Monetary Policy and Market Competition: Is Europe Different?*

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Abstract

Using a large euro-area micro dataset spanning the entire firms size distribution, we show that on impact, the elasticity of firm growth to monetary policy shocks is non-linear in firm size: micro, small and large firms respond more than medium-sized firms. Following monetary easing, firms in the left tail of the size distribution substitute long-term for short-term debt and increase employment, see an increase in mark-ups, and their growth response is amplified in local markets with higher bank competition. Over a three-year horizon, micro and small firms gain market share on medium-sized and old firms. In contrast to recent US evidence, our results suggest that low interest rates do not only benefit market leaders as long as monetary policy is transmitted via competitive banking markets.

JEL classification: E2, G1, G12.

Keywords: Eurozone, monetary policy, firm growth, market competition.

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1 Introduction

In recent years, two empirical regularities have independently captured the interest of macro economists. First, in the past two decades, the world has witnessed an extraordinary decline in both short- and long-term advanced economy interest rates, from levels of around 4-6% to close to or even below zero. While there are a number of structural reasons behind low interest rates, such as the demographic transition and the integration of China in global financial markets[1], recent falls have been largely associated with Central Banks' attempts to stimulate the economy in the wake of financial crises. Second, industrial concentration has gradually increased in the US, but not in Europe ((Gutiérrez & Philippon, 2023)).

Can these two empirical facts be not only reconciled, but even related? To answer this question, we study how monetary policy shocks in the euro area affect market competition in local markets. We use firm-level data from twelve euro area economies during the first two decades after the introduction of the euro (1999–2018). This samples is representative of the European corporate sector as it covers at total of 750,000+ listed and unlisted firms spanning the entire firm size distribution. In terms of monetary policy shocks, we rely on a recent dataset of identified changes in the ECB's monetary policy by Altavilla et al. (2019). We use these shocks to study the impact of monetary policy on sales growth – as well as changes in mark-ups, investment, employment, and debt – depending on firm size.

Our main finding is that the elasticity of firm growth to monetary policy shocks is non-linear in firm size: small and large firms respond more than medium-sized firms on impact. Numerically, a monetary easing that corresponds to one sample standard deviations increases sales growth of micro (large) firms by up to 0.28 (0.36) percentage points more than the sales growth of medium-sized firms. This corresponds to a non-negligible 40% (51%) of the sample mean sales growth. Over a three-year horizon, however, After three years, however, sales by micro (small) firms grow by 0.86 (0.66) percentage points more than medium-sized and large firms, and together they gain about 1% in market share. Importantly, not only sales growth, but also price-cost margins increase relatively more for micro firms in the wake of monetary easing.

Our results suggests that accommodative monetary policy leads firms in the left tail of the size distribution to exert competitive pressure on industry leaders. Recent US evidence (see Kroen et al.

[1] See Bean et al. (2015).

(2021)) points to increased industry concentration in a low-interest-rate environment, the theoretical mechanism being that for strategic reasons, large firms borrow more and invest more aggressively when borrowing costs decline. In contrast, our evidence suggests that low interest rates do not only benefit industry leaders as long as monetary policy is transmitted via competitive banking markets. Our evidence has implications not just at the micro level, but also for important characteristics of the aggregate economy, such as mark-ups and productivity.

Identification. The main result of the paper is robust to three main potential confounding factors. First, a significant correlation between monetary policy shocks and market competition can obtain in the data because a third, unobservable factor (e.g., risk-taking) are driving both competition and monetary policy. This makes interpreting the correlation between the monetary policy stance and market-wide measures of competition problematic. To tackle this criticism, we establish our main result at the firm level, rather than at the sector or country level, and we show that the relation between monetary policy shocks and firm growth varies by firm size. In this way, we are able to hold a number of unobservable background forces at the geographic and sectoral level constant. Among these are region-sectors-specific trends related for example to shocks to local demand for specific products or to technology adoption by specific industries.

Second, monetary policy is endogenous to economic development, which can introduce omitted variable bias in the estimation of the effect of policy shocks on industrial concentration even if one distinguishes the effect across sectors. This is because financially dependent sectors could be relatively large in an economy that the ECB places a large weight on when making decisions about the policy rate. 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. Moreover, we control directly for the effect of the local business cycle on industry concentration by explicitly accounting for the differential effect of changes in GDP growth on changes in firm-level output by firm size.

Third, changes in the central banks' monetary policy stance can be correlated with unobservable changes in the global environment that affect competition differently in sectors more and less sensitive to changes in funding conditions. For example, demand for goods produced or services delivered by sectors more sensitive to changes in external funding costs may shift in a way favoring small firms precisely during monetary easing. This would result in a decline in industrial concentration without any direct contribution of monetary policy itself. At the same time, the econometrician will erroneously attribute the decline in industrial competition to changes in the monetary policy stance. To address this concern, we run our empirical tests on a sample of non-euro-area European countries where firms ex ante should not be affected by changes in the ECB's monetary policy stance.

We also show that there are important interactions between size and other fundamental firm characteristics. In particular, we show that firms in the left tail of the size distribution are more sensitive to monetary policy shocks – in terms of growth – if they have low leverage and are neither too you young nor too old.

Channels. We also shed light on the microeconomic channels responsible for the main effect. We show that following monetary easing, small firms substitute long-term for short-term debt and increase employment. Moreover, the relatively larger effect of monetary loosening on micro and small firms' growth is amplified in markets with deeper credit markets. The totality of the facts we document suggests that in the euro area, low interest rates benefit smaller firms rather than market leaders. This is plausibly because the euro-area is a bank-based economy where monetary policy is largely transmitted via bank balance sheets, and because of the importance of bank credit for small firms (e.g., Berger & Udell (1998)). At the same time, to the extent that our results appear to be symmetric, they suggest that the competitive advantage that small firms derive from monetary accommodation can be undone when the monetary policy stance reverses.

Literature & policy debate. Our paper 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.[2] At the same time, despite the ongoing lively debate in academic and

[2]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

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 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.

Our work also 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); Giannone et al. (2012); Gilchrist & Zakrajsek (2013); Gilchrist et al. (2015); Heider et al. (2019); Ferrando et al. (2022); Ferrando et al. (2019)) on both nominal and real economic variables. Since the financial crisis in 2008-09, Central Banks around the world have been busy employing a range of tools to circumvent the zero-lower-bound constraint, revive economic activity, and bring inflation closer to target. One of the main tools in this arsenal has been keeping the policy rate low, and committing to do so for a prolonged amount of time. 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.

To the best of our knowledge, there has been comparatively little analysis of the effect of monetary policy on such well-defined characteristic of product markets as competition. A major exception are two recent papers by Kroen et al. (2021) and Liu et al. (2022) which provide theoretical support and empirical evidence for the notion that by benefiting incumbents more than entrants, low interest rates have contributed to increasing industrial concentration in US markets. These papers highlights a strategic force whereby when interest rates are low, market leaders have a stronger strategic incentive to increase investment relative to followers. This stronger investment response leads to more market concentration

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).

and eventually to lower productivity growth. Their evidence thus strongly supports the notion that by benefiting incumbents more than entrants, low interest rates are one of the sources of increasing industrial concentration in US markets.

We show that the opposite is true in the euro area. As monetary policy becomes more accommodating, micro and small firms grow relatively faster and increase markups relatively more, helping to close the gap with large firms. This is plausibly because monetary policy in Europe is primarily transmitted to the real economy through banks. As micro and small enterprises are more bank-dependent than large firms (Berger & Udell, 1998), they benefit more from changes in the level and composition of the bank credit supply, allowing them to grow relatively faster than large firms. We therefore argue that in the euro area at least, low interest rates have supported market competition, and we provide evidence consistent with bank credit benefiting small firms relatively more in a low-interest-rate environment.

Finally, our work contributes to the vibrant literature 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 (Cloyne et al. (2024); Durante et al. (2022)), 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. (2024)), debt maturity (Jungherr et al. (2022)), asset tangibility (Durante et al. (2022)), and size (Gertler & Gilchrist (1994); 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 – in terms of, e.g., investment, sales, or inventories behavior – to monetary policy shocks.

At the same time, in this strand of literature, the analysis typically relies on aggregate series or uses data on publicly traded firms. In contrast, we analyze a sample of both public and private firms that span the firm size distribution, which allows us to study whether individual small firms respond more or less forcefully to changes in the monetary policy stance than market leaders.[3] Our analysis highlights the importance of incorporating data on private firms when analysing the impact of monetary policy on salient aggregate features of the economy.

Roadmap. The paper proceeds as follows. In Section 2, we describe the data used in the analysis.

[3]Our approach is thus closest to Durante et al. (2022) who employ a sample of micro firms from four euro-area countries to study the response of investment to monetary policy shocks, depending on firm age and asset tangibility.

In Section 3, we introduce the empirical strategy. Section 4 presents and discusses the headline empirical results alongside a battery of robustness tests. In Section 5, we investigate the role of adjustment in investment and employment. In section 6, we present evidence some on the role of debt and competition in credit markets. In Section 7, we propose an interpretation of our results and illustrate them with a stylized model of firm investment in the presence of two separate borrowing constraints. Section 8 concludes.

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

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 2018 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 1999–2018, 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, tangible fixed assets, employment, EBITDA, operating revenues, long-term debt, and short-term debt. We deflate all underlying financial data using the country-specific GDP 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), 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 asset 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. We also drop firm-year observations if there are less than 10 firms in each NACE Rev. 2 sector. Because coverage varies by country, we drop countries based on a small number of firm observations, resulting in poor coverage. Finally, because we want to investigate the importance of credit factors, we require all firms in the dataset to have at least one banking relationship. In practice, this means reporting at least one unique name in the field where firms are asked to list their creditors. In this way, we make sure from the start that any results we document will not be driven by firms not being served by banks.

After applying all these procedures, we are left with 756,258 companies unique firms in 12 euro area countries over the sample period 1999–2018, for a maximum of 6,128,391 observations. The countries in question are Austria, Estonia, France, Germany, Greece, Latvia, Lithuania, Malta, Netherlands, Portugal, Slovenia, and Spain. We also construct a placebo sample of 211,519 firms in 2 European countries with similarly good coverage (Croatia and Hungary) that during the sample period in question were not euro-area member states.

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[4] 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. These shocks mute the potential endogeneity of monetary policy by focusing on price movements in a narrow window around monetary policy communication events (see (Nakamura & Steinsson, 2018)).

While the authors also analyze the impact of quantitative easing and forward guidance when looking at the yield curve as far away as ten years, 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 two years (Andrade & Ferroni, 2021).[5] Following Holm et al. (2021), we sum up the shocks to semi-annual frequency. Then we multiply them by (-1) so that positive shocks correspond to monetary easing. Finally, we map the cumulative monetary policy shocks over a six-month period into changes in various firm-specific outcomes over the next twelve months.

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. Potential misspecification of a structural VAR model is thus not an issue.

2.3 Summary statistics

Table 1 reports summary statistics on the main 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 for both adjacent and non-adjacent years (i.e., when observations for the years in between are missing), assuming in the latter case a constant growth rate over periods when actual values are not

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

[5] 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).

recorded. On average, firms' sales grew by 0.7 percent during our sample period. This is accompanied by a 2.4-percent decline in investment and a 1.1-percent increase in employment. Price-cost margins also declined over the sample period, by 0.3 percent. Firm indebtedness declined on average too, both in terms of short-term (1.5-percent) and long-term (7-percent) debt.

Turning to the main explanatory variables, we find that more than half (52.8 percent) of firms in the dataset are micro firms. A further 34.7 percent of firms are defined as small, and 9.1 percent are medium-sized. Only 3.4 percent of the firms in the dataset are large. We designate the firm size bins using a standard SME classification whereby micro firms have fewer than 10 employees, small firms have between 10 and 50 employees, medium firms have between 50 and 250 employees, and large firms have more than 250 employees.

The sample is similarly skewed away from old firms. 49.5 percent of the firms are less than 15 years old, and 46.9 percent of the firms are between 15 and 50 years old. In terms of leverage, about a third of firms have low leverage (debt-to-assets ratio of less than 0.05), 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).

In terms of macro variables, changes in monetary policy have on average pointed to easing of 4.1 basis points over 6-month periods. GDP growth in the countries in the dataset has been 1.4 percent on average. Average GDP growth during the sample period is 1.4 percent. Finally, the average region in the dataset exhibits a bank branch concentration of 6.7 branches per 100,000 population, but a wide range between 0 and 36.[6]

3 Empirical strategy

We use panel local projections to investigate the role of firm size for firms' growth response to monetary policy shocks. Formally, we estimate

$$\begin{aligned} \Delta^{h+1} log\, Sales_{ft+h} &= \textstyle\sum_{k=m,s,l} 1[j \in k] \beta^h_{1k} k \Delta MP_{t-1} \\ &+ \textstyle\sum_{k=m,s,l} 1[j \in k] \beta^h_{2k} k \Delta GDP_{t-1} + \gamma^h_f + \phi^h_{r,s,t} + \varepsilon^h_{ft+h}, \end{aligned} \tag{1}$$

[6]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.

for $h = 0, 1, 2, 3$ years. On the left-hand side of Equation 1, $\Delta^{h+1} log\, Sales_{ft+h}$ 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 is a micro firm (m), a small firm (s), or a large firm (l). The omitted category is medium-sized firms.

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 6-month periods. We then construct ΔMP_{t-1} as this aggregated monetary policy shock multiplied by (-1). In this way, when interpreting the results from the regressions, higher values should be understood as more forceful monetary accommodation.

One advantage of the Orbis dataset is that firms report their financials in different months of each year. While the vast majority of firms (89.8%) report in December, 2.3%, 2%, and 2.8% report in April, June, and September, respectively. A further 3.1% report during the remaining eight months of the year. At the same time, a reporting months is fixed over the years for each firms. This allows us to map different firms' sales growth into different 6-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 to control for a very high-frequency business cycle.

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 interactions of region, sector, and year-month dummies $\phi_{r,s,t}$. Regions are defined using the NUTS3 classification (there are 694 NUTS3 regions in the 12 countries in the final dataset), and sectors are defined as 2-digit industries (there are 58 such industries in the final dataset). This allows us to hold constant a number of unobservable background forces at the level of both industry and narrow geography. $\phi_{r,s,t}$ absorbs any time-varying varying variation in business conditions that is common to all sectors in a region and to a sector across all regions. Thereby we are able to purge the point estimates on the main variable of interest of demand and technology and therefore compare supply-side responses to monetary policy shocks of firms of different sizes within the same region-sector.

In the preferred specification, we do not include the variables ΔMP_{t-1} and ΔGDP_{t-1} on their own, because their independent effect is absorbed by $\phi_{r,s,t}$, but we include these variables in tests that do not control for the regional business cycle.

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

The coefficients of interest are β_{1m}, β_{1s}, and β_{1l}. They capture the extent to which sales growth responds to changes in the monetary policy stance, for micro firms, small firms, and large firms, respectively, relative to the control group (medium-sized firms).

4 Empirical evidence

4.1 Headline result

Figure 1 presents the main empirical result of our paper. The Figure plots estimated β_{1k}^{h} coefficients. These capture the differential response of firm growth for micro ($k = m$), small ($k = s$), and large ($k = l$) firms, relative to medium-sized firms, at the time of an expansionary monetary policy shock. The figure shows that on impact ($h = 0$), sales growth increases relatively more for micro, small and large firms, relative to medium-sized firms. After that, sales growth by large firms declines, while sales growth of micro and small firms keep increasing, in relative terms. After three years, in response to a monetary easing that corresponds to one sample standard deviation (4.1), sales by micro (small) firms grow by 0.68 (0.44) percentage points more than medium-sized firms. The shaded area is a 95% confidence band based on standard errors that are clustered by firm. For micro (small) firms, the differential response is statistically different from zero at the 5% significance level at horizons between 1 and 3 years after the shock. Given that the average sales growth response is positive, this means that over a medium horizon, micro and small firms are more responsive to monetary policy shocks than medium-sized and large firms. Our results thus strongly support the notion that accommodative monetary policy in the euro area has not been conducive to higher market concentration in the short-t0-medium term.

In Table 2, we present the estimates from Equation 1 for $h = 0$, first without any fixed effects and then with the full set of fixed effects.[7] In column (1), where we do not include γ_f and $\phi_{r,s,t}$, we can estimate

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

the direct effect of the size class and the non-interactive effect of ΔMP_{t-1} and ΔGDP_{t-1}. We find that small firms grow on average the fastest, followed by micro firms, while large firms growth significantly more slowly than the reference group (medium-sized firms). In line with expectations, the point estimate on the monetary policy shock has a positive sign, implying that monetary easing (i.e., higher values of ΔMP_{t-1} in the past six months) increases sales growth for all firms on average. Analogously, higher GDP growth in the past year is associated with higher firm sales growth.

In the preferred specification with firm fixed effects and interactions of region, sector, and time dummies (column (2)), we find that on impact, micro, small, and large firms experience a higher increase in sales growth than medium-sized firms. The effect of monetary policy is thus non-linear in size, being largest at the tails of the firm-size distribution. 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 micro (large) firm dummy is 0.0007 (0.0009). This implies that a monetary easing that corresponds to one sample standard deviation increases sales growth of micro (large) firms by 0.28 (0.36) percentage points more than the sales growth of medium-sized firms. This corresponds to a non-negligible 40% (51%) of the sample mean sales growth.

Finally, we find that the effect of past GDP growth on firm growth is only significant for large firms, compared with medium-sized firms.

Aggregate implications. What are the aggregate implications of this heterogeneous response of firm growth, in terms of market shares, over a three-year horizon? We note that according to the summary statistics reported in Table 1, 53 percent of the firms in our sample are micro firms, 35 percent are small firms, 9 percent are medium-sized firms, and 3.4 percent are large firms. The average sales by size class in millions of euro are 1.4, 5.4, 31.4, and 648.4, respectively. Using the cumulative growth rates in Figure 1, and for a one-standard-deviation monetary easing, the share in total sales of micro and small firms increases from 9.2 percent to 9.3 percent, which corresponds to an increase of approximately 1.1 percent.

4.2 Robustness

4.2.1 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 transmission: age and leverage.

In Table 3, we account for the interaction of size and age. Age appears to be 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. (2024)). We create tree dummies for firm age (less than 15 years, between 15 and 50 years, and 50+ years) and interact them with the four size dummies to create a total of 12 size-age dummies. The estimates from this updated version of Equation 1 suggest that among micro and small firms, those aged 15-to-50 (rather than the youngest firms) react the most to monetary policy shocks, relative to the control group (medium-sized firms between 15 and 50 years old).

In Table 4, we account similarly for firm leverage, which recent work has singled out as a significant source of heterogeneity in the firm 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 these three dummies with the four firm-size, for a total of 12 size-leverage dummies. The estimates suggest that among micro, those with low leverage react the most, relative to the control group (medium-sized firms with medium leverage).

4.2.2 Placebo test

Another potential criticism with our approach is that changes in the ECB's monetary policy can be correlated with unobservable changes in the global environment that affect industry concentration differently in sectors more and less sensitive to changes in funding conditions – that is, sectors which typically respond more elastically to monetary policy shocks. For example, demand for goods produced or services delivered by sectors more sensitive to changes in external funding costs may shift in a way favoring small firms precisely at the time when monetary policy is becoming more accommodative. This would result in an increase in market competition without any direct contribution of monetary policy itself. At the same time, the econometrician will erroneously attribute the increase in the relative market share of small firms to changes in the monetary policy stance.

To address this concern, we re-run Equation 1 on a sample of 211,519 firms in non-euro-area European countries. Ex-ante, these countries should not be as affected by changes in the ECB's stance as euro area member states. Therefore, if we observe that changes in the market share of small firms in these countries move in sync with changes in the ECB's policy rate, we will conclude that also changes in market concentration in the euro area are likely unrelated to the monetary policy stance. We require that this sample has satisfactory coverage in Orbis. As a result of this choice, we end up with two countries: Croatia and Hungary.

The estimates from this placebo test are reported in Table 5. The data fail to reject the hypothesis that monetary policy shocks affect the differential growth rate of firms in these non-euro-area countries in the same way that they affect the firms in the euro-area sample, according to the results reported in Table 2. We therefore conclude that the headline result presented in Table 2 is consistent with a direct link in the euro area between the monetary policy shocks, on the one hand, and the extent of local market competition, on the other hand.

4.2.3 Model robustness

We also report estimates from regressions where we make alternative empirical modelling choices. To begin with, in our main regressions, we calculate sales growth as the year-on-year change in firm sales, excluding non-adjacent observations when an observation is missing. In this way, we lose about 7.9 percent of all observations. In column (1) of Table 6, we include observations based on sales reported in non-adjacent years. We assume constant growth during years with missing observations. The results are fully consistent with the estimates reported in column (2) of Table 2, as well as very similar in terms of statistical significance and numerical effect.

Finally, our results continue to obtain when instead of by firm, we cluster the standard errors by country-sector (column (2) of Table 6).

4.3 Price-cost margins

So far, we have proxied for changes in market competition by means of changes in the share on overall sales by firms of different size class. An alternative approach would involve looking at mark-ups. There is a large literature that has used price-cost margins to address questions related to competition and productivity (e.g., (De Loecker et al., 2020)). In Table 7, we run a version of Equation 1 where the dependent variable is the change in the firm's profit margin. We calculate price-cost margins 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 price-cost margin (e.g., (De Loecker & Warzynski, 2012)).

The point estimates suggest that following monetary policy easing (tightening), the price-cost margin of micro and small firms increases (declines), relative to medium-sized firms. In the case of micro firms, the effect is around four times larger than in the case of small firms. The data therefore suggest that firms at the left tail of the firm-size distribution do not only benefit from monetary easing in terms of market share in sales, but also in terms of profitability. Table 7 thus provides another piece of evidence that competition increases (decreases) when monetary policy is looser (tighter).

5 Mechanisms

What are the channels whereby monetary policy shocks affects firm-level sales growth differently, depending on firm size? In Table 8, we complement the main results with evidence on firms' investment and employment decisions in response to changes in the monetary policy stance. Here, we estimate a variant of Equation 1 where the dependent variable is the year-on-year log difference in firm-level investment or employment. As is common in the literature, we calculate investment as tangible assets (property, plant, and equipment).

The evidence in Table 8 points to a nuanced firm response to monetary policy shocks, depending on firm size. Following monetary easing, 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, micro and large firms experience a significant increase in employment, relative to medium-sized firms, when monetary policy becomes more accommodative (column (2)). Once again, the numerical effect capturing the heterogeneous effect of monetary policy on growth by firm size is substantial. In the case of employment, the point estimate on the interaction of monetary policy shocks with the micro firm dummy is 0.0009. This implies that a monetary easing that corresponds to one sample standard deviation (4.1) increases the employment growth of micro firms by 0.36 percentage points more than the sales growth of medium-sized firms. This corresponds to a non-negligible one-third of the sample mean employment growth.

The data thus provides some support to the notion that the non-linear response in size to changes in monetary policy on impact that we document in Table 2 is driven by a mechanism whereby firms in the left tail of the size distribution adjust employment rather than tangible assets.

Figure 2 plots estimated β^h_{1k} coefficients from a variant of Equation 1 where the dependent variable is investment and employment growth, respectively, for micro, small, and large firms, relative to medium-sized firms, at the time of an expansionary monetary policy shock. The data suggest that over a 3-year horizon, micro and small firms substitute employment (right panel) for tangible assets (left panel). In contrast, and relative to medium-sized firms, large firms increase their asset base, and only in the long run.

Why does employment react more than investment in the case of micro and small firms? One potential explanation is that if the boom caused by monetary easing is expected to be of a temporary nature, such a behavior might make sense if it is cheaper to hire workers than to purchase new equipment. To the extent that this behavior is symmetric, the propensity to increase investment more than employment in response to a contractionary monetary policy shock might be due difference in credit constraints. Unconstrained firms may take advantage of the decline in the user cost of capital caused by the monetary contraction, while constrained firms may be forced to cut back (Howes (2024)).

6 Monetary policy, firm debt, and credit access

What is the mechanism whereby small firms grow faster than large firms following monetary easing? One obvious candidate are adjustments in firm borrowing in response to borrowing constraints becoming less tight for small firms. To address this possibility, we next study the role that debt and credit play in the effect of monetary policy on competition. 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 and long-term debt. 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 1 using growth rates in short- and long-term debt as dependent variables. We note that accounting for short-term and long-term debt individually 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 9. Micro and small firms reduce their short-term debt in response to monetary easing, relative to medium-sized firms (column (1)). At the same time, small firms increases significantly their long-term debt (column (2)). In both cases, large firms do not take advantage of the lower cost of borrowing (if anything, the sign of the coefficient is negative), a result that runs contrary to the mechanism in Kroen et al. (2021)) and Liu et al. (2022). The evidence thus suggests that when monetary policy loosens, small firms increase their employment and sales, an effect accompanied by a higher proclivity to borrow long-term.

The opposite reaction of short-term and long-term debt to changes in the monetary policy stance, in the case of small firms, supports the notion that the liability structure responds to the cost of external finance. The fact that small firms reduce short-term debt and increase long-term debt when monetary policy loosens, and that this process is accompanied by an increase in growth, is consistent with theories where long-term debt imposes lower debt overhang than short-term debt (e.g., Myers (1977)).

Is this result driven by credit demand or by credit supply? While it is not easy in practice to disentangle the two 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. In practice, the number of physical branches in a region is divided by the population in the region. This information is available for 433 of the 818 regions in the data.[8] We then split the firms in our sample into those in above-median and those in below-median regions, based on the number of physical branches per 100,000 population.

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

The estimates from these regressions are reported in Table 10. We find that in regions with relatively lower bank branch density, sales growth by micro (large) firms declines (increases) after monetary easing (column (1)). The opposite is true in regions with high bank branch density: in these, sales growth by micro and small firms increases, and sales growth by large firms declines, relative to medium-sized firms (column (2)). Our results are consistent with the notion that the increase (decline) in market competition following monetary easing (tightening) is larger in regions that are better served by banks. Conceivably, these are regions where the transmission of monetary policy is both faster and stronger.

Figures 3-5 plot estimated β^h_{1k} coefficients from a variant of Equation 1 where the dependent variables are sales, investment, and employment growth, for firms in low- (left panel) and firms in high- (right panel) bank-branch-density regions respectively, for micro, small, and large firms, relative to medium-sized firms, at the time of an expansionary monetary policy shock. The data show that over a 3-year horizon, the sales, employment, and investment response to monetary accommodation on micro and small firms is larger for firms in regions with more competitive credit markets, while the sales and employment effect on large firms in larger for firms in region with less competitive credit markets.

7 Interpretation

7.1 Why is Europe different?

The evidence presented in the paper runs contrary to the main prediction in Liu et al. (2022) and the empirical result in Kroen et al. (2021). The mechanism developed in these papers suggests that by creating funding advantage to incumbent firms, accommodative monetary policy allows industry leaders to grow relatively faster, keeping competitors small and entrants out of the market. As a result, monetary easing is reflected in higher industrial concentration, especially when the accommodative stance persists for long.

In contrast, we find that monetary easing leads to higher growth by micro and small firms, especially over a medium horizon, accompanied by an expansion in employment. Consequently, in the euro area at least, a fall in the policy rate is associated with an increase in competition, as proxied by both market shares in sales and by mark-ups. Our results are thus consistent with earlier evidence from the US on the differential response by small and large firms (Gertler & Gilchrist (1994)).

The natural candidate to explain the difference between the two economic areas at present is the precise monetary transmission mechanism. The argument is often made that while in the US, monetary policy propagates to the real economy via asset prices, in the euro area it does so via credit markets. The latter is a well-accepted fact, to the point where some researchers have posed the question whether Europe is not "overbanked" (e.g., Langfield & Pagano (2016)). At the same time, in an economic area where monetary policy mainly affects funding conditions mostly through the bank lending channels, it is natural to expect that smaller, bank-dependent firms will respond more forcefully to changes in the monetary policy stance than large firms for which bank funding is not the primary source of external finance.

We formalize this observation next with a stylized model of firm investment in the presence of two separate borrowing constraints.

7.2 A stylized model

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:

$$y_t = [\alpha k_{t-1}^{\frac{\sigma-1}{\sigma}} + (1-\alpha) n_t^{\frac{\sigma-1}{\sigma}}]^{\frac{\sigma}{\sigma-1}}, \tag{2}$$

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

$$\pi_t = y_t - w_t n_t. \quad (3)$$

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

$$k_t = (1 - \delta) k_{t-1} + i_t, \quad (4)$$

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:

$$r_t i_t + w_t n_t \leq \theta_\pi \pi_t + \theta_k p_{k,t+1} (1 - \delta) k_t \quad (5)$$

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.[9]

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

Therefore, it is natural to assume that θ_π and θ_k increase with firm size.

Monetary policy 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 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 benefit more from monetary easing, especially if the transmission of monetary policy to the real economy via bank balance sheets is smoother. In practical terms, firms at the left tail of the size distribution borrow relatively more and grow faster than larger firms. This is ultimately reflected in an increasing market share of micro and small firms, suggesting a higher degree of product market competition.

A final nuance is related to our finding that employment adjusts more than investment in response to monetary policy shocks. One way to model this is to assume that in addition to reducing the tightness of the constraint – more so for micro and small firms – monetary easing also makes labor relatively cheaper. The CES production function we adopted implies that the firm's optimal capital intensity is given by

$$\frac{k_t}{l_t} = \left(\frac{r_t}{w_t}\frac{1-\alpha}{\alpha}\right)^{-\sigma} \tag{6}$$

In this way, $\partial\frac{k_t}{l_t}/\partial\frac{r_t}{w_t}$ is a negative function of σ. In other words, firms faced with relatively lower employment costs substitute into labor (the more so the higher is σ). For this argument to carry through, σ needs to be sufficiently high: in the limiting case of a Leontief production function where $\sigma = 0$, capital and labor are consumed in fixed proportions, and so changes in the relative cost of labor and capital do not affect the firm's optimal capital intensity.

8 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).[10] 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 affects the industry structure in a currency area where individual countries typically experience different economic conditions. This is an important question because competition in product markets 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 large firm-level dataset with high-frequency identified monetary policy shocks over the period 1999-2018 and estimate their effect on size-dependent firm growth using panel local projections. We do so for a sample of 750,000+ listed and unlisted firms in 12 euro area countries spanning the entire firm size distribution. Our main finding is that on impact, monetary easing is associated with higher sales growth by micro and large firms, but that over a 3-year horizon, micro and small firms grow the most. Numerically, and over a short-to-medium horizon, a monetary easing that corresponds to one standard deviations in the sample increase sales growth of micro and small firms by as much as 0.7 percentage points more than the sales growth of large firms. Small firms' price-cost margins increase as well, as does employment. Our results thus strongly support the notion that accommodative monetary policy in the euro area has been conducive to higher market competition.

Our findings stand in stark contrast to the US experience documented in Kroen et al. (2021). We hypothesize that this is largely because 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 – is more prominent in Europe than in the US. In support of this conjecture, we show that the underlying

[10] 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)).

mechanism is one whereby smaller firms increase their levels of long-term debt in response to monetary easing, and that the main result of the paper is stronger in regions with a more competitive banking sector. Our evidence suggests that in a bank-dependent economic area, low interest rates benefit relatively more smaller firms that are notoriously dependent on bank lending for their operations. At the same time, to the extent that the documented effect is symmetric, our evidence does caution that one of the consequences of tightening the monetary policy stance after a protracted period of low interest rates can be reduced market competition.

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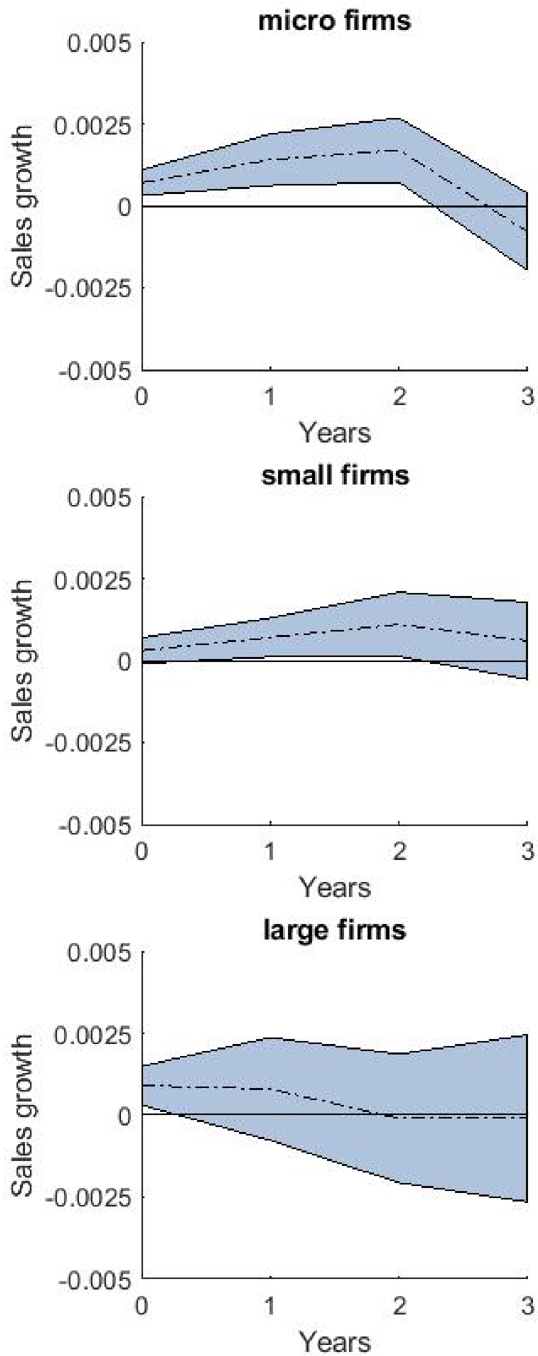
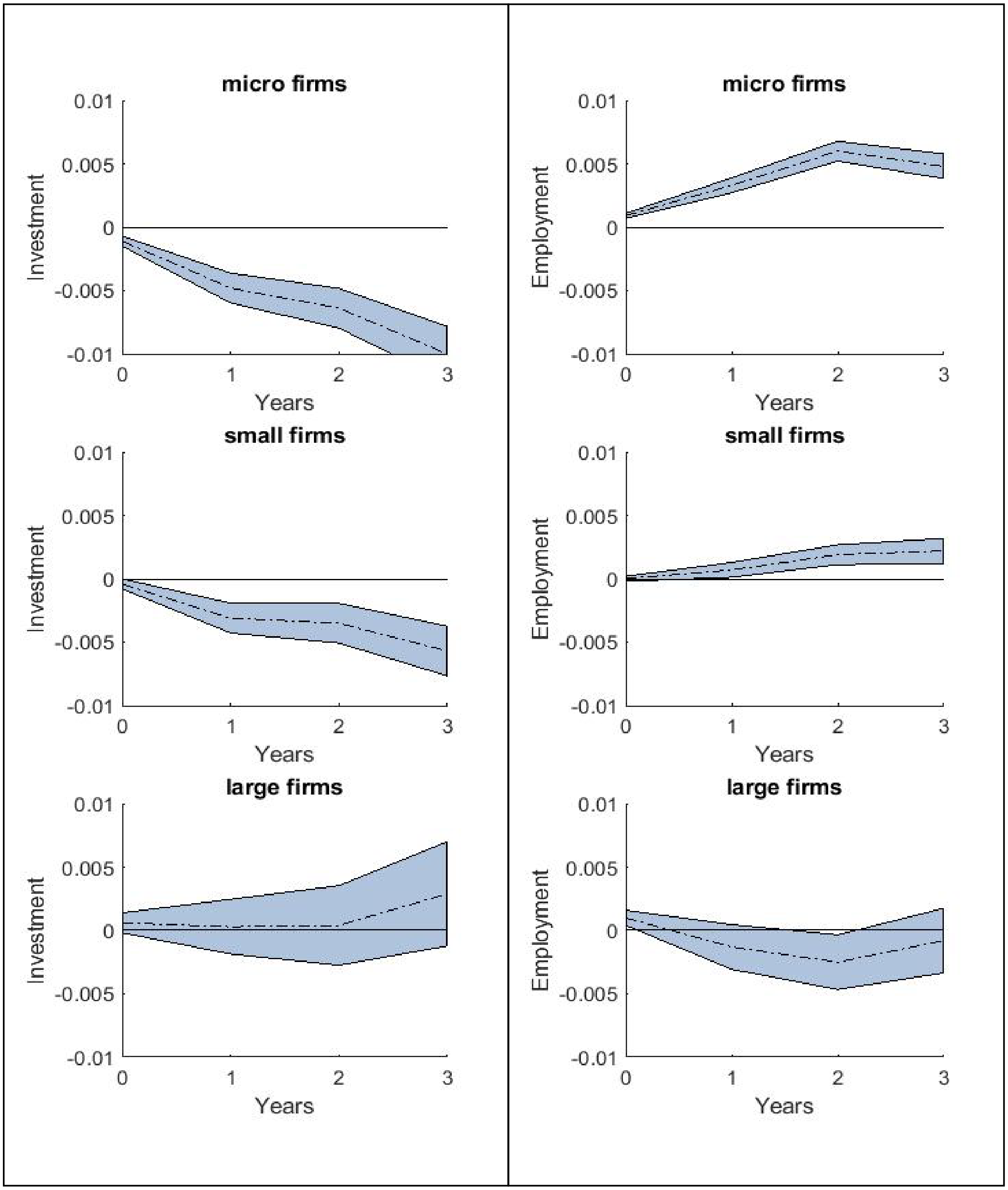
Figure 1. Local projections: Differential sales growth response associated with monetary easing



Note: *The Figure plots differential responses in sales growth by firm size class to a one standard deviation monetary policy easing shock, relative to medium-sized firms. The coefficients are etimated using the baseline specification in Equation (1). Shaded areas indicate a 95% confidence bands calculated from standard errors clustered by firms. The sample period is 1999—2018.*

Figure 2. Local projections: Differential assets and employment growth response associated with monetary easing



***Note**: The Figure plots differential responses in tangible investment growth (left panel) and employment (growth (right panel) by firm size class to a one standard deviation monetary policy easing shock, relative to medium-sized firms. The coefficients are etimated using the baseline specification in Equation (1). Shaded areas indicate a 95% confidence bands calculated from standard errors clustered by firms. The sample period is 1999—2018.*

Table 1. Summary statistics

	(1)	(2)	(3)	(4)	(5)
	Observations	Mean	St. dev.	Min.	Max.
sales growth	4,774,560	0.0070	0.3120	-1	1
assets growth	4,664,447	-0.0238	0.4050	-1	1
employment growth	4,673,113	0.0108	0.2754	-1	1
price-cost margin growth	4,408,754	-0.0031	0.1170	-1	1
short-term debt growth	2,026,077	-0.0150	0.5805	-1	1
long-term debt growth	2,891,398	-0.0703	0.5221	-1	1
micro	6,128,391	0.5281	0.4992	0	1
small	6,128,391	0.3469	0.4760	0	1
medium	6,128,391	0.0908	0.2874	0	1
large	6,128,391	0.0342	0.1817	0	1
baby	5,830,995	0.4948	0.5000	0	1
mature	5,830,995	0.4691	0.4990	0	1
old	5,830,995	0.0360	0.1863	0	1
low leverage	4,788,602	0.3431	0.4747	0	1
mid leverage	4,788,602	0.3344	0.4718	0	1
high leverage	4,788,602	0.3225	0.4674	0	1
MP_{t-1}	5,912,323	0.2633	4.0540	-13.5	8.4833
GDP growth $_{t-1}$	6,128,391	0.0142	0.0254	-0.1512	0.1269
branch density	2,845,154	6.7004	7.6810	0.0031	36.0476

***Note**: The Table summarizes the variables used in the empirical tests. The sample period is 1999—2018. Only firms that report a credit association with at least one bank are included. 'sales growth' denotes the year-on-year log difference in total sales. 'assets growth' denotes the year-on-year log difference in property, plants and equipment. 'employment growth' denotes the year-on-year log difference in total employment. 'price-cost margin growth' denotes the year-on-year log difference in the ratio of EBITDA to operating revenue. 'short-term debt growth' denotes the year-on-year log difference in total debt with maturity of less than one year. 'long-term debt growth' denotes the year-on-year log difference in total debt with maturity of more than one year. 'micro' is a dummy variable equal to one if the firm has fewer than 10 employees. 'small' is a dummy variable equal to one if the firm has between 10 and 50 employees. 'medium' is a dummy variable equal to one if the firm has between 50 and 250 employees. 'large' is a dummy variable equal to one if the firm has more than 250 employees. 'baby' is a dummy variable equal to one if the firm is less than 15 years old. 'mature' is a dummy variable equal to one if the firm is between 15 and 50 years old. 'old' is a dummy variable equal to one if the firm is more than 50 years old. 'low leverage' is a dummy variable equal to one if the firm's ratio of debt-to-assets is less than 0.05. 'mid leverage' is a dummy variable equal to one if the firm's ratio of debt-to-assets is between 0.05 and 0.25. 'high leverage' is a dummy variable equal to one if the firm's ratio of debt-to-assets is more than 0.25. 'MP_{t-1}' is the (lagged) 6-month average EA-wide MP shock based on changes in OIS with 2-year maturity. 'GDP_{t-1}' is the growth of GDP in the past 12 months. '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 firm growth: Headline results

	(1) *sales growth*	(2) *sales growth*
microMP_{t-1}*	0.0007***	0.0007***
	(0.0001)	(0.0002)
smallMP_{t-1}*	0.0016***	0.0003**
	(0.0001)	(0.0002)
largeMP_{t-1}*	-0.0011***	0.0009***
	(0.0002)	(0.0003)
micro	-0.0429***	
	(0.0005)	
small	-0.0171***	
	(0.0005)	
large	0.0265***	
	(0.0011)	
*micro*GDP growth $_{t-1}$*	0.5698***	0.0355
	(0.0190)	(0.0249)
*small*GDP growth $_{t-1}$*	0.2246***	-0.0116
	(0.0188)	(0.0233)
*large*GDP growth $_{t-1}$*	-0.1271***	0.3160***
	(0.0359)	(0.0481)
MP_{t-1}	0.0036***	
	(0.0001)	
GDP growth $_{t-1}$	0.8159***	
	(0.0165)	
firm FE	No	Yes
*region*sector*time FE*	No	Yes
N	4,577,203	3,934,721
R^2	0.02	0.25

Note: *The dependent variable denotes the change in aggregate sales at firm-level at time t. 'MP_{t-1}' is the (lagged) 6-month average EA-wide MP shock based on changes in OIS with 2-year maturity. 'micro' is a dummy variable equal to one for firms with <10 employees at time t, and zero otherwise. 'small' is a dummy variable equal to one for firms with 10-49 employees, and zero otherwise. 'large' is a dummy variable equal to one for firms with >250 employees, and zero otherwise. The sample is based on all euro area countries with good coverage in Orbis (Austria, Estonia, France, Germany, Greece, Latvia, Lithuania, Malta, Netherlands, Portugal, Slovenia, and Spain). The sample period is 1999—2018. Only firms that report a credit association with at least one bank are included. 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: Interaction between size and age

	(1) *sales growth*
*micro*baby*MP_{t-1}*	-0.0029
	(0.0027)
*micro*mature*MP_{t-1}*	0.0013*
	(0.0008)
*micro*old* MP_{t-1}*	-0.0000
	(0.0013)
*small*baby*MP_{t-1}*	-0.0048*
	(0.0025)
*small*mature*MP_{t-1}*	0.0008**
	(0.0003)
*small*old*MP_{t-1}*	0.0010
	(0.0009)
*medium*baby*MP_{t-1}*	-0.0058***
	(0.0018)
*medium*old*MP_{t-1}*	0.0010*
	(0.0005)
*large*baby*MP_{t-1}*	-0.0045**
	(0.0017)
*large*mature*MP_{t-1}*	0.0008
	(0.0019)
*large*old*MP_{t-1}*	0.0003
	(0.0027)
*micro*baby*GDP $gr._{t-1}$*	0.4914***
	(0.1593)
*micro*mature*GDP $gr._{t-1}$*	-0.2150
	(0.1608)
*micro*old*GDP $gr._{t-1}$*	-0.4609*
	(0.2525)
*small*baby*GDP $gr._{t-1}$*	0.5513***
	(0.1521)
*small*mature*GDP $gr._{t-1}$*	-0.1829***
	(0.0524)
*small*old*GDP $gr._{t-1}$*	-0.3487***
	(0.1074)
*medium*baby*GDP $gr._{t-1}$*	0.5363***
	(0.1435)
*medium*old*GDP $gr._{t-1}$*	-0.3204***
	(0.1094)
*large*baby*GDP $gr._{t-1}$*	0.8028***
	(0.2283)
*large*mature*GDP $gr._{t-1}$*	0.3208
	(0.2635)
*large*old*GDP $gr._{t-1}$*	0.4724
	(0.3078)
firm FE	Yes
*region*sector*time FE*	Yes
N	3,934,721
R^2	0.25

Notes: *The dependent variable denotes the change in aggregate sales at firm-level at time t. 'MP_{t-1}' is the (lagged) 6-month average EA-wide MP shock based on changes in OIS with 2-year maturity. 'micro' is a* *dummy variable equal to one for firms with <10 employees at time t, and zero otherwise. 'small' is a dummy variable equal to one for firms with 10-49 employees, and zero otherwise. 'large' is a dummy variable equal to one for firms with >250 employees, and zero otherwise. 'baby' is a dummy variable equal to one for firms of <15 years of age, and zero otherwise. 'mature' is a dummy variable equal to one for firms between 15 – 50 years of age, and zero otherwise. 'old' is a dummy variable equal to one for firms of ≥50 years of age, and zero otherwise. The sample is based on all euro area countries with good coverage in Orbis (Austria, Estonia, France, Germany, Greece, Latvia, Lithuania, Malta, Netherlands, Portugal, Slovenia, and Spain). The sample period is 1999—2018. Only firms that report a credit association with at least one bank are included. 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 firm growth: Interaction between size and leverage

	(1) *sales growth*
*micro*low leverage*MP_{t-1}*	0.0006*
	(0.0004)
*micro*mid leverage*MP_{t-1}*	0.0001
	(0.0003)
*micro*high leverage*MP_{t-1}*	-0.0010
	(0.0014)
*small*low leverage*MP_{t-1}*	0.0002
	(0.0005)
*small*mid leverage*MP_{t-1}*	-0.0001
	(0.0004)
*small*high leverage*MP_{t-1}*	-0.0015**
	(0.0007)
*medium*low leverage*MP_{t-1}*	-0.0003
	(0.0010)
*medium*high leverage*MP_{t-1}*	-0.0014**
	(0.0005)
*large*low leverage*MP_{t-1}*	0.0005
	(0.0021)
*large*mid leverage*MP_{t-1}*	0.0012
	(0.0034)
*large*high leverage*MP_{t-1}*	-0.0003
	(0.0036)
*micro*low leverage*GDP $gr._{t-1}$*	-0.0029
	(0.0320)
*micro*mid leverage*GDP $gr._{t-1}$*	0.1414***
	(0.0478)
*micro*high leverage*GDP $gr._{t-1}$*	0.2348
	(0.1471)
*small*low leverage*GDP $gr._{t-1}$*	-0.0387
	(0.0640)
*small*mid leverage*GDP $gr._{t-1}$*	0.0468
	(0.0562)
*small*high leverage*GDP $gr._{t-1}$*	0.1871**
	(0.0642)
*medium*low leverage*GDP $gr._{t-1}$*	0.0110
	(0.0729)
*medium*high leverage*GDP $gr._{t-1}$*	0.1318*
	(0.0658)
*large*low leverage*GDP $gr._{t-1}$*	0.1213
	(0.1657)
*large*mid leverage*GDP $gr._{t-1}$*	0.4510
	(0.3177)
*large*high leverage*GDP $gr._{t-1}$*	0.6225
	(0.3886)
firm FE	Yes
*region*sector*time FE*	Yes
N	3,934,721
R^2	0.25

Notes: *The dependent variable denotes the change in aggregate sales at firm-level at time t. 'MP_{t-1}' is the (lagged) 6-month average EA-wide MP shock based on changes in OIS with 2-year maturity. 'micro' is a* *dummy variable equal to one for firms with <10 employees at time t, and zero otherwise. 'small' is a dummy variable equal to one for firms with 10-49 employees, and zero otherwise. 'large' is a dummy variable equal to one for firms with >250 employees, and zero otherwise. 'low leverage' is a dummy variable equal to one for firms with total debt/total assets ≤ 0.05, and zero otherwise. 'mid leverage' is a dummy variable equal to one for firms with total debt/total assets > 0.05 and ≤ 0.25, and zero otherwise. 'high leverage' is a dummy variable equal to one for firms with total debt/total assets > 0.25, and zero otherwise. The sample is based on all euro area countries with good coverage in Orbis (Austria, Estonia, France, Germany, Greece, Latvia, Lithuania, Malta, Netherlands, Portugal, Slovenia, and Spain). The sample period is 1999—2018. Only firms that report a credit association with at least one bank are included. 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 firm growth: Placebo sample

	(1) *sales growth*
microMP_{t-1}*	-0.0019***
	(0.0004)
smallMP_{t-1}*	0.0005
	(0.0004)
largeMP_{t-1}*	-0.0004
	(0.0008)
*micro*GDP gr.$_{t-1}$*	-0.0350
	(0.0303)
*small*GDP gr.$_{t-1}$*	0.0705**
	(0.0301)
*large*GDP gr.$_{t-1}$*	-0.0830
	(0.0574)
firm FE	Yes
*region*sector*time FE*	Yes
N	941,751
R^2	0.25

Notes: *The dependent variable is firm-level sales growth in non-euro are countries. 'MP_{t-1}' is the (lagged) 6-month average EA-wide MP shock based on changes in OIS with 2-year maturity. 'micro' is a dummy variable equal to one for firms with <10 employees at time t, and zero otherwise. 'small' is a dummy variable equal to one for firms with 10-49 employees, and zero otherwise. 'large' is a dummy variable equal to one for firms with >250 employees, and zero otherwise. The sample is based on Croatia and Hungary. The sample period is 1999—2018. Only firms that report a credit association with at least one bank are included. 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 firm growth: Robust model

	(1) *sales growth*	(2) *sales growth*
*micro*MP$_{t-1}$*	0.0006***	0.0007*
	(0.0002)	(0.0004)
*small*MP$_{t-1}$*	0.0002*	0.0003
	(0.0001)	(0.0003)
*large*MP$_{t-1}$*	0.0011***	0.0009*
	(0.0003)	(0.0006)
*micro*GDP gr.$_{t-1}$*	0.1155***	0.0355
	(0.0234)	(0.0958)
*small*GDP gr.$_{t-1}$*	0.0526**	-0.0116
	(0.0219)	(0.0403)
*large*GDP gr.$_{t-1}$*	0.3016***	0.3160***
	(0.0468)	(0.0914)
firm FE	Yes	Yes
*region*sector*time FE*	Yes	Yes
N	4,294,335	3,934,721
R^2	0.24	0.25

Notes: *The dependent variable in column (1) denotes the change in aggregate sales at firm-level at time t which includes non-adjacent observations; robust standard errors (in parentheses) are clustered at the firm-level. The dependent variable in column (2) denotes the change in aggregate sales at firm-level at time t, as usual, but robust standard errors (in parentheses) are clustered at the country-sector level. 'MP_{t-1}' is the (lagged) 6-month average EA-wide MP shock based on changes in OIS with 2-year maturity. 'micro' is a dummy variable equal to one for firms with <10 employees at time t, and zero otherwise. 'small' is a dummy variable equal to one for firms with 10-49 employees, and zero otherwise. 'large' is a dummy variable equal to one for firms with >250 employees, and zero otherwise. The sample is based on all euro area countries with good coverage in Orbis (Austria, Estonia, France, Germany, Greece, Latvia, Lithuania, Malta, Netherlands, Portugal, Slovenia, and Spain). The sample period is 1999—2018. Only firms that report a credit association with at least one bank are included. 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 firm growth: Price-cost margin

	(1) *price-cost margin growth*
micro$*MP_{t-1}$*	0.0004***
	(0.0001)
small$*MP_{t-1}$*	0.0001**
	(0.0001)
large$*MP_{t-1}$*	0.0001
	(0.0001)
*micro*GDP gr.*$_{t-1}$	0.1012***
	(0.0089)
*small*GDP gr.*$_{t-1}$	0.0520***
	(0.0082)
*large*GDP gr.*$_{t-1}$	-0.0580***
	(0.0197)
firm FE	Yes
*region*sector*time FE*	Yes
N	3,820,639
R^2	0.1140

Notes: *The dependent variable is the firm-level price-cost margin growth at time t. 'MP_{t-1}' is the (lagged) 6-month average EA-wide MP shock based on changes in OIS with 2-year maturity. 'micro' is a dummy variable equal to one for firms with <10 employees at time t, and zero otherwise. 'small' is a dummy variable equal to one for firms with 10-49 employees, and zero otherwise. 'large' is a dummy variable equal to one for firms with >250 employees, and zero otherwise. The sample is based on all euro area countries with good coverage in Orbis (Austria, Estonia, France, Germany, Greece, Latvia, Lithuania, Malta, Netherlands, Portugal, Slovenia, and Spain). The sample period is 1999—2018. Only firms that report a credit association with at least one bank are included. 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 firm growth: Investment and employment

	(1) *assets growth*	(2) *employment growth*
$micro*MP_{t-1}$	-0.0011***	0.0009***
	(0.0002)	(0.0001)
$small*MP_{t-1}$	-0.0004**	-0.0000
	(0.0002)	(0.0001)
$large*MP_{t-1}$	0.0006	0.0010***
	(0.0004)	(0.0003)
$micro*GDP\ gr._{t-1}$	0.2038***	-0.9454***
	(0.0309)	(0.0232)
$small*GDP\ gr._{t-1}$	0.1735***	-0.1379***
	(0.0294)	(0.0218)
$large*GDP\ gr._{t-1}$	0.3036***	0.5282***
	(0.0591)	(0.0503)
firm FE	Yes	Yes
*region*sector*time FE*	Yes	Yes
N	3,834,815	3,899,891
R^2	0.25	0.21

Notes: *The dependent variables in columns (1), (2) and (3) are asset growth, investment growth, and employment growth at the firm-level at time t, respectively. 'MP_{t-1}' is the (lagged) 6-month average EA-wide MP shock based on changes in OIS with 2-year maturity. 'micro' is a dummy variable equal to one for firms with <10 employees at time t, and zero otherwise. 'small' is a dummy variable equal to one for firms with 10-49 employees, and zero otherwise. 'large' is a dummy variable equal to one for firms with >250 employees, and zero otherwise. The sample is based on all euro area countries with good coverage in Orbis (Austria, Estonia, France, Germany, Greece, Latvia, Lithuania, Malta, Netherlands, Portugal, Slovenia, and Spain). The sample period is 1999—2018. Only firms that report a credit association with at least one bank are included. 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 9: Monetary policy shocks & firm growth: Firm debt structure

	(1) *short-term debt growth*	(2) *long-term debt growth*
*micro*MP$_{t-1}$*	-0.0040***	0.0000
	(0.0005)	(0.0004)
*small*MP$_{t-1}$*	-0.0019***	0.0014***
	(0.0004)	(0.0004)
*large*MP$_{t-1}$*	-0.0009	-0.0004
	(0.0008)	(0.0007)
*micro*GDP gr.$_{t-1}$*	-0.3001***	-0.0844
	(0.0701)	(0.0558)
*small*GDP gr.$_{t-1}$*	-0.1559**	-0.0808
	(0.0631)	(0.0546)
*large*GDP gr.$_{t-1}$*	0.5641***	0.3224***
	(0.1233)	(0.1043)
firm FE	Yes	Yes
*region*sector*time FE*	Yes	Yes
N	1,508,639	2,269,681
R^2	0.22	0.23

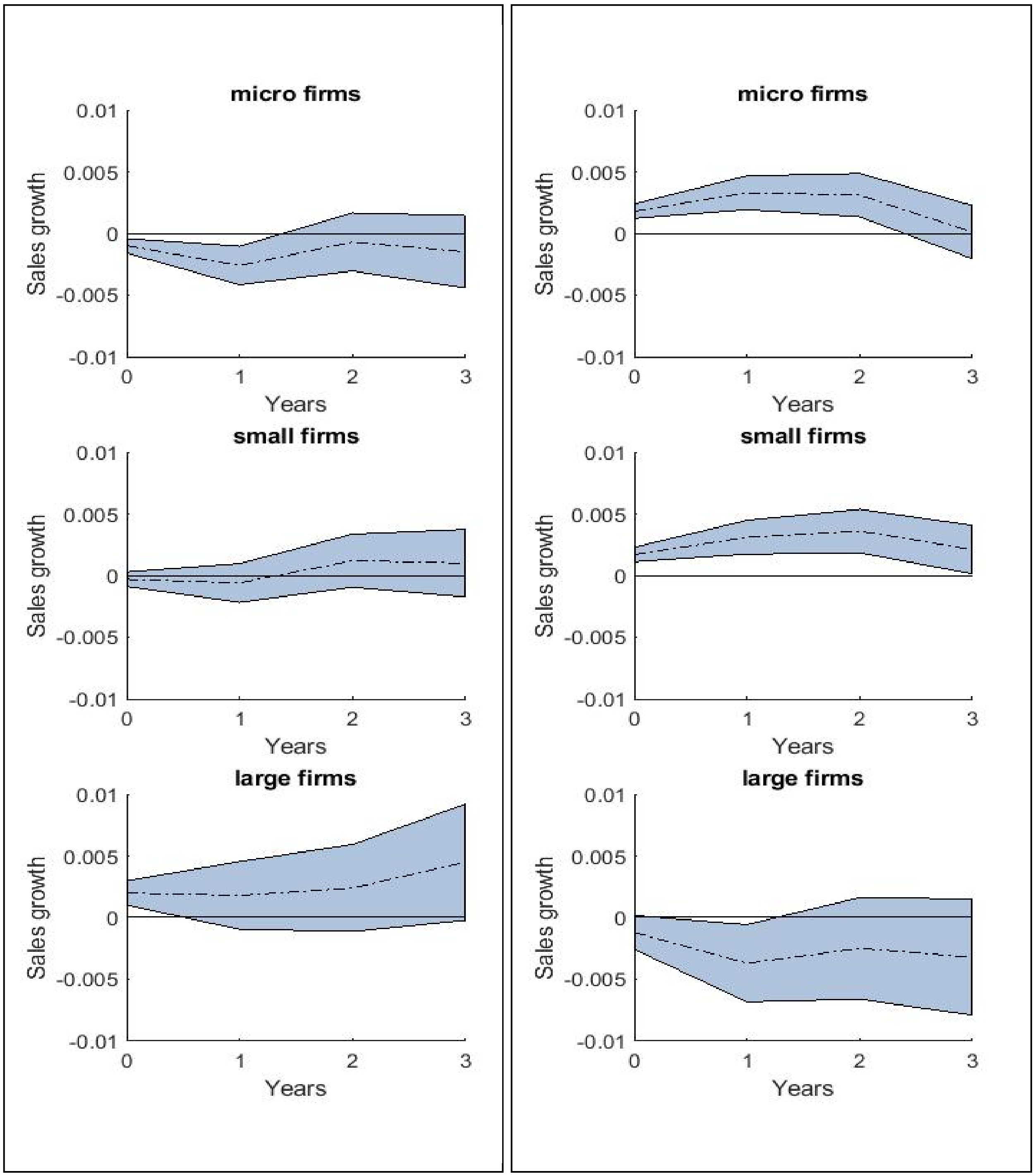
Notes: *The dependent variable in columns (1) and (2) are the firm-level short-term ("Current Liabilities") and long-term ("Non-Current Liabilities") debt growth rates at time t, respectively. 'MP$_{t-1}$' is the (lagged) 6-month average EA-wide MP shock based on changes in OIS with 2-year maturity. 'micro' is a dummy variable equal to one for firms with <10 employees at time t, and zero otherwise. 'small' is a dummy variable equal to one for firms with 10-49 employees, and zero otherwise. 'large' is a dummy variable equal to one for firms with >250 employees, and zero otherwise. The sample is based on all euro area countries with good coverage in Orbis (Austria, Estonia, France, Germany, Greece, Latvia, Lithuania, Malta, Netherlands, Portugal, Slovenia, and Spain). The sample period is 1999—2018. Only firms that report a credit association with at least one bank are included. 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 10: Monetary policy shocks and firm growth: Role of bank branch density

	(1) *sales growth,* *low bank branch density*	(2) *sales growth,* *high bank branch density*
*micro*MP*$_{t-1}$	-0.0010***	0.0018***
	(0.0003)	(0.0003)
*small*MP*$_{t-1}$	-0.0003	0.0017***
	(0.0003)	(0.0003)
*large*MP*$_{t-1}$	0.0020***	-0.0012
	(0.0005)	(0.0007)
*micro*GDP gr.*$_{t-1}$	0.1325***	0.1437***
	(0.0487)	(0.0484)
*small*GDP gr.*$_{t-1}$	0.0503	0.0497
	(0.0467)	(0.0460)
*large*GDP gr.*$_{t-1}$	0.5331***	0.4233***
	(0.0836)	(0.1101)
firm FE	Yes	Yes
*region*sector*time FE*	Yes	Yes
N	951,388	1,081,320
R^2	0.30	0.22

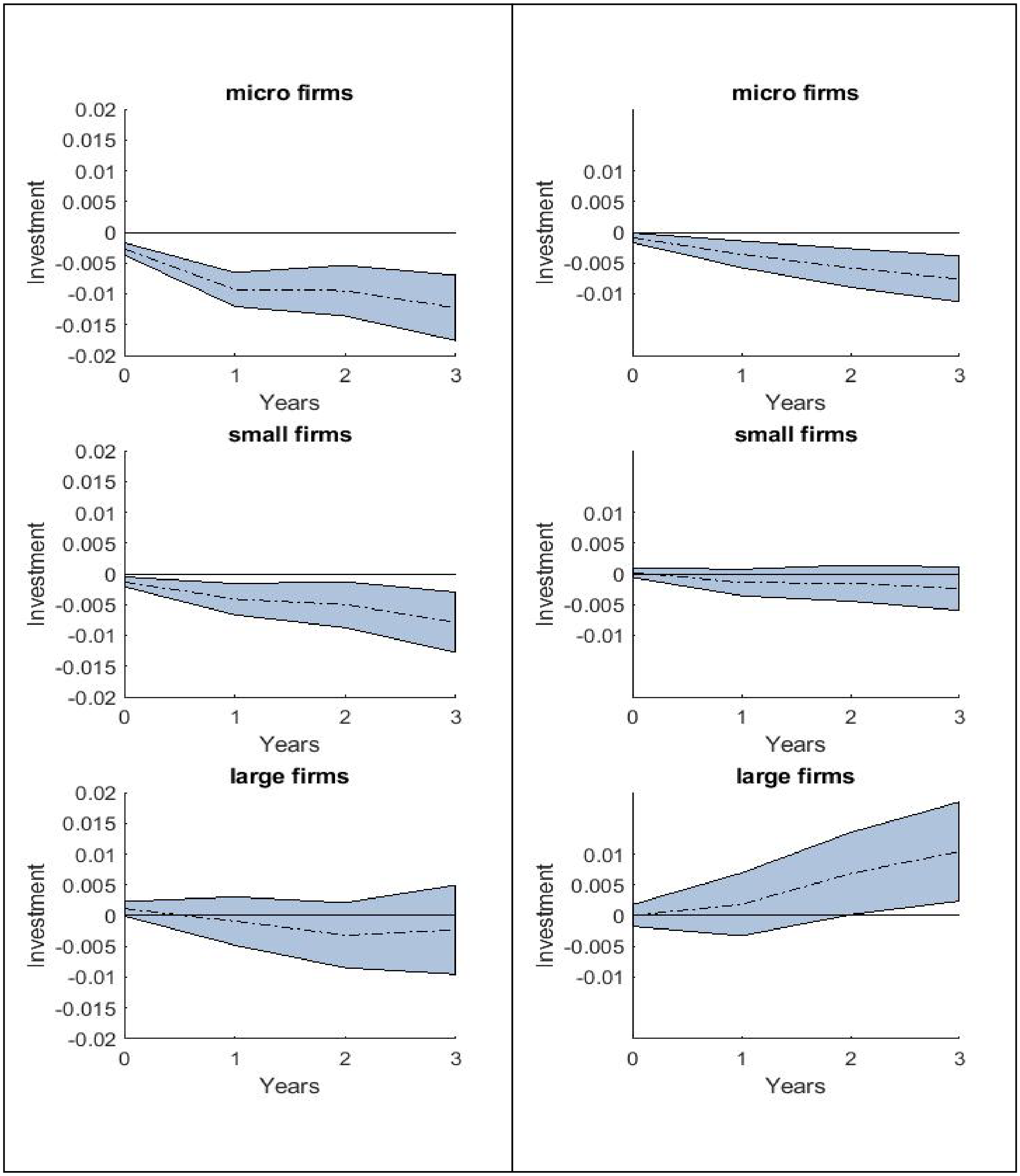
Notes: *The dependent variable denotes the change in aggregate sales at firm-level at time t. The left-hand side (right-hand side) column displays the results from a sample split of firms in areas of lower (higher) than average bank branch density. '*MP_{t-1}*' is the (lagged) 6-month average EA-wide MP shock based on changes in OIS with 2-year maturity. 'micro' is a dummy variable equal to one for firms with <10 employees at time t, and zero otherwise. 'small' is a dummy variable equal to one for firms with 10-49 employees, and zero otherwise. 'large' is a dummy variable equal to one for firms with >250 employees, and zero otherwise. The sample is based on all euro area countries with good coverage in Orbis (Austria, Estonia, France, Germany, Greece, Latvia, Lithuania, Malta, Netherlands, Portugal, Slovenia, and Spain). The sample period is 1999—2018. Only firms that report a credit association with at least one bank are included. 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.*

Figure 3. Local projections: Differential sales growth response associated with monetary easing, depending on local bank branch density



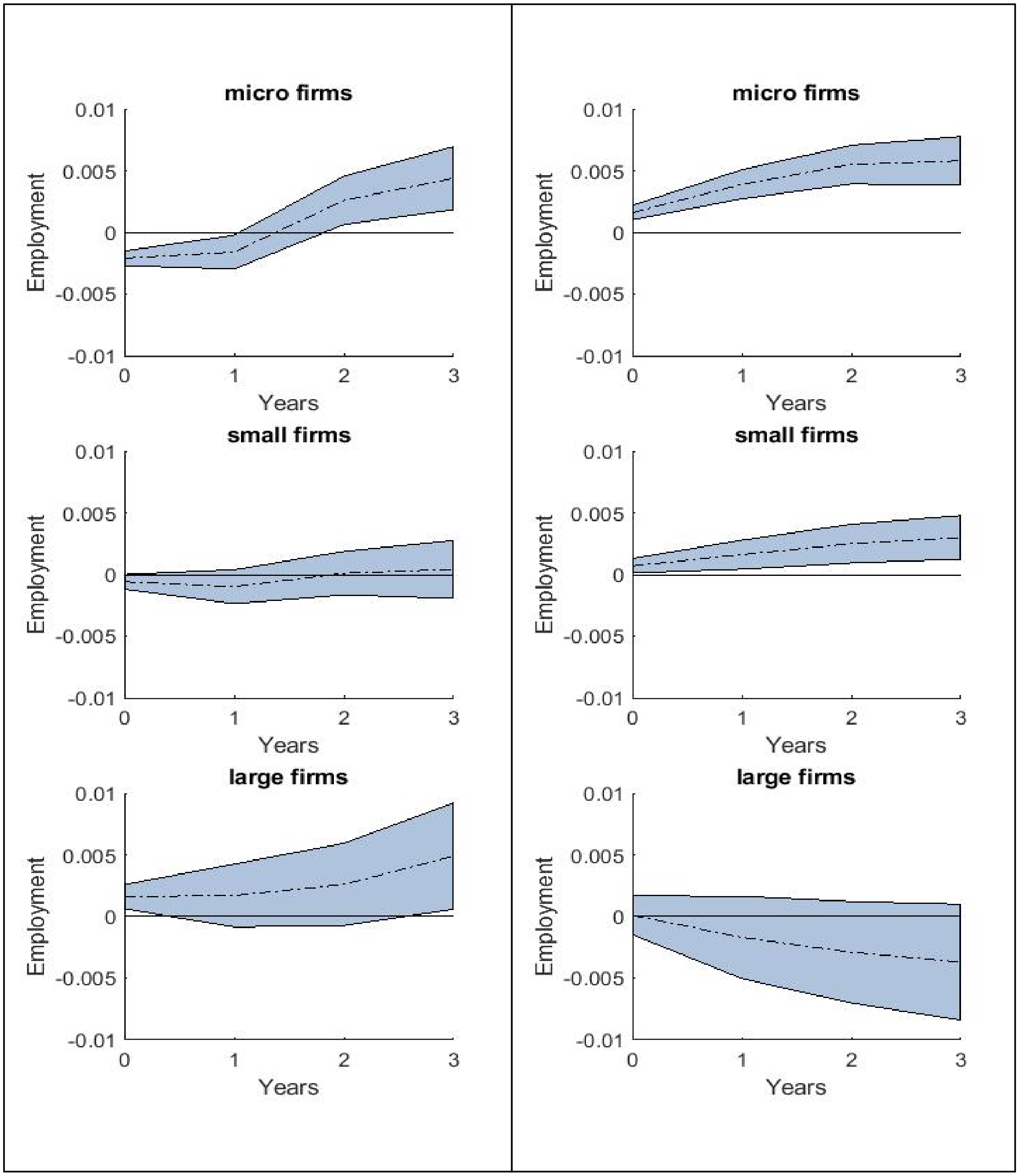
***Note**: The Figure plots differential responses in sales growth by firm size class to a one standard deviation monetary policy easing shock, relative to medium-sized firms, in regions with low (left panel) and with high (right panel) bank branch density. The coefficients are etimated using the baseline specification in Equation (1). Shaded areas indicate a 95% confidence bands calculated from standard errors clustered by firms. The sample period is 1999—2018.*

Figure 4. Local projections: Differential assets growth response associated with monetary easing, depending on local bank branch density



***Note**: The Figure plots differential responses in tangible assets growth by firm size class to a one standard deviation monetary policy easing shock, relative to medium-sized firms, in regions with low (left panel) and with high (right panel) bank branch density. The coefficients are etimated using the baseline specification in Equation (1). Shaded areas indicate a 95% confidence bands calculated from standard errors clustered by firms. The sample period is 1999—2018.*

Figure 5. Local projections: Differential employment growth response associated with monetary easing, depending on local bank branch density



***Note**: The Figure plots differential responses in employment growth by firm size class to a one standard deviation monetary policy easing shock, relative to medium-sized firms, in regions with low (left panel) and with high (right panel) bank branch density. The coefficients are etimated using the baseline specification in Equation (1). Shaded areas indicate a 95% confidence bands calculated from standard errors clustered by firms. The sample period is 1999—2018.*