given firm in Euros. Source: IEB.
- **firm age:** the year of observation minus the year of incorporation. Source: Dafne.
- **main bank:** first bank reported in the firm-bank relationship. Source: Dafne.
- **number of banks:** number of reported (active) bank relationships at a given year. Source: Dafne, Bankscope, Bankfocus.
- **bank equity ratio:** lag firm level (average) bank equity ratio of relationship bank(s) at a given year. Source: Dafne, Bankscope, Bankfocus.
- **firm total assets:** lag three year moving average of firm total assets in thousand Euros. Source: Dafne.
- **firm leverage:** lag ratio of total long-term and short term debt to total assets, three year moving average. Source: Dafne.

A.3 Descriptive statistics

Panel A: AWFP Sample							
	mean	min	p10	p50	p90	max	observations
employment	11.61	1	1	3	19	55264	87,348,601
mean daily wage	76.58	0.01	35.17	70.24	122.22	3296.25	87,348,601
wage sum	1282.46	0.01	43.42	183.82	1722.34	12813336	87,348,601
Panel B: IEB Establishment Sample							
employment	44.43	1	4	18	85	55377	9,812,189
wage	97.08	0.03	57.87	91.14	143.70	773.02	9,812,189
wage sum	5050.08	0.03	372.97	1681.81	8777.37	12502244	9,812,189

TABLE A.1: Summary statistics at the establishment level, 2005-2019. Panel A reports establishments' employment and wage statistics using AWFP. Panel B reports establishment level employment and wage outcomes using baseline IEB firm sample. Employment is defined as full time employment subject to regular social security notification. Mean daily wage is the average imputed wages of full-time regular employees (in Euros). For the AWFP sample, we drop establishments in the financial sector and in public administration and defense. No other filters are applied. Source: AWFP, IEB.

Industry	IEB Sample	AWFP Sample
1 Agriculture, forestry and fishing	1.24	2.14
2 Mining and quarrying	0.33	0.14
3 Manufacturing	27.29	10.95
4 Electricity, gas, steam and air conditioning supply	0.69	0.31
5 Water supply, sewerage, waste management and remediation activities	1.23	0.57
6 Construction	14.75	12.31
7 Wholesale and retail trade; repair of motor vehicles, and motorcycles	18.05	21.62
8 Transportation and storage	6.35	4.58
9 Accommodation and food service activities	2.65	6.23
10 Information and communication	4.67	2.9
12 Real estate activities	1.34	2.25
13 Professional, scientific and technical activities	7.23	9.79
14 Administrative and support service activities	6.42	5.51
16 Education	0.96	2.88
17 Human health and social work activities	4.73	11.41
18 Arts, entertainment and recreation	0.73	1.39
19 Other service	1.31	5.02

TABLE A.2: Industry distribution at the firm (establishment) level. The industry classification is based on 1-digit WZ 2008 industries. The IEB sample is the baseline linked firm sample as described above. The AWFP sample is based on establishments with at least 1 regular full-time employees for the same set of industries as in the baseline sample. IEB (AWFP) sample provides firm (establishment) level averages for the years between 2005-2019.

Panel A: multiple banks							
	mean	min	p10	p50	p90	max	observations
employment	63.898	1.00	11.00	25.00	120.00	55256.00	4147054
inflow	0.057	0.00	0.00	0.04	0.14	62.09	4147054
outflow	0.054	0.00	0.00	0.04	0.13	1.00	4147054
mean wage	98.398	8.43	63.88	94.24	137.78	396.18	4147054
wage sum	7402.940	8.43	939.11	2364.77	12824.25	12498928.00	4147054
age	36.894	0.00	11.00	29.00	75.00	773.00	4147054
num. of banks	2.538	2.00	2.00	2.00	4.00	16.00	4147054
bank equity ratio	0.060	0.00	0.03	0.06	0.09	0.16	4147054
assets	8446.872	56.90	555.67	2302.00	19253.00	135844.33	3583942
leverage	0.327	0.00	0.00	0.27	0.73	1.41	3526958

Panel B: single banks							
	mean	min	p10	p50	p90	max	count
employment	47.163	1.00	11.00	20.00	83.00	32509.00	3619227
inflow	0.077	0.00	0.00	0.05	0.19	196.82	3619227
outflow	0.072	0.00	0.00	0.05	0.18	1.00	3619227
mean wage	93.512	0.93	55.00	86.65	141.91	382.23	3619227
wage sum	5193.599	1.85	775.63	1777.87	8258.01	7542181.00	3619227
age	21.393	0.00	5.00	17.00	40.00	804.00	3619227
num. of banks	1.000	1.00	1.00	1.00	1.00	1.00	3619227
bank equity ratio	0.063	0.00	0.03	0.06	0.10	0.16	3619227
assets	5344.828	56.90	297.33	1262.33	9421.00	135844.33	3030761
leverage	0.324	0.00	0.00	0.25	0.76	1.41	2973482

TABLE A.3: Summary statistics at the firm level, 2005-2019. Employment is defined as full-time employment subject to regular social security notification. Mean daily wage is the average imputed wages of full-time regular employees (in Euros). Firm age is calculated as the difference between the year of observation and the year of incorporation. Number of banks are the sum of unique bank relationships with balance sheet information. Bank equity ratio is the total equity to total assets ratio. In case of multiple bank firms, we take the average at the firm level. Firm total assets are reported in thousand Euros. Firm leverage is defined as the ratio of long-term and short term debt liabilities to total assets. Firm total assets and firm leverage are calculated as a 3-year backward-looking moving average. Source: IEB, Dafne, Bankscope-Bankfocus.

	Loan to assets
MP shock	-0.0791***
	(0.0104)
Equity Ratio (t-1)	1.116***
	(0.0549)
MP shock × Equity Ratio (t-1)	0.603***
	(0.146)
Constant	0.505***
	(0.00416)
Observations	19848
MP shock	-0.0619***
	(0.00729)
MP shock × Equity Quartile 2 (t-1)	0.0104
	(0.0106)
MP shock × Equity Quartile 3 (t-1)	-0.00210
	(0.00971)
MP shock × Equity Quartile 4 (t-1)	0.00470
	(0.00963)
MP shock × Equity Quartile 5 (t-1)	0.0215**
	(0.0102)
Observations	19848

TABLE A.4: Bank-level regressions. Results from estimating equation (7) and (8).

Panel A: low-equity banks							
	mean	min	p10	p50	p90	max	observations
employment	87.779	1.00	11.00	27.00	165.00	53918.00	1509311
inflow	0.068	0.00	0.00	0.04	0.16	58.06	1509311
outflow	0.063	0.00	0.00	0.04	0.15	1.00	1509311
mean wage	104.834	9.17	58.69	98.00	161.30	380.00	1509311
wage sum	11136.267	10.11	903.82	2708.84	19322.94	11815061.00	1509311
age	26.602	0.00	6.00	20.00	50.00	761.00	1509311
num. of banks	1.683	1.00	1.00	1.00	3.00	8.00	1509311
bank equity ratio	0.032	0.00	0.01	0.03	0.05	0.06	1509311
assets	11213.489	56.90	410.21	2335.00	34192.25	135844.33	1229828
leverage	0.280	0.00	0.00	0.21	0.69	1.41	1200039
Panel B: high-equity banks							
employment	35.793	1.00	11.00	19.00	64.00	14070.00	1554714
inflow	0.069	0.00	0.00	0.04	0.17	196.82	1554714
outflow	0.066	0.00	0.00	0.05	0.17	1.00	1554714
mean wage	90.022	0.93	58.73	86.82	124.32	311.48	1554714
wage sum	3502.224	1.85	807.62	1661.30	6016.39	3729791.25	1554714
age	28.280	0.00	7.00	22.00	53.00	804.00	1554714
num. of banks	1.489	1.00	1.00	1.00	2.00	9.00	1554714
bank equity ratio	0.088	0.05	0.06	0.09	0.11	0.16	1554714
assets	3709.065	56.90	354.00	1315.00	6628.67	135844.33	1346000
leverage	0.353	0.00	0.00	0.30	0.78	1.41	1325722

TABLE A.5: Summary statistics at the firm level, 2005-2019. Employment is defined as full-time employment subject to regular social security notification. Mean daily wage is the average imputed wages of full-time regular employees (in Euros). Firm age is calculated as the difference between the year of observation and the year of incorporation. Number of banks are the sum of unique bank relationships with balance sheet information. Bank equity ratio is the total equity to total assets ratio. In case of multiple bank firms, we take the average at the firm level. Firm total assets are reported in thousand Euros. Firm leverage is defined as the ratio of long-term and short term debt liabilities to total assets. Firm total assets and firm leverage are calculated as a 3-year backward-looking moving average. Source: IEB, Dafne, Bankscope-Bankfocus.

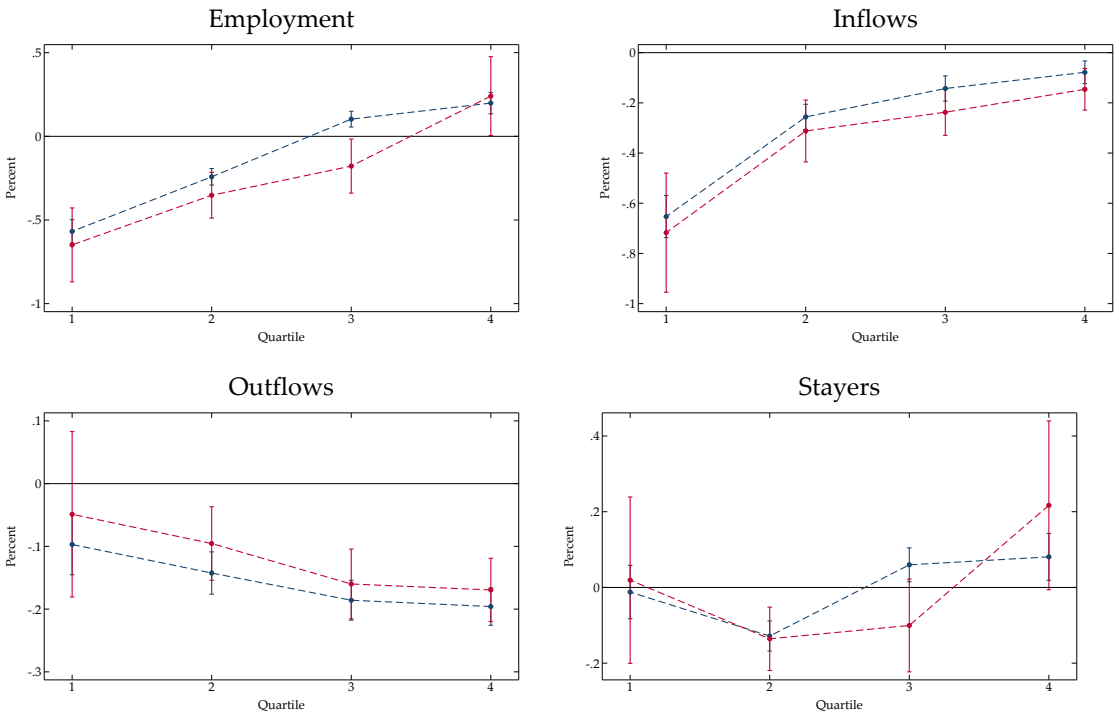


FIGURE B.1: Employment decomposition by bank equity, wage quartiles. Full sample.

B Additional results

	Full Sample					
	(1) Employment	(2) Wage sum	(3) Wage	(4) Employment	(5) Wage sum	(6) Wage
shock	-0.94***	-1.32***	-0.36***			
	(0.20)	(0.25)	(0.08)			
equity Q2× shock	0.14	0.11	-0.05	0.09	0.06	0.06
	(0.19)	(0.21)	(0.06)	(0.12)	(0.12)	(0.12)
equity Q3× shock	0.29	0.23	-0.08	0.08	0.04	0.04
	(0.20)	(0.24)	(0.07)	(0.11)	(0.11)	(0.11)
equity Q4× shock	0.34*	0.31	-0.06	0.16	0.12	0.12
	(0.21)	(0.25)	(0.08)	(0.12)	(0.12)	(0.12)
equity Q5× shock	0.43**	0.42*	-0.05	0.21	0.17	0.17
	(0.21)	(0.25)	(0.08)	(0.13)	(0.13)	(0.13)
N	7,776,954	7,776,954	7,776,954	7,776,954	7,776,954	7,776,954
	Single Bank Firms					
shock	-0.70***	-1.03***	-0.30***			
	(0.24)	(0.30)	(0.09)			
equity Q2× shock	-0.13	-0.28	-0.19*	-0.10	-0.14	-0.14
	(0.32)	(0.38)	(0.11)	(0.19)	(0.19)	(0.19)
equity Q3× shock	0.17	0.04	-0.16*	-0.09	-0.19	-0.19
	(0.26)	(0.32)	(0.09)	(0.16)	(0.17)	(0.17)
equity Q4× shock	0.18	0.08	-0.13	0.12	0.05	0.05
	(0.26)	(0.31)	(0.09)	(0.17)	(0.19)	(0.19)
equity Q5× shock	0.26	0.17	-0.14	0.20	0.12	0.12
	(0.25)	(0.31)	(0.09)	(0.17)	(0.18)	(0.18)
N	3,622,310	3,622,310	3,622,310	3,622,310	3,622,310	3,622,310
Benchmark controls	Y	Y	Y	Y	Y	Y
county-time, industry-time FE				Y	Y	Y

TABLE B.1: Effects of monetary policy on employment and wage sum by bank-lending channel. Effects at horizon $h = 6$. Benchmark controls include, unemployment rate, quarter fixed effects and firm-main bank fixed effects. Single bank sample includes firms that are linked with one bank 1 year before the monetary policy shock. Standard errors (in parentheses) are clustered at the main bank-time level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.

	Full Sample					
	(1) Employment	(2) Inflow	(3) Outflow	(4) Employment	(5) Inflow	(6) Outflow
shock	-0.94***	-1.41***	-0.47***			
	(0.20)	(0.26)	(0.13)			
equity Q2× shock	0.14	0.14	0.00	0.09	0.09	-0.00
	(0.19)	(0.24)	(0.11)	(0.12)	(0.15)	(0.07)
equity Q3× shock	0.29	0.25	-0.04	0.08	0.04	-0.04
	(0.20)	(0.25)	(0.13)	(0.11)	(0.15)	(0.08)
equity Q4× shock	0.34*	0.22	-0.12	0.16	0.06	-0.10
	(0.21)	(0.26)	(0.14)	(0.12)	(0.16)	(0.08)
equity Q5× shock	0.43**	0.28	-0.15	0.21	0.06	-0.14
	(0.21)	(0.27)	(0.14)	(0.13)	(0.18)	(0.09)
N	7,776,954	7,776,954	7,776,954	7,776,954	7,776,954	7,776,954
	Single Bank Firms					
shock	-0.70***	-1.24***	-0.54***			
	(0.24)	(0.33)	(0.18)			
equity Q2× shock	-0.13	-0.22	-0.09	-0.10	-0.04	0.06
	(0.32)	(0.43)	(0.25)	(0.19)	(0.29)	(0.16)
equity Q3× shock	0.17	0.08	-0.08	-0.09	-0.12	-0.03
	(0.26)	(0.36)	(0.20)	(0.16)	(0.24)	(0.14)
equity Q4× shock	0.18	0.07	-0.10	0.12	0.06	-0.06
	(0.26)	(0.35)	(0.19)	(0.17)	(0.25)	(0.14)
equity Q5× shock	0.26	0.25	-0.01	0.20	0.20	-0.00
	(0.25)	(0.34)	(0.19)	(0.17)	(0.25)	(0.14)
N	3,622,310	3,622,310	3,622,310	3,622,297	3,622,297	3,622,297
Benchmark controls	Y	Y	Y	Y	Y	Y
county-time, industry-time FE				Y	Y	Y

TABLE B.2: Employment decomposition in response to monetary policy by bank-lending channel. Effects at horizon $h = 6$. Benchmark controls include, unemployment rate, quarter fixed effects and firm-main bank fixed effects. Single bank sample includes firms that are linked with one bank 1 year before the monetary policy shock. Standard errors (in parentheses) are clustered at the main bank-time level. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.