Heterogeneous Growth Response to Monetary Policy along the Firm-Size Distribution*

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Abstract

We study size heterogeneity in the response of firm growth to monetary policy. Using a data set of 24 mln. firm-year observations in 11 euro-area countries over 1999—2022, we estimate firm-specific sales growth elasticities to exogenous changes in interest rates. In response to monetary tightening, sales growth declines significantly more for micro and small firms than for medium-sized and large firms, as do profit margins, investment, employment, and debt. Over a three-year period, a 1-standard-deviation contractionary shock reduces the sales of firms with fewer than 50 employees by around 3.8 percent more than those with 250+ employees.

JEL classification: E2, E5, G1, G12.

Keywords: Firm heterogeneity, sales growth, monetary policy transmission, product market competition.

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1 Introduction

A growing body of empirical macroeconomic research documents significant heterogeneity in the responses of non-financial corporations to monetary policy. Existing evidence indicates that firms' investment responses to monetary policy shocks vary systematically with characteristics such as age (Cloyne et al. (2023); Krusell et al. (2025)), leverage (Ottonello & Winberry (2020)), debt maturity (Jungherr et al. (2022)), asset tangibility (Durante et al. (2022)), and size (Gertler & Gilchrist (1994); Liu et al. (2022)). In contrast, much less is known about how monetary policy influences firms' product market outcomes, or about the extent and nature of heterogeneity in these effects. Documenting such evidence would enhance our understanding of the broader transmission of monetary policy while also contributing to the recently revived interest in monetary non-neutrality.

We go straight to the heart of this question by investigating the impact of well-identified high-frequency plausibly exogenous changes in interest rates on firms' sales growth. To capture firm-size heterogeneity, we distinguish between different classes of micro, small, medium-sized and large firms. For the empirical analysis, we rely on the comprehensive firm-level Orbis database by Bureau van Dijk, which covers a large number of non-financial firms that span the entire firm-size distribution. After applying the well-established cleaning procedure proposed by Kalemli-Özcan et al. (2024), the dataset contains 24 mln.+ firm-year observations in 11 euro-area countries between 1999 and 2022. For each firm, we estimate a firm-specific elasticity of sales growth to monetary policy shocks. For identification, we rely on high-frequency surprises in interest rates around meetings of the European Central Bank's Governing Council, from the Euro Area Monetary Policy Event-Study Database, provided by Altavilla et al. (2019).

Our main finding is that the elasticity of firms' sales growth to monetary policy shocks declines in firm size. Over three years, a 1-standard-deviation contractionary shock reduces the sales of firms with fewer than 50 employees by around 3.8 percent more than those with 250+ employees. This heterogenous decline in output is underlined by a similar heterogeneous decline in inputs (i.e., investment and employment). Moreover, we find that profit margins also decline more for micro and small firms than they do for large firms. Our results thus suggest that beyond a sizeable firm-size heterogeneity in the transmission of monetary policy, the data point to important implications of monetary policy shocks for industry structure and competition.

When digging deeper into the mechanisms behind the documented differential product market outcomes, we find that the main result is observed primarily in regions with less competitive credit markets, and that in response to monetary tightening, and relative to large firms, micro and small firms reduce borrowing. These extensions suggest a potentially important role for the bank lending channels in explaining the heterogeneous transmission of monetary policy.

The main result of the paper is robust to a number of potential confounding factors. First, a significant correlation between monetary policy shocks and firm growth can obtain in the data because a third, unobservable factor (e.g., investment opportunities) is driving both. We tackle this concern by using the orthogonal proxy for changes in the monetary policy stance introduced by Altavilla et al. (2019). Similar in spirit to other recent contributions to the literature (e.g., Jarocinski & Karadi (2019), and Nakamura & Steinsson (2018)), these shocks are constructed by relying on high-frequency market reactions to differentiate between exogenous monetary policy and its endogenous response to the business cycle. In this framework, even a reduction of the interest rate can be contractionary if the market expected a larger reduction. In addition, we net out any residual independent effect of the country-specific business cycle by controlling for (lagged) GDP growth and inflation.

Second, size can be correlated with another, more fundamental firm-specific factor that is in reality driving the heterogeneous impact of monetary policy shocks on firm growth. We show that our results still obtain when we control for factors such as age and firm leverage.

Third, changes in the central banks' monetary policy stance can coincide with other unobservable changes in the global environment that exert a heterogeneous impact on firms along the firm-size distribution. For example, demand for goods produced or services delivered by sectors more sensitive to changes in external funding costs may shift in a way impeding small firms precisely during periods of monetary tightening. This would result in a relatively larger decline in the growth of micro and small firms, relative to large firms. At the same time, the econometrician will erroneously attribute this divergence in growth rates to changes in the monetary policy stance. To address this concern, we run our empirical tests on a sample of European countries that during the sample period were not euro-area member states (Bulgaria, Croatia, Czechia, Hungary, Norway, Romania, and Poland), where firms ex ante should not be affected by changes in the ECB's monetary policy stance. We show that the strong size-specific response to monetary tightening that we observe in the sample of euro-area firms does not obtain in the sample of non-euro-area firms, confirming that we identify a genuine heterogeneous transmission of monetary policy along the firm-size distribution.

Our work contributes to a growing body of research on the impact of both conventional (e.g., Gertler & Gilchrist (1994); Jimenez et al. (2012)) and unconventional monetary policy (e.g., Acharya et al. (2018); Eser & Schwaab (2016); Ferrando et al. (2019); Ferrando et al. (2022); Giannone et al. (2012); Gilchrist & Zakrajsek (2013); Gilchrist et al. (2015); Heider et al. (2019)) on both nominal and real economic variables. Since the Global Financial Crisis, Central Banks around the world have been busy employing a range of tools to circumvent the zero-lower-bound constraint, to revive economic activity, and to bring inflation closer to target. A number of studies (see, e.g., Gertler & Karadi (2015), Jarocinski & Karadi (2019), and Swanson (2021)) have studied the effectiveness of this approach in maintaining inflation at target.

Motivated by these questions, evidence has been mounting on the heterogeneous transmission of monetary policy to the corporate sector. In their search for meaningful sources of such heterogeneity, researchers have sliced the population of firms in various ways, including by age (Durante et al. (2022); Cloyne et al. (2023); Krusell et al. (2025)), dependence on bank credit (Crouzet (2021); Holm-Hadulla & Tuerwachter (2021)), leverage (Ottonello & Winberry (2020); Auer et al. (2021)), propensity to pay dividends (Cloyne et al. (2023)), debt maturity (Jungherr et al. (2022)), asset tangibility (Durante et al. (2022)), and size (Liu et al. (2022)). The evidence presented in these papers unequivocally suggests that various characteristics of non-financial corporations affect the elasticity of their response – typically in terms of investment – to monetary policy shocks. To the best of our knowledge, there has been comparatively little analysis of the effect of monetary policy on product market outcomes and of whether it varies heterogeneously across firms. By studying the effect of monetary policy shocks on sales growth and profit margins in a comprehensive micro sample spanning the entirety of the firm size distribution, we attempt to make a salient contribution in this direction. Our analysis highlights the importance of incorporating data on private firms when analysing the impact of monetary policy on aggregate features of the economy.

The evidence we present – that after monetary tightening, growth rates for smaller and larger firms diverge over the course of at least 4 years – contributes to the recent literature on the persistent effect of monetary policy that has sprung out of revived interest in the notion of monetary non-neutrality. For example, Jorda et al. (2025) show that the GDP response to monetary shocks does not revert to zero even after 10 years, confirming earlier evidence by Bernanke & Mihov (1998). Much of this persistence appears to be due to the fact that monetary policy shocks affect corporate innovation via changes in aggregate demand and the cost of external finance (e.g., Moran & Querato (2018)). Ma & Zimmermann (2023) and Grimm et al. (2021) show for the US and the euro area, respectively, that monetary policy – both conventional and unconventional – affects materially R&D investment and patenting activity, and it does so over a horizon of up to 4 years. Asriyan et al. (2025) show that monetary policy shocks can affect the distribution of TFP across firms in a persistent way.

Our paper also informs the current debate on the evolution of industrial competition. For the United States, recently a number of studies have concluded that market power is on the rise. For example, Covarrubias et al. (2020) analyze mark-ups and market shares as proxies for market power, and document a recent increase in inefficient concentration in the US since 2000, as leaders have become more entrenched.[1] At the same time, despite the ongoing lively debate in academic and policy circles on the evolution of industrial competition in the US, far less is known about the degree and evolution of market power and competition intensity in Europe. Nevertheless, recent evidence tentatively points to a broad-based decline (or at least a lack of increase) in concentration in Europe. For example, Gutiérrez & Philippon (2023) document a persistent decline in broad measures of market concentration in a sample of European countries between 1997 and 2007. Cavalleri et al. (2019) find

[1] The implications for productivity are unclear. Some authors (e.g., De Loecker et al. (2020)) have concluded that such trends have an explanatory role in outcomes such as the decline productivity, the rise in inequality and fall in the labor share of income. Others have argued that market concentration and rising markups are a natural side effect of the rise of global technology giants (and their increased global reach) and that such developments are beneficial for growth, as they could spur investment and innovation. For example, Hartman-Glaser et al. (2019) document that the firm-level capital share has decreased on average, even though the aggregate capital share for U.S. firms has increased. They explain the divergence with the fact that large firms now produce a larger output share even if the labor compensation has not increased proportionately. Autor et al. (2020) show the growing importance of large firms that dominate the market. They show that this leads to higher concentration and decreases the labor share, as also shown by Kehrig & Vincent (2021).

that, in contrast to the trend in the US, most market power metrics have been relatively stable over recent years and mark-ups in particular have been marginally trending down since the late 1990s, driven largely by increased competition in the manufacturing sector. By showing that relatively larger firms gain market share on relatively smaller ones following a monetary tightening shock, our evidence contributes to this debate. At the same time, because we do not account for firm entry and exit, our analysis does not allow for micro behaviors to be aggregated at the macro level, and thus only partially informs the debate on the link between monetary policy and competition.

2 Data

Our empirical strategy aims at identifying firm-size-driven differences in the response of growth to changes in the monetary policy stance, as well as at identifying potential microeconomic channels whereby this response takes place. The analysis therefore relies on two main sources of data. The first one is firm-level data from Orbis on sales, investment, employment, and debt. The second is a recent dataset on well-identified exogenous changes in the ECB's monetary policy stance by Altavilla et al. (2019). We now discuss these in turn.

2.1 Firm-level data

2.1.1 Construction of the dataset

The firm-level data come from the Orbis data set provided by Bureau van Dijk (BvD). Orbis contains financial and ownership data for more than 170 million firms from more than 100 countries. Financial data include balance sheet information and income statements, while ownership data contain information about the shareholders of the company. The database has been compiled since the 1990s by BvD and is currently updated quarterly. Every vintage contains a history of up to ten years of financial information for an individual firm. BvD offers to link the latest vintage with historical vintages going back to the 1990s. The analysis in this paper is based on the vintage as of the fourth quarter of 2023 linked with all historical files available from BvD.

A common feature of Orbis is that financial information for a given firm and year is updated from one vintage to the next. When constructing the historical files, special care is taken to put the latest available information for any given year and company. The resulting data set contains many more firm-year observations than are available in the latest vintage alone. This is because the companies frequently drop out from the sample over time. For instance, there are about 30% more companies in the historical files compared to the latest vintage. The reason is that BvD deletes companies that do not report for a certain period from each vintage. Such companies are nevertheless included in the linked historical files, thereby reducing the survivorship bias that is present in a single vintage.

For our analysis, we focus on companies in euro area and selected non-euro countries with financial data in the period 1999–2022, and we work with unconsolidated accounts. We follow the downloading methodology and cleaning procedure described in Kalemli-Özcan et al. (2024) in order to ensure the database is nationally representative and contains minimal missing information. In terms of firm-specific data, we make use of the following variables: sales, fixed assets, employment, profit margin, operating revenues, long-term debt, and short-term debt. We deflate all underlying financial data using a country-specific deflator.

Our consistency checks make sure that balance-sheet identities hold within a small margin and entries are meaningful from an accounting point of view. Following Kalemli-Özcan et al. (2022) and Kalemli-Özcan et al. (2024), we drop firm-year observations in which age, sales, tangible fixed assets, long-term debt, or short-term debt have negative values. Furthermore, we drop firm-year observations for which some basic accounting identities are violated by more than 10 percent. These identities ensure that (i) total assets match total liabilities, and (ii) total assets match the sum of fixed assets and current assets. Because we want to identify within-firm variation in growth, we drop firms that are observed only once. In terms of sectors, we exclude the following NACE industries: 'Agriculture, forestry, fishing' (A), 'Financial and insurance activities' (K), 'Real estate activities' (L), 'Public administration and defence' and 'Compulsory social security' (O), 'Education' (P), 'Activities of households as employees' (T), and 'Activities of extraterritorial organizations and bodies' (U). In terms of countries, we keep those that have been members of the euro area from its inception, as long as the firm coverage relative to the number of firms according to Eurostat is sufficiently good. We also require that we observe for each firm-time both sales and assets.

After applying all these procedures, we are left with 5,577,672 unique firms in 11 euro area countries over the sample period 1999–2024, for a maximum of 38,215,240 firm-year observations on sales growth, 36,164,606 firm-year observations on changes in profit margins, 38,213,911 firm-year observations on assets growth, 23,020,078 firm-year observations on employment growth, 13,137,922 firm-year observations on changes in short-term debt, and 16,550,793 firm-year observations on changes in long-term debt. We know firm employment for 26,443,156 firm-year observations, firm age for 38,000,594 firm-year observations, and firm leverage for 33,225,693 firm-year observations.

The 11 countries in question are Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. Combined, they account for more than 96% of total euro area GDP. All countries have been members of the monetary union since 1999 except for Greece, which joined the euro area in 2001.

Although firms report only once in a given calendar year, there is variation in the month of reporting across firms. To keep the largest possible variation along the time series dimension, we take into account the month and year of each observation. We exclude observations where firms vary the month of reporting over time so that the time between reports for any given firm is always twelve months. All nominal variables are deflated with the monthly Harmonized Index of Consumer Prices (HICP) from the country where the firm filed its report. To avoid distortions due to outliers, we winsorize all variables, including growth rates and other transformations, at -1 and 1.

2.1.2 Sample description

Table 1 reports summary statistics on the main firm-level variables used in the analysis. The main dependent variable is the year-on-year log difference in firm sales. As well as all other firm-level variables, we calculate it only for adjacent years (i.e., when observations for the years in between are missing, we do not calculate a growth variable). On average, firms' sales grew by 1.7 percent per year during our sample period. This is accompanied by a 2.6 percent decline in profit margins. The average firms also experienced on average a 3.3-percent increase in investment and a 1.5-percent increase in employment per year. Firm indebtedness declined on average, both in terms of short-term

(0.8 percent) and long-term (9.3 percent) debt.

The main explanatory variable in our analysis is firm size as proxied by number of employees. We split the firms in the sample into 7 size classes (1-9, 10-24, 25-49, 50-99, 100-249, 250-999, and 1000+ employees). These aggregate up to the standard SME classification of micro (1-9 employees), small (10-49 employees), medium-sized (50-249 employees), and large (250+ employees). More than two-thirds (69.1 percent) of the firms in the dataset are micro firms. A further 24.2 percent of the firms are small, and 5.3 percent are medium-sized. Only 1.5 percent of the firms in the dataset are large.

The sample is also skewed away from old firms, albeit less so. 44 percent of the firms are less than 10 years old, and 39.2 percent of the firms are between 10 and 25 years old. A further 14.8 percent are between 25 and 50 years old. 2 percent are older than 50 years.

In terms of leverage, 42.4 percent of firms have low leverage (debt-to-assets ratio of less than 0.05), and slightly less than a third (27.1 and 30.5 percent) have medium leverage (debt-to-assets ratio of between 0.05 and 0.25) and high leverage (debt-to-assets ratio of more than 0.25), respectively.

Three important features of the final Orbis dataset deserve highlighting. First, the number of observations is significant. In fact, without the strict cleaning procedure recommended by Kalemli-Özcan et al. (2024), combined with our added requirement that both sales and assets are observed, the number of observations in the starting dataset is about 15% larger than the number of observations in our final dataset (see Appendix Table 1). Second, the data are representative of the population of firms, spanning the full firm-size distribution, as opposed to survey datasets such as the ECB's SAFE, which focuses on SMEs, or Compustat, which is skewed towards large firms. The dataset is similarly representative in terms of firm age. Third, as the dataset runs until the end of 2022, we capture a number of distinct monetary policy periods, including the Global Financial Crisis, the post-crisis low-interest period, and the COVID pandemic and post-COVID tightening.

2.2 Monetary policy shocks

We employ the monetary policy shocks identified by Altavilla et al. (2019) who report the response of future short-term rates to the ECB's Governing Council decision announcements. Specifically, Altavilla et al. (2019) provide a rich online database[2] on minute-by-minute observations of EA overnight indexed swap (OIS) contracts along the yield curve from which they compute changes in the forward rate when decisions are publicly communicated. The identifying assumption is that a change in the interest rate over a narrow window around a policy meeting is driven exclusively by the decisions of the central bank, and does not reflect other changes in aggregate conditions. By focusing on price movements in a narrow window around monetary policy communication events (for a similar approach, see Nakamura & Steinsson (2018)), these shocks therefore mute the potential endogeneity of monetary policy. The dataset is continuously updated and at present contains information until mid-2025.

Similar to Krusell et al. (2025), we focus on the surprise effect of the current policy rate observed around the initial press release and consider the forward rate associated with a horizon of three months.[3] In robustness tests, we also look at the effect of unexpected changes in the OIS over a longer window. We then sum up the shocks to an annual frequency (i.e., a 12-month period).

One helpful feature of the Orbis dataset is that while firms report only once a year, they do so in different months (e.g., some in March, others in June, yet others in September or December, and yet others in the months in between). This allows us to match firm-level observations in a given month to the sum of all monetary policy shocks in the previous twelve months. In this fashion, we have variation in monetary policy shocks within the same year. Finally, we map the cumulative monetary policy shocks over a twelve months into changes in various firm-specific outcomes over the subsequent period.

Figure 1 shows the time series of the twelve-month moving sum. The visual evidence makes it readily apparent that between 1999 and 2025, monetary policy decisions by the ECB were surprising to markets in both directions. For example, the monetary stance eased appreciably after the 2001

[2]The Euro Area monetary policy Event-Study Database (EA-MPD).

[3]We consider change in the forward rate between the window 13:25-13:35 before and the window 14:00-14:10 after the press conference (Altavilla et al., 2019).

attack on the World Trade Center, during the Global Financial Crisis, and during the euro-area sovereign debt crisis. In contrast, monetary policy was tighter than expected in 2001, before the Global Financial Crisis, between the Global Financial Crisis and the euro-area sovereign debt crisis, in 2016 and 2017, during the first phase of the COVID pandemic, and during the high-inflation episode following the Russian invasion of Ukraine.

In contrast to Jarocinski & Karadi (2019), the shocks we employ do not rely on economic theory to distinguish between an information and a surprise effect but *directly* infer from central bank news to asset movements.

2.2.1 Summary statistics of the macro variables

We summarize the macro variables in Table 1. Changes in monetary policy during the sample period are on average close to zero (i.e., consistent with expectations). The average value points to a slight loosening of -0.134 basis points over a 12-month periods. At the same time, there is large variation over time, with a maximum tightening of 33.8 basis points and a maximum loosening of 22.9 basis points. Average GDP growth during the sample period is 0.26 percent. Inflation has been on average 1.6 percent. Finally, the average region in the dataset exhibits a bank branch concentration of 6.5 branches per 100,000 population, but a wide range between 0.003 and 30.048.[4]

3 Empirical strategy

We use panel local projections to investigate the role of firm size for firms' growth response to monetary policy shocks. We do so in two different ways. First, we estimate the following equation:

$$\Delta^h log\, Sales_{f,t+h} \quad = \beta_1^h \Delta MP_{t-1} + \beta_2^h \Delta GDP_{c,t-1} + \beta_3^h \Delta CPI_{c,t-1} + \gamma_f + \phi_t^h + \varepsilon_{f,t+h}, \tag{1}$$

for $h = 0, 1, 2, 3$ years. On the left-hand side of Equation (1), $\Delta^h log\, Sales_{f,t+h}$ denotes the percentage change (or log difference) in firm-level sales between time $t-1$ and time $t+h$.

[4]These data are calculated as the number of physical bank branches in a NUTS-3 regions, from SNL Financials, divided by the region's population.

The variable ΔMP_{t-1} measures the change in the ECB's monetary policy stance. To compute this change, we start from the monthly exogenous monetary policy shocks as per Altavilla et al. (2019), and aggregate them over 12-month periods, which gives us ΔMP_{t-1}. Positive values of ΔMP_{t-1} indicate an overall tightening over the past 12 months.

Similarly, ΔGDP_{t-1} denotes the 1-year lagged country-specific GDP growth, and $\Delta CPI_{c,t-1}$ denotes the 1-year lagged country-specific inflation, for firms domiciled in country c.

We include firm fixed effects γ_f which ensure that we are identifying within-firm variation in sales growth in response to exogenous changes in monetary policy. This is enormously important because due to time-invariant differences across firms, variation in growth rates can be observed even in the absence of any variation over time. We also include year dummies ϕ_t^h which controls for the global growth cycle.

Finally, $\varepsilon_{f,t+h}$ is the residual. The standard errors are clustered by firm. This takes into account potential serial correlation within a firm over time.

The coefficient of interest is β_1^h. It captures the extent to which a firm's sales growth responds to changes in the monetary policy stance, at time h.

Second, we estimate the following differences-in-differences version of Equation (1):

$$\begin{aligned}\Delta_h log\, Sales_{f,t+h} \quad &= \textstyle\sum_{k=m,s,l} \beta_{1k}^h 1[j \in k] \Delta MP_{t-1} \\ &+ \textstyle\sum_{k=m,s,l} \beta_{2k}^h 1[j \in k] \Delta GDP_{c,t-1} \\ &+ \textstyle\sum_{k=m,s,l} \beta_{3k}^h 1[j \in k] \Delta CPI_{c,t-1} \\ &+ \beta_4 \Delta MP_{t-1} + \beta_5 \Delta GDP_{c,t-1} + \beta_6 \Delta CPI_{c,t-1} \\ &+ \textstyle\sum_{k=m,s,l} \beta_{7k}^h 1[j \in k] + \gamma_f^h + \phi_t^h + \varepsilon_{f,t+h}^h,\end{aligned} \tag{2}$$

for $h = 0, 1, 2, 3$ years. As in Equation (1), on the left-hand side of Equation (2), $\Delta^{h+1} log\, Sales_{ft+h}$ denotes the change in firm-level sales between time $t-1$ and time $t+h$. On the right-hand side, $1[j \in k]$ is an indicator variable equal to one if the firm has 1-9, 10-24, 25-49, 50-99, 250-999, or 1000+ employees. The omitted category is firms with 100-249 employees.

One advantage of the Orbis dataset is that firms report their financials in different months of each year. While the vast majority of firms (85.9%) report in December, 3.1%, 3%, and 4% report in April, June, and September, respectively. A further 4% report during the remaining eight months of the year. At the same time, a reporting month is fixed over the years for each firms. This allows us to map different firms' sales growth into different 12-month cumulations of monetary policy shocks, even if these firms issue financial report during adjacent months. This creates a year-month variation in the time series which allows us capture high-frequency effects within the business cycle.[5]

As in Equation (1), we also include time-varying (country-specific) variables: lagged monetary shocks, lagged GDP growth, and lagged inflation. Furthermore, we include firm fixed effects γ_f which ensure that we are identifying within-firm variation in sales growth in response to exogenous changes in monetary policy. We also include time fixed effects ϕ_t that in different specifications control for: global shocks that affect all firms equally at the same point in time; country-time fixed effects, i.e. shocks that affect all firms in the same country equally at the same point in time; and sector-time fixed effects, i.e. shocks that affect all firms in the same sector equally at the same point in time. This allows us to hold constant a number of unobservable background forces at the level of both industry and geography, such as demand and technology.

We cluster the standard errors by firm in the main specification, and by country-sector, country-time, and firm and time, in robustness tests.

The coefficients of interest are β_{1k}^h. They capture the extent to which sales growth responds to changes in the monetary policy stance, for firms with 1-9, 10-24, 25-49, 50-99, 250-999, or 1000+ employees, relative to the omitted category (firms with 100-249 employees), at time h.

[5] We make sure that the main results of the paper still obtain when we only use the sub-sample of firms that report in December.

4 Empirical evidence

4.1 Headline result: Local projections

4.1.1 Homogeneous transmission

The first (top-left) panel of Figure 2 presents the response of firms' sales to a contractionary monetary policy shock, as per Equation (1). The figure plots estimated β_1^h coefficients for horizons $h = 0, \ldots, 3$. Firms' sales fall, and the cumulative effect reaches a trough of -0.5% after two years (corresponding to a 1.9% decline in sales for a 1-standard-deviation contractionary shock). The effect is statistically significant at the 1-percent level at each point in time.

4.1.2 Heterogeneous transmission

The remaining seven panels of Figure 2 present the response of firms' sales to a contractionary monetary policy shock for firms in different size classes. The figure plots estimated β_{1k}^h coefficients. In practice, we estimate Equation (1) separately for firms with 1–9, 10–24, 25–49, 50–99, 100–249, 250–999, and 1000+ employees. A monotonic decline in the elasticity of sales growth to monetary contraction is readily apparent. For micro and small firms (i.e., those with 1–9, 10–24, and 25–49 employees), the decline in sales is significant at each point in time and the cumulative effect reaches a trough of around -0.9% after one year (corresponding to a 3.3% decline in sales for a 1-standard-deviation contractionary shock). In contrast, firms with 250–999 employees only experience a statistically significant decline after one year. Even more strikingly, firms with 1000+ employees do not experience a statistically significant decline in sales during the first two years and even record a significant increase in sales of around 0.8% (corresponding to a 2.9% increase in sales for a 1-standard-deviation contractionary shock) in the third year after the shock. When comparing micro and small to large firms, we find that over a three-year period, a 1-standard-deviation contractionary shock reduces the sales of firms with fewer than 50 employees by around 3.8 percent more than those with 250+ employees.

These results are consistent with early evidence from the US on the heterogeneous response of small and large manufacturing firms in terms of sales and inventories (Gertler & Gilchrist (1994)).

Figure 3 and Figure 4 replicate Equation (1) for assets and employment, respectively. A similar pattern emerges whereby investment and employment decline in response to a contractionary monetary policy shock. Importantly, in both cases the decline over time is larger for relatively smaller firms.

4.1.3 Aggregate effect

What are the aggregate implications of this heterogeneous response of firm growth to a contractionary monetary policy shock, in terms of market shares, over a three-year horizon? We note that according to the summary statistics reported in Table 1, 93.3% of the firms in our sample are micro and small (i.e., have less than 50 employees) while around 1.5% have more than 250 employees. At the same time, firms with less than 50 employees account for 16.11% of total sales while firms with more than 250 employees account for 70.14% of total sales.

Using the cumulative growth rates in Figure 1, and for a one-standard-deviation contractionary monetary policy shocks, we find that the share in total sales of micro and small firms declines to 15.80% while the share in total sales of firms with more than 250 employees increases to 70.77%. In other words, three years after a one-standard-deviation contractionary monetary policy shocks, the largest firms gain a market share of almost one percentage point (0.94) on micro and small firms.

4.2 Headline result: Differences-in-differences

In Table 2, we present the estimates from Equation (1) for $h = 0$, first with firms fixed effects and then with firm and time fixed effects.[6] In column (1), where we do not include ϕ_t, we find that relative to the omitted category (firms with 100-244 employees), micro firms (1-9 employees) decline the most, followed by firms with 10-24 employees, firms with 25-49 employees, and firms with 50-99 employees. In contrast, firms with 1000+ employees experience a relative increase in sales. The same is true of firms with 250-999 employees, but the effect is 1/5 of that for large firms, and the effect is not significant in the statistical sense.

We document very similar results in the preferred specification with firm fixed effects and time

[6] For ease of presentation, in all remaining tables we report results for $h = 0$, while the figures present results for the full horizon.

fixed effects (column (2)). The numerical effect describing the heterogeneous effect of monetary policy on growth by firm size is substantial. The point estimate on the interaction of monetary policy shocks with the size 1-9 (size 1000+) dummy is -0.00197 (0.00245). This implies that a contractionary monetary policy shock that corresponds to one sample standard deviation increases sales growth of firms with 1000+ employees by 1.6 percent more than the sales growth of firms with less than 10 employees.

On their own, the macroeconomic variables have the expected effect. A monetary contraction reduces sales growth significantly on average, as does lagged inflation. In contrast, lagged GDP growth is positively correlated with future firm-level sales growth.[7]

Figure 5 plots point estimates and confidence intervals from local projections based on Equation (2). The various panels of Figure 5 record results for firms with between 1 and 9 employees, between 10 and 24 employees, between 25 and 49 employees, between 50 and 99 employees, between 250 and 999 employees, and more than 1000 employees, relative to firms with between 100 and 249 employees. The figure makes it apparent that the diff-in-diff results in Table 2 for $h = 0$ carry forward in time: the sales growth of firms with less than 100 employees decline significantly more compared with larger firms, and the effect is monotonic in size. Conversely, sales growth by firms with 250+ employees declines relatively less, and this effect is significant at $h = 3$.

5 Robustness

5.1 Placebo test

In this section, we address a number of concerns about our identification strategy. The first potential criticism of our approach is that changes in the ECB's monetary policy can be correlated with unobservable changes in the global environment that affect firm growth heterogeneously along the firm-size distribution. For example, demand for goods produced or services delivered by sectors more sensitive to changes in external funding costs may shift in a way impeding small firms precisely during

[7] The sizeable reduction in the number of observations relative to Table 1 is driven by the fact that we only consider tightening shocks and by the inclusion of the fixed effects.

monetary tightening. This would result in a size-dependent evolution of firm growth, which we could erroneously be interpreting as a size-heterogeneous transmission of monetary policy.

To address this concern, we re-run Equation (1) on a sample of 3,325,726 firms in 7 non-euro-area European countries (Bulgaria, Croatia, Czechia, Hungary, Norway, Poland, and Romania). Ex-ante, these countries should not be as affected by changes in the ECB's stance as euro area member states.[8] Therefore, if we observe that firm growth in these countries along the firm size distribution moves in sync with firms in euro-area countries after the ECB tightens monetary policy, we will conclude that what we have identified as a size-heterogeneous transmission of monetary policy is likely unrelated to monetary policy shocks.

Figure 6 juxtaposes the effect of monetary policy tightening by the ECB on euro-area firms (Panel A) and non-euro-area firms (Panel B). We estimate Equation (1) separately for firms with 1–9, 10–24, 25–49, 50–99, 100–249, 250–999, and 1000+ employees. Without loss of generality, we report the estimates for $h = 3$. The Figure makes it clear that in the euro area, a monetary tightening is associated with a significant divergence in growth rates along the firm-size distribution, with sales by small firms declining even after three years, while sales of large firms are significantly higher after the same period. In contrast, there is no significant effect of euro area monetary policy shocks on firm growth for firms in any firm size bin in non-euro-area countries.

We therefore conclude that the headline result presented in Figure 2 and in Table 2 is consistent with a direct and size-heterogeneous effect of monetary policy shocks in the euro area on output growth.

5.2 Size, age, or leverage?

In order to make sure that our results are not driven by a particular empirical choice, we perform a number of robustness checks. We first check whether size is not a proxy for another fundamental firm characteristic that generates heterogeneous reactions to monetary policy shocks. We focus on two factors that have been highlighted in the recent literature on the heterogeneity of monetary

[8] We also replicate this test on a sub-sample excluding Bulgaria and Croatia whose currencies were pegged to the euro for much of the sample period.

transmission: age and leverage.

In Table 3, we account for the interaction of monetary policy shocks with age and leverage. Age appears to be the single most fundamental firm property when it comes to job creation (Haltiwanger et al. (2013)) and to the investment response to monetary policy shocks (Cloyne et al. (2023); Krusell et al. (2025)). We create four dummies for firm age (less than 10 years, between 10 and 25 years, between 25 and 50 years, and 50+ years) and interact them with the variable ΔMP_{t-1}. When we add three of these interactions to Equation (2) (age 25-49 being the reference category), we find that the main result of the paper is little affected (column (1)). The effect of a contractionary monetary policy shock on sales growth by micro firms is similar to that in column (2) of Table 2, and size continues to play an economically and statistically significant role in the transmission of monetary policy.

In column (2), we account similarly for firm leverage, which recent work has singled out as a significant source of heterogeneity in firms' investment response to monetary policy shocks (Ottonello & Winberry (2020)). We create three dummies for low, medium, and high leverage where low leverage is defined as a debt-to-assets ratio of less than 0.05, medium leverage as a debt-to-assets ratio of between 0.05 and 0.25, and high leverage as debt-to-assets ratio of more than 0.25. We then interact two of these three dummies with ΔMP_{t-1} (medium leverage being the reference category) and add them to Equation (2). The point estimates capturing the heterogeneity in the elasticity of sales growth to monetary policy shocks are little changed compared to those in column (2) of Table 2.

Finally, the main result of the paper continues to obtain in column (3) where we add both sets of interactions to the right-hand side of Equation (2).

5.3 Alternative monetary policy shocks

Recall that similar to Krusell et al. (2025), we focus on the surprise effect of the current policy rate observed around the initial press release with respect to the forward rate associated with a horizon of three months. At the same time, this monetary policy shocks could be less relevant for firm outcomes beyond the short-run. To address this concern by calculating in a similar fashion the time series of exogenous surprises from the reaction to the press announcement of the 6-month OIS and of the 1-year OIS.

The estimates from this variant of Equation (2) for $h = 0$ are reported in Table 4. In both cases, firms with fewer than 100 employees experience a significant decline in sales, compared to firms with between 100 and 249 employees, after monetary tightening. In contrast, the effect is positive and in some cases statistically significant for firms more than 250 employees. We therefore conclude that the results reported in Table 2 are not an artefact of using a particular portion of the yield curve to measure the effectiveness of monetary policy.

5.4 Model and sample robustness

In the Appendix, we also report estimates from regressions where we make alternative empirical modelling choices. In Appendix Table 2, we replace the time-varying macroeconomic variables with sector-year (column (1)), country-year-month (column (2)), and sector-year and country-year-month (column (3)) dummy interactions. These should hold constant any time-varying background forces that are common to all firms in a sector and/or a country at the same point in time. In Appendix Table 3, we cluster the standard errors by country-sector (column (1)) and by country-time (column (2)), and we double cluster them by firm and time (column (3)). In Appendix Table 4, we exclude one by one the three largest countries, in terms of number of firms in the dataset, namely Spain (column (1)), France (column (2)), and Italy (column (3)). In all of these, the main results of the paper broadly continue to obtain, and we still find that relative to medium-sized firms, sales growth declines in response to a monetary contraction for the smallest, and increases for the largest, firms.

6 Profit margins

An alternative approach to measuring product market outcomes involves looking at the evolution of profit margins. There is a large literature that has used price-cost margins to address questions related to relative performance by firm size, as well as to competition and productivity (e.g., (De Loecker et al., 2020)). In Table 5, we run a version of Equation (2) where the dependent variable is the change in the firm's profit margin. We calculate this as the ratio of EBITDA to operating revenue, where EBITDA stands for earnings before interest, taxes, depreciation and amortization. The resulting ratio is a commonly used proxy for the profit (or price-cost) margin (e.g., (De Loecker & Warzynski, 2012)). Once again, we estimate Equation (2) for $h = 0$.

The point estimates suggest that following monetary policy tightening, the profit margins of firms with less than 100 employees decline, relative to firms with between 100 and 249 employees. In the case of firms with between 10 and 25 employees, the effect is significant at the 5-percent statistical level. At the same time, the profit margins of large firms increases, but in the statistical sense they do not evolve differently in response to monetary policy shocks from those of medium-sized firms.

The evidence in Table 5 thus tentatively suggests that monetary tightening does not only reduce the sales share of micro and small firms, but also their profitability. Both pieces of evidence have salient implications for the capacity of firms in the left tail of the size distribution to compete with larger firms.

7 Heterogeneous effect on firm inputs in production

Based on a variant of Equation (1), Figures 3 and 4 suggested that the heterogeneous decline in sales growth across the firm-size distribution is accompanied by a similar decline in investment and employment. In Table 6, we complement this evidence by replicating Equation (2) for investment and employment, for $h = 0$. Here, the dependent variable is the year-on-year log difference in firm-specific total assets (column (1)) and the year-on-year log difference in firm-specific employment (column (2)). This brings our analysis closer to the bulk of the literature on the heterogeneity of monetary transmission that has tended to focus on heterogeneity in firms' investment responses.

The evidence in Table 6 broadly confirms that in Figures 3 and 4. Following a contraction monetary policy shock, on impact micro and small firms see a relative decline in investment, compared with medium-sized and large firms (column (1)). At the same time, large firms experience a significant increase in investment, mirroring their relative increase in sales. In the case of employment, the evidence is also similar to that on sales, with firms with less than 50 employees experiencing a relative decline, and firms with more than 250 employees experiencing a relative increase in employment.

The data thus provide strong support to the notion that the heterogeneous response in size to changes in monetary policy on impact that we document in Table 2 is driven by a mechanism whereby in response to monetary contraction, firms in the left tail of the size distribution reduce, while the largest firms increase, investment and employment (in relative terms).

8 Monetary policy, firm debt, and the structure of credit markets

8.1 Firm debt

What is the mechanism whereby small firms' sales growth declines faster than large firms' sales growth following a contractionary monetary policy shock? One obvious candidate are adjustments in firm borrowing in response to borrowing constraints becoming tighter for small firms. To address this possibility, we next study the role that debt and credit play in the heterogeneous effect of monetary policy on sales growth by firm size. Given that in a bank-based economy such as the euro area, monetary policy mostly transmits into real economic activity via the bank lending channel, it is natural to hypothesize that access to credit may have such a role to play.

To test for this possibility, we first look at the response of firm debt to monetary policy shocks, by size bin. Orbis contains data on short-term debt (i.e., debt with maturity of less than 1 year) and long-term debt (i.e., debt with maturity of more than 1 year). We calculate changes in the two types of debt in the same way in which we calculate changes in sales, investment, and employment, as the year-on-year log difference in the stock. Subsequently, we re-run Equation (2) for $h = 0$ using growth rates in short- and long-term debt as dependent variables. We note that accounting for short-term and long-term debt separately is important because theory has suggested that the maturity of debt, in addition to its level, is a critical determinant of firm investment (e.g., Myers (1977), Diamond & He (2014)).

The estimates from these tests are reported in Table 7. We document a significant heterogeneous response of both short-term debt (column (1)) and of long-term debt (column (2)) to a contractionary monetary policy shock: debt levels decline for micro firms, relative to firms with between 100 and 250 employees. In contrast, firms with more than 250 employees record a significant increase (or a smaller decline) in short-term debt (column (1)). Combined with the previous table, the evidence suggests that when monetary policy tightens, small firms reduce their assets and number of employees, an effect accompanied by a reduction in their proclivity to borrow.

8.2 Credit markets structure

What role does credit market competition play in the totality of our results? In theory, the effect of the structure of banking market on the transmission of monetary policy is ambiguous. On the one hand, Drechsler et al. (2017) argue that when the policy rate rises, banks with more market power raise deposit rates less, and so deposit spreads widen, deposits flow out, funding tightens, and as a result the credit supply declines by more. In their framework, less bank competition is associated with a stronger monetary transmission. In a similar vein, Goedl-Hanisch (2023) finds that banks operating in high-concentration markets adjust short-term lending rates more. In contrast, Bikker et al. (2013) and Segev & Schaffer (2020) show that bank retail rates respond more strongly and faster to changes in policy rates in more competitive markets, implying that higher bank competition strengthens the impact of monetary policy on bank loan supply.

While it is not easy in practice to disentangle the credit demand and the credit supply effects, we next attempt to provide some evidence as to the role of supply factors. To that end, we account for the extent of bank competition and credit access in different regions in our sample. We use data on the number of physical bank branches in NUTS-3 regions, from SNL Financials, divided by the region's population.[9] We split the sample in below-median and above-median number of physical branches per 100,000 regional population. This information is available for about a quarter of the NUTS-3 regions in our dataset.

The estimates from these regressions are reported in Table 8. We continue to obtain a strong heterogeneous response of firm sales to monetary contraction by firm size in regions with low bank branch density. In these regions, for both small and large firms, the relative decline (increase) in sales growth is numerically larger than in the full sample (column (2) of Table 2). In contrast, that

[9] The data were kindly provided to us by Glenn Schepens.

heterogeneous response disappears (at least in the statistical sense) in regions with high bank branch density, except for firms with fewer than 10 employees. Our results are thus consistent with the notion that the relative decline in sales growth by firms in the left tail of the size distribution is stronger in geographies with less competitive credit markets.

9 Interpretation

We now present a simple model with constraints on firm borrowing to formalize the microeconomic evidence presented so far. While deliberately stylized, the model allows us to think about the role that monetary policy-induced changes in access to external debt can have on non-financial corporations, and how this effect may vary with firm size. Because the purpose is to motivate a partial equilibrium effect, many of the standard components of a proper general equilibrium model are assumed away.

For a start, assume that a representative firm produces a final consumption good using capital, which it owns and accumulates, and labor, which it hires on a competitive labor market taking the wage rate w_t as given. Time is discrete, denoted by t, and continues infinitely. The consumption good is produced using a Constant Elasticity of Substitution production function:

$$y_t = [\alpha k_{t-1}^{\frac{\sigma-1}{\sigma}} + (1-\alpha) n_t^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}}, \tag{3}$$

and its price is normalized to 1. $\alpha \in (0, 1)$ is the share of capital in production. $\sigma \in [0, \infty)$ is the elasticity of substitution between capital and labor. The firm's earnings flow, or operational profit, is denoted as π_t and is defined as

$$\pi_t = y_t - w_t n_t. \tag{4}$$

Capital k_{t-1} is predetermined at the beginning of period t and its law of motion is

$$k_t = (1-\delta) k_{t-1} + i_t, \tag{5}$$

where δ is the depreciation rate and i_t is investment.

Finally, the firm's increase in labor and capital is constrained to be an exogenous share of their profit and of their stock of tangible assets:

$$r_t i_t + w_t n_t \leq \theta_\pi \pi_t + \theta_k p_{k,t+1}(1-\delta)k_t \tag{6}$$

where r_t is the rental cost of capital and $p_{k,t+1}$ is the expected value of the capital stock net of depreciation in the next period. The term on the right-hand side is a combination of an earnings-based constraint and a collateral constraint.

The parameters $\theta_\pi < 1$ and $\theta_k < 1$ capture the exogenous tightness of the constraints. As in much of the literature, the constraints reflect the fact that the ability of a firm to borrow is limited due to an underlying friction such as information or enforcement limitations. An earnings-based constraint can emerge for a number of different reasons – e.g., because the firm is unable to directly pledge its full earnings stream or because regulation requires that lenders engage in different risk treatment of loans that feature different earnings-to-debt ratios. In turn, a collateral constraint can be an optimal solution in a setting in which borrowers have the ability to divert funds or withdraw their human capital from an investment project (e.g., Hart & Moore (1994)).

In this fashion, the model provides useful intuition for why firm investment and employment growth – and from there, firm growth – can depend on firm size. The two constraints θ_π and θ_k are measures of market access. The underlying frictions that add to the cost of external finance apply mainly to firms with riskier projects, to firms that with a high degree of idiosyncratic risk, and to firms with too little collateral, and the extant empirical literature has shown that these are overwhelmingly small firms.[10] Therefore, it is natural to assume that θ_π and θ_k increase with firm size, as larger firms are less risky, less opaque, have access to higher-quality collateral, and are less affected by information asymmetries (e.g., Petersen & Rajan (1995)).

Monetary policy tightening can enter the picture in different ways. One possibility is that a rise in interest rates directly weakens balance sheets by reducing cash flows net of interest and by lowering the value of collateralizable assets. This tends to magnify the overall impact of monetary policy on borrowers' spending. In the stylized model we presented, this works through changes in the value of

[10] For early empirical evidence supporting this notion, see Fazzarri et al. (1988) and Berger & Udell (1998).

capital and of firm profits.

This discussion suggests that extending the model to a world where the constraints θ_π and θ_k depend heterogeneously on firm size would yield predictions in line with the principal evidence in our paper. Monetary policy induces fluctuations in firm profits, in the value of capital available to firms, or in a combination of these channels. As a result, smaller firms are affected more adversely when monetary policy tightens, especially if the transmission of monetary policy to the real economy via bank balance sheets is stronger. In practical terms, firms at the left tail of the size distribution borrow relatively less and decline by more than larger firms.

10 Conclusion

The academic consensus is that similar to the US economy for the first 100-150 years of its history, the economy of the euro area does not fit the criteria for an optimum currency area (Lane, 2021).[11] While the creation of the euro itself was widely expected to become a catalyst for further economic integration within Europe, the evidence suggests that especially after the global financial crisis, incomes, unemployment rates, and current account balances across the euro area have diverged rather than converged (e.g. Corrado et al. (2005), Ramajo et al. (2008), Mody (2018)). Yet, very little is known about how one-size-fit-all monetary policy propagates heterogeneous across the firm size distribution in a currency area where individual countries typically experience different economic conditions. This is an important question because the differential growth of small and large firms crucially affects a number of factors that are both related to welfare and underpin the question of economic convergence versus divergence, such as productivity and wages (e.g., Nickell (1996), Fabrizio et al. (2007), and Caggese (2019)).

In this paper, we combine a comprehensive firm-level dataset with high-frequency well-identified plausibly exogenous monetary policy shocks over the period 1999-2022 and estimate their effect on size-dependent firm growth using panel local projections. We do so for a sample of 6.6+ mln. listed

[11] This argument was made long before the euro was introduced in 1999 (e.g., DeGrauwe (1992), Eichengreen (1991), Feldstein (1997), Wiplosz (1997)), and it remains true despite deepening integration in product and labor markets and in fiscal policy (e.g., Blanchard et al. (2016), DeGrauwe (2018)).

and unlisted firms in 11 euro-area countries spanning the entire firm size distribution. Our main finding is that a contractionary monetary is associated with a relatively more pronounced decline in sales growth by firms in the left tail of the size distribution. Over three years, a 1-standard-deviation contractionary shock reduces the sales of firms with fewer than 50 employees by around 3.8 percentage points more than those with 250+ employees. This heterogenous decline in output is mirrored by an analogous heterogeneous decline in investment and employment. Profit margins also decline more for micro and small firms than they do for large firms. Our results thus suggest that beyond a sizeable firm-size heterogeneity in the transmission of monetary policy, the data point to important implications for size-dependent growth. Our results thus strongly support the notion that contractionary monetary policy can affect the industry structure in the medium-run by reducing (increasing) the relative market share of large (small) firms.

We further hypothesize that the bank lending channel – i.e., the transmission of monetary policy to the real economy chiefly through adjustments in the volume and composition of bank credit – plays a role in the evidence we document. In support of this conjecture, we document evidence of an underlying mechanism whereby in response to a contractionary monetary policy shocks, smaller firms reduce their borrowing. Furthermore, and consistent with Drechsler et al. (2017), we find that the main result of our analysis is stronger in regions with lower bank competition. Our evidence therefore points to an important interaction between the structure of the banking sector and the monetary policy stance in determining the relative product market performance of firms along the firm-size distribution.

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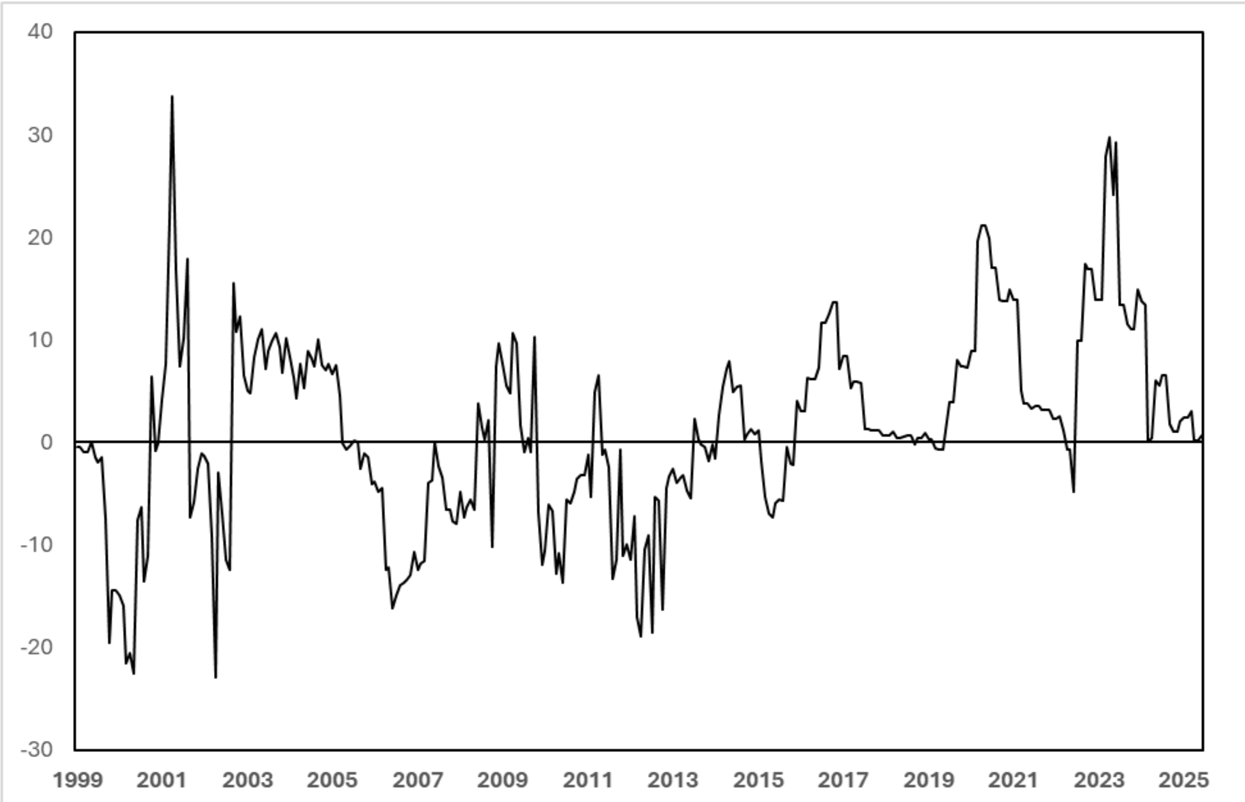
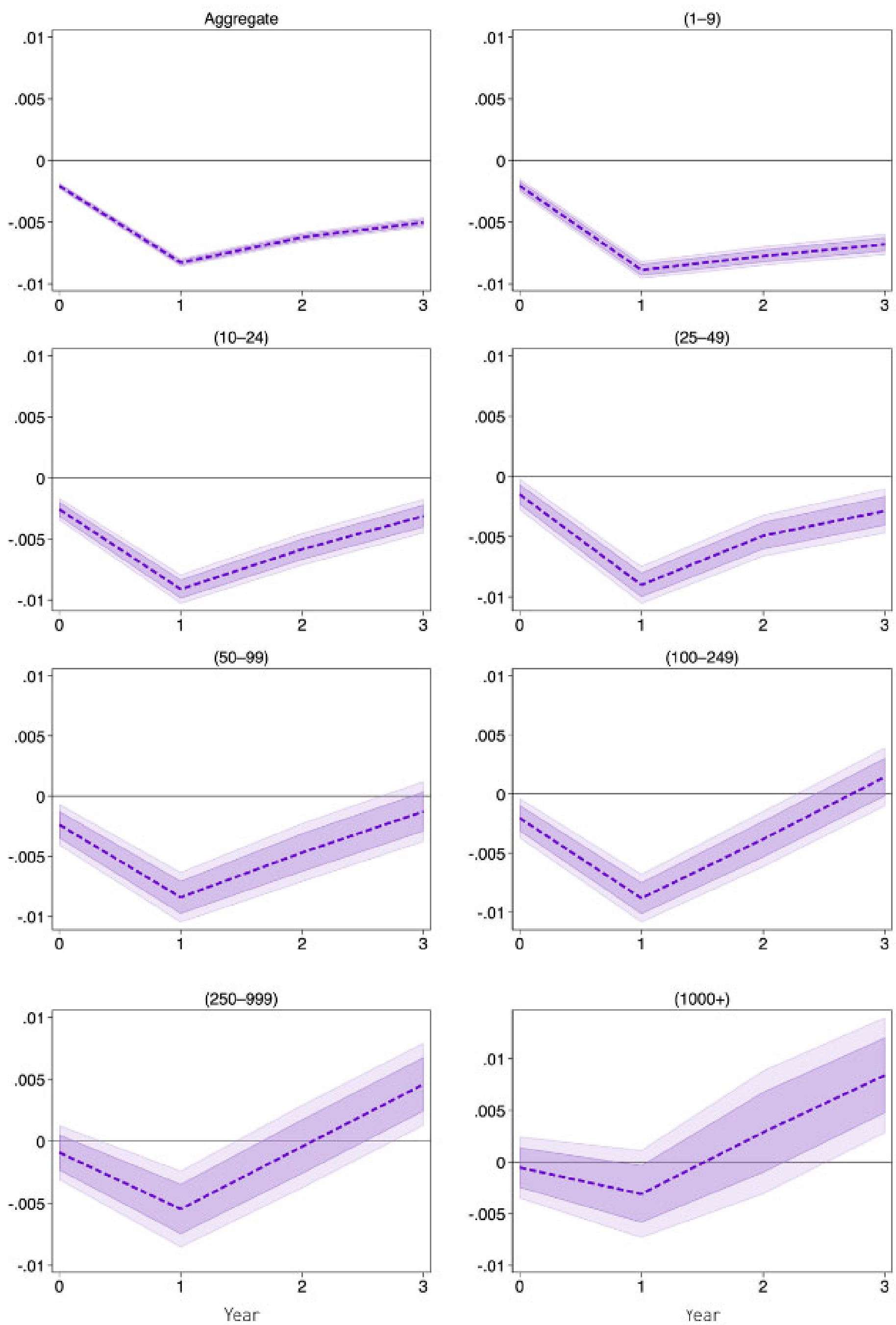
Figure 1. Monetary policy shocks over time



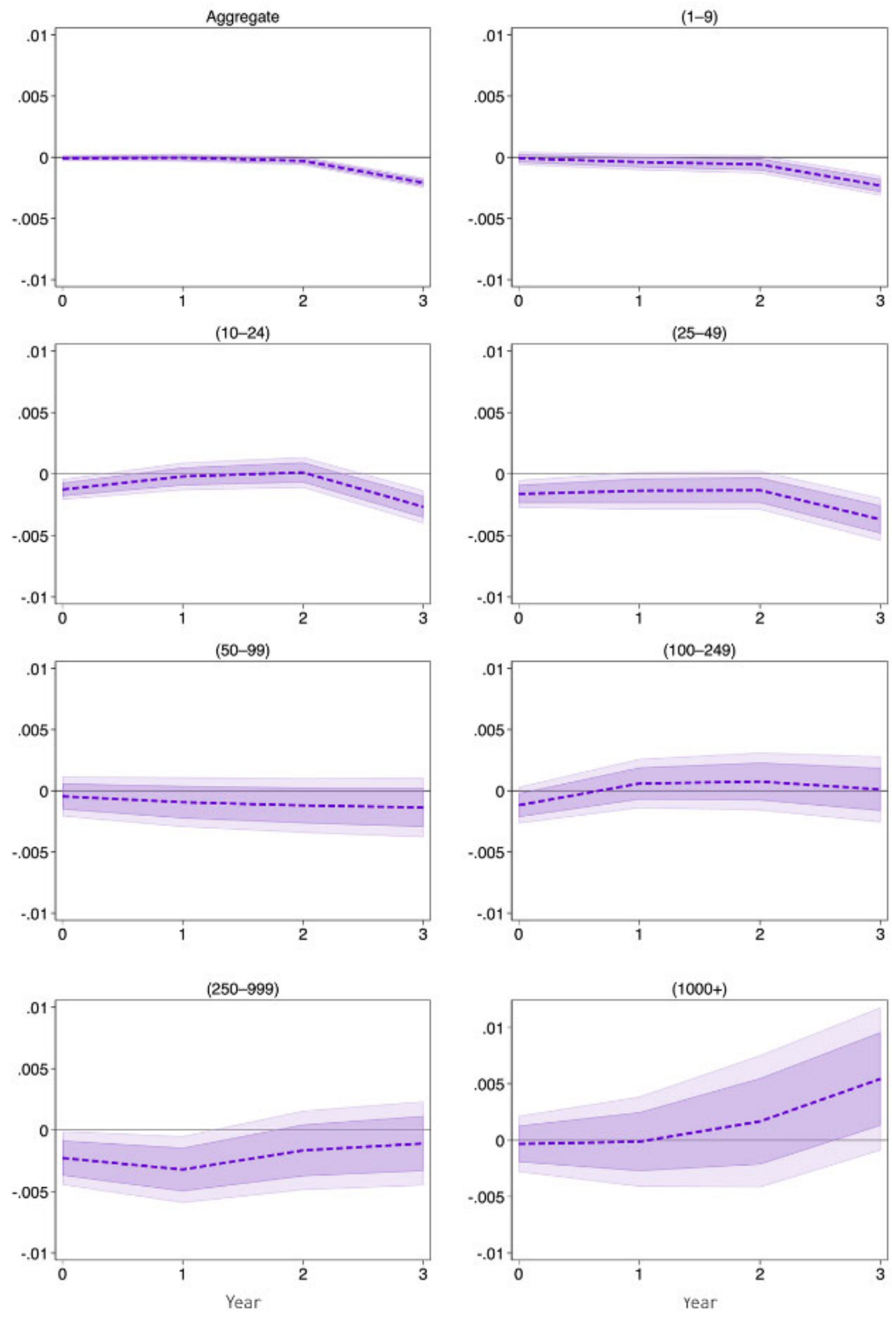
Note: The Figure plots the time series of the moving sum of the past 12 observations of the identified monetary policy shock to the 3-month OIS. Positive values correspond to tighter monetary policy shocks than the market expected.

Figure 2. Local projections: Sales growth response to monetary tightening



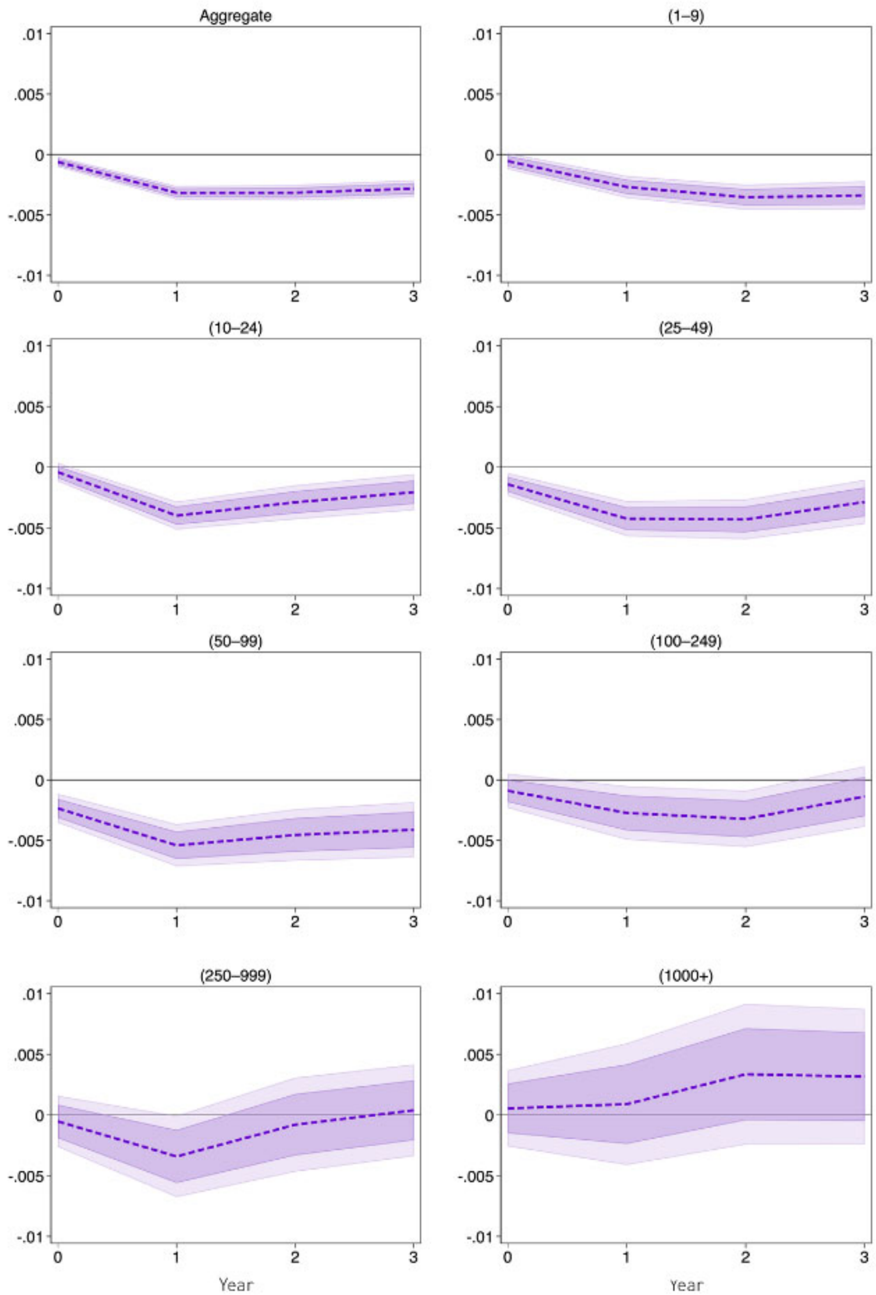
Note: The figure plots firm-specific sales growth response to a monetary policy tightening shock, at the aggregate level and by firm size bin. The figure shows the cumulative log-change in sales between period *t-1* and *t+h* with the monetary policy shock dated at *t*. Time is in years. In the panel 'Aggregate', we estimate Equation (1) on the sample of all firms. In the rest of the panels, we estimate Equation (1) on the subsamples of firms with between 1 and 9 employees, between 10 and 24 employees, between 25 and 49 employees, between 50 and 99 employees, between 100 and 249 employees, between 250 and 999 employees, and more than 1000 employees. Shaded (dark) areas represent 95 (68) percent confidence bands.

Figure 3. Local projections: Assets growth response to monetary tightening



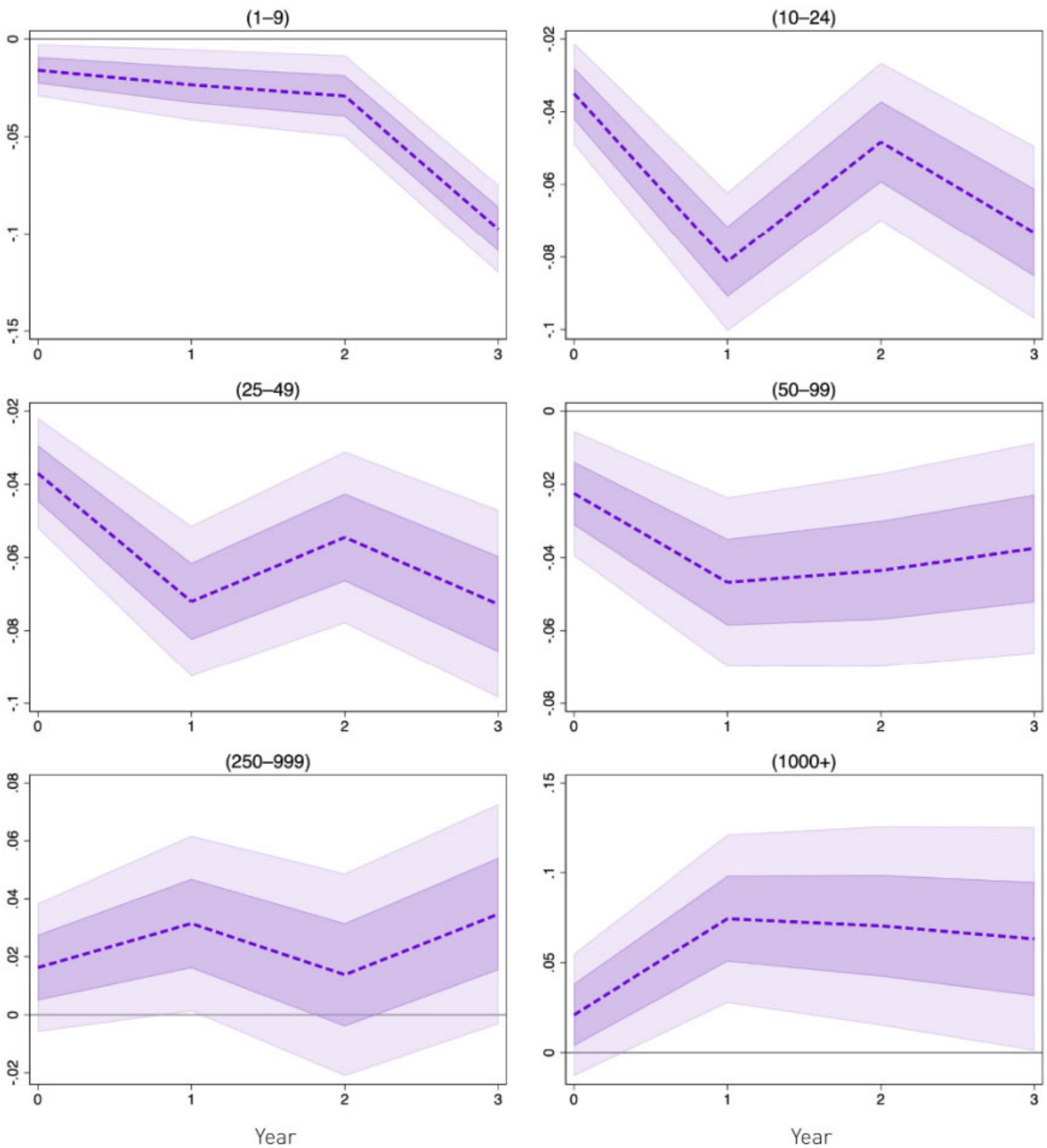
Note: The figure plots firm-specific investment growth response to a monetary policy tightening shock, at the aggregate level and by firm size bin. The figure shows the cumulative log-change in assets between period *t-1* and *t+h* with the monetary policy shock dated at *t*. Time is in years. In the panel 'Aggregate', we estimate Equation (1) on the sample of all firms. In the rest of the panels, we estimate Equation (1) on the subsamples of firms with between 1 and 9 employees, between 10 and 24 employees, between 25 and 49 employees, between 50 and 99 employees, between 100 and 249 employees, between 250 and 999 employees, and more than 1000 employees. Shaded (dark) areas represent 95 (68) percent confidence bands.

Figure 4. Local projections: Employment growth response to monetary tightening



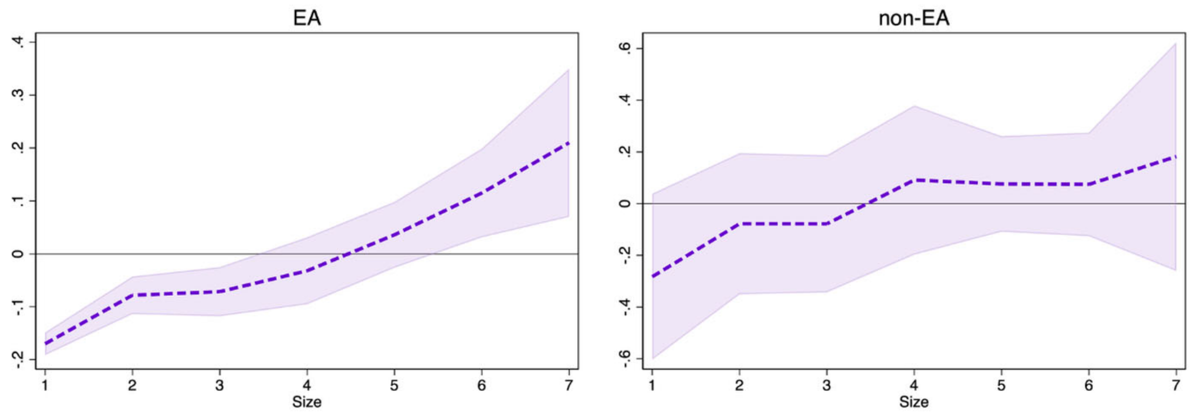
Note: The figure plots firm-specific employment growth response to a monetary policy tightening shock, at the aggregate level and by firm size bin. The figure shows the cumulative log-change in employment between period *t-1* and *t+h* with the monetary policy shock dated at *t*. Time is in years. In the panel 'Aggregate', we estimate Equation (1) on the sample of all firms. In the rest of the panels, we estimate Equation (1) on the subsamples of firms with between 1 and 9 employees, between 10 and 24 employees, between 25 and 49 employees, between 50 and 99 employees, between 100 and 249 employees, between 250 and 999 employees, and more than 1000 employees. Shaded (dark) areas represent 95 (68) percent confidence bands.

Figure 5. Local projections: Sales growth response to monetary tightening, diff-in-diff



Note: The figure plots firm-specific sales growth response to a monetary policy tightening shock, at the aggregate level and by firm size bin. The figure shows the cumulative log-change in sales between period *t-1* and *t+h* with the monetary policy shock dated at *t*. Time is in years. We estimate Equation (2) for the full sample of firms, and the figure records the regression coefficients for firms with between 1 and 9 employees, between 10 and 24 employees, between 25 and 49 employees, between 50 and 99 employees, between 250 and 999 employees, and more than 1000 employees, relative to firms with between 100 and 249 employees. Shaded (dark) areas represent 95 (68) percent confidence bands.

Figure 6. Local projections, *t=3*: Sales growth response to monetary tightening, EA vs. non-EA firms



Note: The firm-level sales growth response to a one standard deviation monetary policy tightening shock along the firm-size distribution of euro-area firms (LHS) and non-euro-area firms (RHS). The figures show the cumulative log-change in sales at *t=3*. The X-axis indicates firm-size bins, where '1' denotes firms with between 1 and 9 employees, '2' firms with between 10 and 24 employees, '3' firms with between 25 and 49 employees, '4' firms with between 50 and 99 employees, '5' firms with between 100 and 249 employees, '6' firms with between 250 and 999 employees, and '7' firms with more than 1000 employees. Shaded purple areas represent 95 percent confidence bands.

Table 1. Summary statistics

	(1) Observations	(2) Mean	(3) St. dev.	(4) Min.	(5) Max.
Δ Sales	38,215,240	0.017	0.382	-1	1
Δ Profit margin	36,164,606	-0.026	0.910	-1	1
Δ Assets	38,213,911	0.033	0.301	-1	1
Δ Employment	23,020,078	0.015	0.312	-1	1
Δ Short-term debt	13,137,922	-0.008	0.594	-1	1
Δ Long-term debt	16,550,793	-0.093	0.529	-1	1
Size (1 , 9)	26,443,156	0.691	0.462	0	1
Size (10 , 24)	26,443,156	0.174	0.379	0	1
Size (25 , 49)	26,443,156	0.068	0.251	0	1
Size (50 , 99)	26,443,156	0.032	0.175	0	1
Size (100 , 249)	26,443,156	0.021	0.143	0	1
Size (250 ,999)	26,443,156	0.011	0.106	0	1
Size (1000+)	26,443,156	0.004	0.062	0	1
Age (1 , 9)	38,000,594	0.440	0.496	0	1
Age (10 , 24)	38,000,594	0.392	0.488	0	1
Age (25 , 49)	38,000,594	0.148	0.355	0	1
Age (50+)	38,000,594	0.020	0.142	0	1
Low leverage	33,225,693	0.424	0.494	0	1
Medium leverage	33,225,693	0.271	0.445	0	1
High leverage	33,225,693	0.305	0.460	0	1
MP_{t-1}	38,215,821	0.858	7.758	-22.9	33.8
GDP growth $_{t-1}$	38,215,821	0.313	0.991	-17.8	22.8
Inflation_{t-1}	38,215,854	1.997	2.010	-2.9	17.1
Branch density	10,977,875	6.476	7.638	0.003	30.048

Note: The Table summarizes the variables used in the empirical tests. The sample includes firms from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. The final sample is based on the Kalemli-Ozcan et al. (2024) cleaning procedure. The sample period is 1999—2022. 'Δ Sales' denotes the year-on-year log difference in total sales. 'Δ Profit margin' denotes the year-on-year log difference in profit margin. 'Δ Assets' denotes the year-on-year log difference in total assets. 'Δ Employment' denotes the year-on-year log difference in total employment. 'Δ Short-term debt' denotes the year-on-year log difference in debt with maturity of less than one year. 'Δ Long-term debt' denotes the year-on-year log difference in debt with maturity of more than one year. 'Size (1 , 9)' is a dummy variable equal to one if the firm has between 1 and 9 employees, and to 0 otherwise. 'Size (10 , 24)' is a dummy variable equal to one if the firm has between 10 and 24 employees, and to 0 otherwise. 'Size (25 , 49)' is a dummy variable equal to one if the firm has between 25 and 49 employees, and to 0 otherwise. 'Size (50 , 99)' is a dummy variable equal to one if the firm has between 50 and 99 employees, and to 0 otherwise. 'Size (100 , 249)' is a dummy variable equal to one if the firm has between 100 and

249 employees, and to 0 otherwise. 'Size (250 , 999)' is a dummy variable equal to one if the firm has between 250 and 9999 employees, and to 0 otherwise. 'Size (1000+)' is a dummy variable equal to one if the firm has more than 1000 employees, and to 0 otherwise. Age (1 , 9) is a dummy variable equal to one if the firm is between 1 and 9 years old, and to 0 otherwise. Age (10 , 24) is a dummy variable equal to one if the firm is between 10 and 24 years old, and to 0 otherwise. Age (25 , 49) is a dummy variable equal to one if the firm is between 25 and 49 years old, and to 0 otherwise. Age (25+) is a dummy variable equal to one if the firm is more than 25 years old, and to 0 otherwise. 'Low leverage' is a dummy variable equal to one if the firm's debt-to-assets ratio is less than 0.05, and to 0 otherwise. 'Medium leverage' is a dummy variable equal to one if the firm's debt-to-assets ratio is between 0.05 and 0.25, and to 0 otherwise. 'High leverage' is a dummy variable equal to one if the firm's debt-to-assets ratio is more than 0.25, and to 0 otherwise. All financial variables are deflated using the CPI of the respective country and are in 2000 euro. 'MP_{t-1}' is the sum of the EA-wide MP shocks during the past 12 months, based on changes in OIS with a 3-month maturity. 'GDP $growth_{t-1}$' is the 1-year lagged change in GDP per capita. '$Inflation_{t-1}$' is the 1 year-lagged change in the CPI. 'Branch density' denotes the sum of physical bank branches divided by 100,000 population in the firm's region.

Table 2: Monetary policy shocks and sales growth: Headline result

	Δ Sales	
	(1)	(2)
Size (1 , 9) × MP_{t-1}	-0.00219***	-0.00197***
	(0.000280)	(0.000280)
Size (10 , 24) × MP_{t-1}	-0.00165***	-0.00146***
	(0.000292)	(0.000292)
Size (25 , 49) × MP_{t-1}	-0.00152***	-0.00149***
	(0.000311)	(0.000311)
Size (50 , 99) × MP_{t-1}	-0.00111***	-0.00108***
	(0.000341)	(0.000340)
Size (250 ,999) × MP_{t-1}	0.000572	0.000547
	(0.000451)	(0.000450)
Size (1000+) × MP_{t-1}	0.00241***	0.00245***
	(0.000713)	(0.000715)
MP_{t-1}	-0.000908***	-0.001614***
	(0.000123)	(0.00017)
GDP $growth_{t-1}$	0.000487	0.00383***
	(0.00085)	(0.000872)
$Inflation_{t-1}$	-0.00478***	-0.004525***
	(0.000419)	(0.000468)
Firm size dummies × GDP growth $_{t-1}$	Yes	Yes
Firm size dummies × Inflation $_{t-1}$	Yes	Yes
Firm FE	Yes	Yes
Time FE	No	Yes
# Observations	12,878,608	12,878,608
R^2	0.51	0.51

Note: The dependent variable denotes the year-on-year log difference in firm sales. 'Size (x , y)' is a dummy variable equal to one if the firm has between x and y employees, and to 0 otherwise, with 'Size (100 , 249)' the omitted category. 'MP_{t-1}' is the sum of the EA-wide MP shocks during the past 12 months, based on changes in OIS with a 3-month maturity. 'GDP $growth_{t-1}$' is the 1-year lagged change in GDP per capita. '$Inflation_{t-1}$' is the 1 year-lagged change in the CPI. For variable definitions and summary statistics, see Table 1. The sample includes firms from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. The final sample is based on the Kalemli-Ozcan et al. (2024) cleaning procedure. The sample period is 1999—2022. The regressions include fixed effects as specified. Robust standard errors clustered by firm appear in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 3: Monetary policy shocks and firm growth: Accounting for firm age and leverage

	Δ Sales		
	(1)	(2)	(3)
Size (1 , 9) × MP_{t-1}	-0.00227***	-0.00195***	-0.00230***
	(0.000288)	(0.000289)	(0.000298)
Size (10 , 24) × MP_{t-1}	-0.00161***	-0.00149***	-0.00168***
	(0.000297)	(0.000300)	(0.000306)
Size (25 , 49) × MP_{t-1}	-0.00157***	-0.00149***	-0.00159***
	(0.000315)	(0.000319)	(0.000323)
Size (50 , 99) × MP_{t-1}	-0.00116***	-0.00106***	-0.00116***
	(0.000345)	(0.000349)	(0.000354)
Size (250 ,999) × MP_{t-1}	0.000582	0.000563	0.000598
	(0.000458)	(0.000464)	(0.000473)
Size (1000+) × MP_{t-1}	0.00253***	0.00254***	0.00263***
	(0.000735)	(0.000733)	(0.000753)
Firm size dummies × GDP growth $_{t-1}$	Yes	Yes	Yes
Firm size dummies × Inflation $_{t-1}$	Yes	Yes	Yes
MP_{t-1}, GDP growth $_{t-1}$, Inflation $_{t-1}$	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Firm age dummies × MP_{t-1}	Yes	No	Yes
Firm leverage dummies × MP_{t-1}	No	Yes	Yes
# Observations	12,793,703	10,845,268	10,774,844
R^2	0.51	0.52	0.52

Note: The dependent variable denotes the year-on-year log difference in firm sales. ‘Size (x , y)’ is a dummy variable equal to one if the firm has between x and y employees, and to 0 otherwise, with ‘Size (100 , 249)’ the omitted category. ‘MP_{t-1}’ is the sum of the EA-wide MP shocks during the past 12 months, based on changes in OIS with a 3-month maturity. ‘GDP $growth_{t-1}$’ is the 1-year lagged change in GDP per capita. ‘$Inflation_{t-1}$’ is the 1 year-lagged change in the CPI. ‘Firm age dummies’ include ‘Age (1 , 9)’, ‘Age (10 , 24)’, and ‘Age (50+)’, with ‘Age (25 , 49)’ the omitted category. ‘Firm leverage dummies’ include ‘Low leverage’ and ‘High leverage’, with ‘Medium leverage’ the omitted category. For variable definitions and summary statistics, see Table 1. The sample includes firms from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. The final sample is based on the Kalemli-Ozcan et al. (2024) cleaning procedure. The sample period is 1999—2022. The regressions include fixed effects as specified. Robust standard errors clustered by firm appear in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 4: Monetary policy shocks and sales growth: Alternative MP shocks

	Δ Sales	
	(1)	(2)
Size (1 , 9) × MP_{t-1}	-0.000943***	-0.000487*
	(0.000299)	(0.000263)
Size (10 , 24) × MP_{t-1}	-0.00123***	-0.000499*
	(0.000310)	(0.000270)
Size (25 , 49) × MP_{t-1}	-0.000953***	-0.000294
	(0.000329)	(0.000283)
Size (50 , 99) × MP_{t-1}	-0.000965***	-0.000760**
	(0.000357)	(0.000300)
Size (250 ,999) × MP_{t-1}	0.000631	0.000229
	(0.000478)	(0.000413)
Size (1000+) × MP_{t-1}	0.00344***	0.000949
	(0.000721)	(0.000662)
Firm size dummies × GDP growth $_{t-1}$	Yes	Yes
Firm size dummies × Inflation $_{t-1}$	Yes	Yes
MP_{t-1}, GDP growth $_{t-1}$, Inflation $_{t-1}$	Yes	Yes
Firm FE	Yes	Yes
Time FE	Yes	Yes
# Observations	10,207,944	10,474,089
R^2	0.53	0.52

Note: The dependent variable denotes the year-on-year log difference in firm sales. 'Size (x , y)' is a dummy variable equal to one if the firm has between x and y employees, and to 0 otherwise, with 'Size (100 , 249)' the omitted category. 'MP_{t-1}' is the sum of the EA-wide MP shocks during the past 12 months, based on changes in OIS with a 6-month maturity (column (1)) and 1-year maturity (column (2)). 'GDP growth$_{t-1}$' is the 1-year lagged change in GDP per capita. 'Inflation$_{t-1}$' is the 1 year-lagged change in the CPI. For variable definitions and summary statistics, see Table 1. The sample includes firms from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. The final sample is based on the Kalemli-Ozcan et al. (2024) cleaning procedure. The sample period is 1999—2022. The regressions include fixed effects as specified. Robust standard errors clustered by firm appear in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 5: Monetary policy shocks and sales growth: Profit margin

	Δ Profit margin
	(1)
Size (1 , 9) × MP_{t-1}	-0.00140
	(0.00127)
Size (10 , 24) × MP_{t-1}	-0.00301**
	(0.00132)
Size (25 , 49) × MP_{t-1}	-0.00202
	(0.00141)
Size (50 , 99) × MP_{t-1}	-0.00167
	(0.00156)
Size (250 ,999) × MP_{t-1}	0.00183
	(0.00204)
Size (1000+) × MP_{t-1}	0.000556
	(0.00326)
Firm size dummies × GDP growth $_{t-1}$	Yes
Firm size dummies × Inflation $_{t-1}$	Yes
MP_{t-1}, GDP growth $_{t-1}$, Inflation $_{t-1}$	Yes
Firm FE	Yes
Time FE	Yes
# Observations	12,627,720
R^2	0.48

Note: The dependent variable denotes the year-on-year log difference in firm profit margin. 'Size (x , y)' is a dummy variable equal to one if the firm has between x and y employees, and to 0 otherwise, with 'Size (100 , 249)' the omitted category. 'MP_{t-1}' is the sum of the EA-wide MP shocks during the past 12 months, based on changes in OIS with a 6-month maturity. 'GDP $growth_{t-1}$' is the 1-year lagged change in GDP per capita. '$Inflation_{t-1}$' is the 1 year-lagged change in the CPI. For variable definitions and summary statistics, see Table 1. The sample includes firms from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. The final sample is based on the Kalemli-Ozcan et al. (2024) cleaning procedure. The sample period is 1999—2022. The regressions include fixed effects as specified. Robust standard errors clustered by firm appear in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 6: Monetary policy shocks and sales growth: Investment and employment

	Δ Assets	Δ Employment
	(1)	(2)
Size (1 , 9) × MP_{t-1}	-0.00172***	-0.00700***
	(0.000497)	(0.000289)
Size (10 , 24) × MP_{t-1}	-0.000876*	-0.00148***
	(0.000506)	(0.000296)
Size (25 , 49) × MP_{t-1}	-0.000494	-0.000758**
	(0.000521)	(0.000311)
Size (50 , 99) × MP_{t-1}	-0.000123	-0.000378
	(0.000532)	(0.000333)
Size (250 ,999) × MP_{t-1}	0.000328	0.00160***
	(0.000737)	(0.000468)
Size (1000+) × MP_{t-1}	0.00561***	0.00611***
	(0.00121)	(0.000941)
Firm size dummies × GDP growth $_{t-1}$	Yes	Yes
Firm size dummies × Inflation $_{t-1}$	Yes	Yes
MP_{t-1}, GDP growth $_{t-1}$, Inflation $_{t-1}$	Yes	Yes
Firm FE	Yes	Yes
Time FE	Yes	Yes
# Observations	12,865,770	12,196,037
R^2	0.51	0.49

Note: The dependent variable denotes the year-on-year log difference in firm assets (column (1)) and in firm employment (column (2)). 'Size (x , y)' is a dummy variable equal to one if the firm has between x and y employees, and to 0 otherwise, with 'Size (100 , 249)' the omitted category. 'MP_{t-1}' is the sum of the EA-wide MP shocks during the past 12 months, based on changes in OIS with a 3-month maturity. 'GDP $growth_{t-1}$' is the 1-year lagged change in GDP per capita. '$Inflation_{t-1}$' is the 1 year-lagged change in the CPI. For variable definitions and summary statistics, see Table 1. The sample includes firms from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. The final sample is based on the Kalemli-Ozcan et al. (2024) cleaning procedure. The sample period is 1999—2022. The regressions include fixed effects as specified. Robust standard errors clustered by firm appear in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 7: Monetary policy shocks and sales growth: Short- and long-term debt

	Δ Short-term debt	Δ Long-term debt
	(1)	(2)
Size (1 , 9) × MP_{t-1}	-0.00733***	-0.00360**
	(0.00183)	(0.00183)
Size (10 , 24) × MP_{t-1}	-0.00483***	-0.00160
	(0.00184)	(0.00189)
Size (25 , 49) × MP_{t-1}	-0.00107	0.000251
	(0.00187)	(0.00195)
Size (50 , 99) × MP_{t-1}	-0.00188	0.00101
	(0.00190)	(0.00201)
Size (250 ,999) × MP_{t-1}	0.00511*	0.00123
	(0.00288)	(0.00271)
Size (1000+) × MP_{t-1}	0.00980**	0.00116
	(0.00493)	(0.00426)
Firm size dummies × GDP growth $_{t-1}$	Yes	Yes
Firm size dummies × Inflation $_{t-1}$	Yes	Yes
MP_{t-1}, GDP growth $_{t-1}$, Inflation $_{t-1}$	Yes	Yes
Firm FE	Yes	Yes
Time FE	Yes	Yes
# Observations	5,355,691	6,529,099
R^2	0.57	0.59

Note: The dependent variable denotes the year-on-year log difference in firm short-term debt (column (1)) and in firm long-term debt (column (2)). 'Size (x , y)' is a dummy variable equal to one if the firm has between x and y employees, and to 0 otherwise, with 'Size (100 , 249)' the omitted category. 'MP_{t-1}' is the sum of the EA-wide MP shocks during the past 12 months, based on changes in OIS with a 3-month maturity. 'GDP $growth_{t-1}$' is the 1-year lagged change in GDP per capita. '$Inflation_{t-1}$' is the 1 year-lagged change in the CPI. For variable definitions and summary statistics, see Table 1. The sample includes firms from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. The final sample is based on the Kalemli-Ozcan et al. (2024) cleaning procedure. The sample period is 1999—2022. The regressions include fixed effects as specified. Robust standard errors clustered by firm appear in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 8: Monetary policy shocks and sales growth: Accounting for bank competition

	Δ Sales	
	Low branch density	High branch density
	(1)	(2)
Size (1 , 9) × MP_{t-1}	-0.00328***	-0.00312**
	(0.000864)	(0.00134)
Size (10 , 24) × MP_{t-1}	-0.00389***	-0.00197
	(0.000855)	(0.00135)
Size (25 , 49) × MP_{t-1}	-0.00189**	-0.00200
	(0.000918)	(0.00139)
Size (50 , 99) × MP_{t-1}	-0.00208**	-0.00253
	(0.000984)	(0.00160)
Size (250 ,999) × MP_{t-1}	0.000507	-0.00167
	(0.00101)	(0.00240)
Size (1000+) × MP_{t-1}	0.00238*	0.00266
	(0.00130)	(0.00533)
Firm size dummies × GDP growth $_{t-1}$	Yes	Yes
Firm size dummies × Inflation $_{t-1}$	Yes	Yes
MP_{t-1}, GDP growth $_{t-1}$, Inflation $_{t-1}$	Yes	Yes
Firm FE	Yes	Yes
Time FE	Yes	Yes
# Observations	1,574,221	1,527,930
R^2	0.68	0.66

Note: The dependent variable denotes the year-on-year log difference in firm sales. 'Size (x , y)' is a dummy variable equal to one if the firm has between x and y employees, and to 0 otherwise, with 'Size (100 , 249)' the omitted category. 'MP_{t-1}' is the sum of the EA-wide MP shocks during the past 12 months, based on changes in OIS with a 3-month maturity. 'GDP growth$_{t-1}$' is the 1-year lagged change in GDP per capita. 'Inflation$_{t-1}$' is the 1 year-lagged change in the CPI. For variable definitions and summary statistics, see Table 1. The sample includes firms from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. The final sample is based on the Kalemli-Ozcan et al. (2024) cleaning procedure. The sample is split by regions with below-median (column (1)) and regions with above-median (column (2)) bank branch density. The sample period is 1999—2022. The regressions include fixed effects as specified. Robust standard errors clustered by firm appear in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Appendix

Appendix Table 1. Number of observations, initial sample

	(1)
	Observations
Sales	44,183,521
Assets	44,182,826
Employment	29,843,340
Age	43,957,541
Leverage	38,467,366

Note: The Table summarizes the number of observations for the initial sample, i.e., before the cleaning procedure recommended by Kalemli-Ozcan et al. (2024). The sample includes firms from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. The sample period is 1999—2022. 'Sales' denotes total sales. 'Assets' denotes total assets. 'Employment' denotes total number of employees. Age denotes years since incorporation. 'Leverage' denotes the debt-to-assets ratio.

Appendix Table 2: Monetary policy shocks and sales growth: Robust fixed effects

	Δ Sales		
	(1)	(2)	(3)
Size (1 , 9) × MP_{t-1}	-0.00251***	-0.00175***	-0.00267***
	(0.000364)	(0.000292)	(0.000378)
Size (10 , 24) × MP_{t-1}	-0.00153***	-0.00126***	-0.00167***
	(0.000375)	(0.000301)	(0.000386)
Size (25 , 49) × MP_{t-1}	-0.00164***	-0.00125***	-0.00159***
	(0.000397)	(0.000315)	(0.000403)
Size (50 , 99) × MP_{t-1}	-0.000809*	-0.000981***	-0.000792*
	(0.000433)	(0.000341)	(0.000435)
Size (250 ,999) × MP_{t-1}	0.000602	0.000475	0.000605
	(0.000590)	(0.000453)	(0.000593)
Size (1000+) × MP_{t-1}	0.00371***	0.00220***	0.00328***
	(0.000892)	(0.000711)	(0.000899)
Firm size dummies × GDP growth $_{t-1}$	Yes	Yes	Yes
Firm size dummies × Inflation $_{t-1}$	Yes	Yes	Yes
MP_{t-1}, GDP growth $_{t-1}$, Inflation $_{t-1}$	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Sector × Time FE	Yes	No	Yes
Country × Time FE	No	Yes	Yes
# Observations	8,008,524	12,805,811	8,008,149
R^2	0.54	0.52	0.54

Note: The dependent variable denotes the year-on-year log difference in firm sales. 'Size (x , y)' is a dummy variable equal to one if the firm has between x and y employees, and to 0 otherwise, with 'Size (100 , 249)' the omitted category. 'MP_{t-1}' is the sum of the EA-wide MP shocks during the past 12 months, based on changes in OIS with a 3-month maturity. 'GDP $growth_{t-1}$' is the 1-year lagged change in GDP per capita. '$Inflation_{t-1}$' is the 1 year-lagged change in the CPI. For variable definitions and summary statistics, see Table 1. The sample includes firms from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. The final sample is based on the Kalemli-Ozcan et al. (2024) cleaning procedure. The sample period is 1999—2022. The regressions include sector-year fixed effects (column (1)), country-year-month fixed effects (column (2)), and both sector-year and country-year-month fixed effects (column (3)). Robust standard errors clustered by firm appear in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Appendix Table 3: Monetary policy shocks and sales growth: Robust clustering

	Δ Sales		
	(1)	(3)	(4)
Size (1 , 9) × MP_{t-1}	-0.00170***	-0.00197***	-0.00197***
	(0.000539)	(0.000557)	(0.000678)
Size (10 , 24) × MP_{t-1}	-0.00112**	-0.00146***	-0.00146***
	(0.000448)	(0.000476)	(0.000393)
Size (25 , 49) × MP_{t-1}	-0.00131***	-0.00149***	-0.00149***
	(0.000440)	(0.000348)	(0.000374)
Size (50 , 99) × MP_{t-1}	-0.000715	-0.00108***	-0.00108***
	(0.000500)	(0.000294)	(0.000283)
Size (250 ,999) × MP_{t-1}	0.000566	0.000547	0.000547
	(0.000683)	(0.000423)	(0.000429)
Size (1000+) × MP_{t-1}	0.00346***	0.00245***	0.00245***
	(0.00104)	(0.000864)	(0.000930)
Firm size dummies × GDP growth $_{t-1}$	Yes	Yes	Yes
Firm size dummies × Inflation $_{t-1}$	Yes	Yes	Yes
MP_{t-1}, GDP growth $_{t-1}$, Inflation $_{t-1}$	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
# Observations	8,011,213	12,865,833	12,865,833
R^2	0.53	0.51	0.51

Note: The dependent variable denotes the year-on-year log difference in firm sales. 'Size (x , y)' is a dummy variable equal to one if the firm has between x and y employees, and to 0 otherwise, with 'Size (100 , 249)' the omitted category. 'MP_{t-1}' is the sum of the EA-wide MP shocks during the past 12 months, based on changes in OIS with a 3-month maturity. 'GDP growth$_{t-1}$' is the 1-year lagged change in GDP per capita. 'Inflation$_{t-1}$' is the 1 year-lagged change in the CPI. For variable definitions and summary statistics, see Table 1. The sample includes firms from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain. The final sample is based on the Kalemli-Ozcan et al. (2024) cleaning procedure. The sample period is 1999—2022. The regressions include fixed effects as specified. Robust standard errors clustered by country-sector (column (1)), country-time (column (2)), and firm and time (column (3)) appear in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Appendix Table 4: Monetary policy shocks and sales growth: Robust sample

	Δ Sales		
	(1)	(3)	(4)
Size (1 , 9) × MP_{t-1}	-0.00115***	-0.00166***	-0.00258***
	(0.000299)	(0.000333)	(0.000324)
Size (10 , 24) × MP_{t-1}	-0.000734**	-0.00122***	-0.00215***
	(0.000312)	(0.000345)	(0.000342)
Size (25 , 49) × MP_{t-1}	-0.000958***	-0.00142***	-0.00158***
	(0.000333)	(0.000369)	(0.000362)
Size (50 , 99) × MP_{t-1}	-0.000663*	-0.00101**	-0.00119***
	(0.000361)	(0.000403)	(0.000400)
Size (250 ,999) × MP_{t-1}	0.000666	0.000468	0.000489
	(0.000473)	(0.000535)	(0.000498)
Size (1000+) × MP_{t-1}	0.00188**	0.00345***	0.00176**
	(0.000759)	(0.000873)	(0.000758)
Firm size dummies × GDP growth $_{t-1}$	Yes	Yes	Yes
Firm size dummies × Inflation $_{t-1}$	Yes	Yes	Yes
MP_{t-1}, GDP growth $_{t-1}$, Inflation $_{t-1}$	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
# Observations	6,989,420	11,235,401	10,183,864
R^2	0.44	0.51	0.57

Note: The dependent variable denotes the year-on-year log difference in firm sales. 'Size (x , y)' is a dummy variable equal to one if the firm has between x and y employees, and to 0 otherwise, with 'Size (100 , 249)' the omitted category. 'MP_{t-1}' is the sum of the EA-wide MP shocks during the past 12 months, based on changes in OIS with a 3-month maturity. 'GDP $growth_{t-1}$' is the 1-year lagged change in GDP per capita. '$Inflation_{t-1}$' is the 1 year-lagged change in the CPI. For variable definitions and summary statistics, see Table 1. The sample includes firms from Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain; column (1) excludes firms from Spain, column (2) firms from France, and column (3) firms from Italy. The final sample is based on the Kalemli-Ozcan et al. (2024) cleaning procedure. The sample period is 1999—2022. The regressions include fixed effects as specified. Robust standard errors clustered by firm appear in parentheses. ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.