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Abstract

We study how monetary policy affects market competition in the euro area. Based on a sample of over 1.4 million firms, we show that when monetary conditions ease (tighten), smaller firms' sales and profit margins increase (decline) relative to medium and large firms. The underlying mechanism is an increase (decline) in long-term debt, investment, and employment by small firms following lower policy rates. The effect is stronger in local markets with higher bank competition. Contrasting recent evidence for the US, our results suggest that monetary easing can strengthen market competition and productivity in a bank-based economy, and highlight the role of financial factors in underpinning this relation. We rationalize these findings by theorizing firm-size-dependent access to external debt financing.

JEL Classification: E2, G1

Keywords: Eurozone

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Monetary Policy and Market Competition: Is Europe Different?*

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Abstract

We study how monetary policy affects market competition in the euro area. Based on a sample of over 1.4 million firms, we show that when monetary conditions ease (tighten), smaller firms' sales and profit margins increase (decline) relative to medium and large firms. The underlying mechanism is an increase (decline) in long-term debt, investment, and employment by small firms following lower policy rates. The effect is stronger in local markets with higher bank competition. Contrasting recent evidence for the US, our results suggest that monetary easing can strengthen market competition and productivity in a bank-based economy, and highlight the role of financial factors in underpinning this relation. We rationalize these findings by theorizing firm-size-dependent access to external debt financing.

JEL classification: E2, G1, G12.

Keywords: Eurozone, Monetary Policy, Low Interest Rates, Firm Growth and Investment, Market Competition.

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1 Introduction

In recent years, two empirical regularities have independently captured the interest of both financial and 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 (Covarrubias et al., 2020), 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 decades after the introduction of the euro (1999–2017). This samples is representative of the European corporate sector as it covers at total of 1.4 million listed and unlisted firms. 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 then translate these orthogonal shocks into the impact of monetary policy changes on sales growth, investment, and employment by individual firms, depending on their size.

Our main finding is that accommodative monetary policy leads to higher market competition, driven by sales growth of small firms, relative to medium and large firms. Numerically, a monetary easing that corresponds to two standard deviations in the sample increase sales growth of micro and small firms by up to 0.56 percentage points more than the sales growth of large firms. This corresponds to a non-negligible 24 percent of the sample mean sales growth in the sample. Importantly, not only sales growth, but also alternative measures of performance and profitability, such as the price-cost margin and cash flow, increase relatively more for small firms in the wake of monetary loosening. Our results thus strongly support the notion that accommodative monetary policy in the euro area has been conducive to higher market competition. In fact, we also show that under plausible assumptions, the reduction in overall industrial concentration, as measured by standard proxies of market competition,

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

is non-negligible. Thus, our results have implications not just at the micro level, but also for important characteristics of the aggregate economy, such as the firm size distribution.

Endogeneity. The main result of the paper is robust to three main potential confounding factors. First and foremost is the issue of endogeneity. A significant correlation between the monetary policy stance and market competition can obtain in the data for example because a third, unobservable factor (e.g., risk-taking) may be 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, showing that the relation between the monetary policy stance and firm growth varies by firm size. In this way, we are able to hold a number of unobservable background forces constant. Among these are sectors-specific trends related for example to shocks to global demand or technology adoption; country-specific trends related for example to regulatory reform or shocks to risk aversion; and heterogeneity at the country-sector related for example to fixed differences in technology or substitutability between capital and labor. Furthermore, we can control directly for the effect of the country-specific 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.

Second, monetary policy can be endogenous to economic development, which may introduce reverse causality 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.

Third, changes in the Central Banks's monetary policy stance 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. 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 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 European countries whose currency is neither the euro, nor is it pegged to the euro. Ex-ante, these countries should not be affected – or at least not to the same extent – by changes in the ECB's monetary policy stance. The data confirm that this is indeed the case, which strengthens further the notion that we are documenting a genuine statistical relation between monetary policy and market competition.

We show that the main result of the paper is robust (see Section 4.2) to a number of alternative empirical choices. First, the underlying monetary policy shocks are constructed at a monthly frequency. In the main analysis, we aggregate them over a 6-month period, and then map them into firm-level changes in sales growth over the following year. However, we show that the effect of changes in monetary policy on sales growth by firm size are qualitatively similar when we aggregate the monthly shocks over shorter (3-month) and longer (12-month) horizons. Second, the main result still obtains when we explicitly control for the independent effect of the local business cycle.

Channels. Finally, we study the microeconomic channels responsible for the main effect. We identify one underlying mechanism whereby both investment and employment by smaller firms grows relatively faster in response to a reduction in policy rates, relative to investment and employment by larger firms. Digging further, we find that smaller firms increase their level of debt, and in particular of long-term debt, when monetary policy loosens. 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 at the expense of larger ones. This is plausible 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, Gutiérrez & Philippon (2023) analyze the HHI of market concentration as a measure of market power, and document a recent increase in concentration. This conclusion is corroborated by considering a number of trends, such as a rise in firm markups based on a variety of approaches and a decline in a variety of measure of economic dynamism. 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 labour share of income. However, some 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. Hartman-Glaser et al. (2019), Autor et al. (2020), and Kehrig & Vincent (2017) focus on the role of large firms. 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 (2017).

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 competitive intensity in Europe. Nevertheless, recent evidence tentatively points to a broad-based decline in concentration in Europe. As noted above, Gutiérrez & Philippon (2023) document a persistent decline in the HHI of market concentration in a sample of European countries between 1997 and 2007. Cavalleri et al. (2019) find that, in contrast to the situation in the US, market power metrics have been relatively stable over recent years and – in terms of the markup specifically – marginally trending down since the late 1990s, driven largely by 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 revive economic activity and to bring inflation closer to policy targets. 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. There has been some analysis of the ability of such policies to maintain inflation close to target (see, e.g., Gertler & Karadi (2015), Jarocinski & Karadi (2019), and Swanson (2021)). More relevant to our work, some authors have also conceptualized and documented international spillovers associated with monetary policy shocks (e.g., Fratzscher et al. (2016), Popov (2016), Morais et al. (2019) Quadrini (2020)). At the same time, this literature has typically analysed the cross-border transmission of monetary policy from more to less developed economic areas. In contrast, we analyse the implications of common monetary policy within a currency area.

Surprisingly, and to the best of our knowledge, there has been comparatively little examination of the real effect of monetary policy, for instance, on well-defined characteristics in product markets, such as industrial competition. A major exception is a recent paper by Liu et al. (2022) which finds that by benefiting incumbents more than entrants, low interest rates have contributed to increasing industrial concentration in US markets. This paper highlights a strategic force that reduces aggregate investment and productivity growth at very low interest rates. In their model, when firms engage in strategic behavior, market leaders have a stronger investment response to lower interest rates relative to followers, and this stronger investment response leads to more market concentration and eventually 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 likely because monetary policy in Europe is primarily transmitted to the real economy through banks. As small and medium 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 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. (2023); 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. (2023)), asset tangibility (Durante et al. (2022)), liquidity (Jeenas (2019)), and size (Gertler & Gilchrist (1994); Liu et al. (2022)). The evidence presented in these paper 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. We contribute to the latter strand of analysis, and to the unresolved debate therein on whether small firms respond more or less forcefully to changes in the monetary policy stance than market leaders.

Roadmap. The paper proceeds as follows. In Section 2, we describe the data used in the analysis. 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 identification strategy is aimed 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. 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 exogenous changes in the ECB's monetary policy stance identified by Altavilla et al. (2019). We now discuss these in turn.

2.1 Firm-level data

Our 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 worldwide. 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 may 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. At this stage, the data set contains about 100 million firm-year observations, but about a quarter of those relate to firms that have not provided financial information in any given year.

For our analysis, we focus on EU – euro area and non-euro area – companies with financial data in the period 1999–2017, and we work with unconsolidated accounts. We follow the downloading methodology and cleaning procedure described in Kalemli-Özcan et al. (2023) in order to ensure the database is nationally representative and contains minimal missing information. In terms of firm-specific information, we make use of the following variables: sales, tangible fixed assets, employment, total debt, long-term debt, and short-term debt. 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 total assets, fixed assets, sales, total debt, 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, (ii) total assets match the sum of fixed assets and current assets, and (iii) current liabilities match the sum of loans, trade credit and other current liabilities.

Because we want to investigate the importance of credit market factors, we only keep firms that report a credit relationship with at least one bank. We also drop country-specific sectors, such as agriculture and mining; sectors with high government ownership, such as public administration; and heavily regulated sectors, such as finance. For our analysis we retain only firms in Manufacturing (NACE Rev. 2 Section C), Construction (F), Wholesale and retail trade (G), Transportation and storage (H), Accommodation and food service activities (I), Information and communication (J), Professional, scientific and technical activities (M) and we drop firm-year observations if there are less than 10 firms in each NACE Rev. 2 digit-4 sector. Finally, because coverage varies widely by country, we do drop countries based on a small number of firm observations, resulting in poor coverage.

After applying all these procedures, we are left with about 1.4 million companies unique firms in 12 euro area countries over the sample period 1999–2017. The countries in question are Austria, Estonia, France, Germany, Greece, Latvia, Lithuania, Malta, the Netherlands, Portugal, Slovenia, and Spain.

We also construct a placebo sample of firms in 6 European countries that during the sample period in question were neither members of the euro area nor had their currency pegged to the euro. These countries are Croatia, Hungary, Great Britain, Macedonia, Romania, and Switzerland.

Finally, 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 being unserved in credit markets.

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. These shocks mute the potential endogeneity of monetary policy by focusing on movements of prices in a narrow window around monetary policy communication events (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).[3] Following Holm et al. (2021), we sum up the shocks to semi-annual frequency in the main specification.[4]

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. Similarly, they are also more appropriate for our purposes than language-based approaches to exogenous monetary policy (e.g. Romer & Romer (2004) and Aruoba & Drechsel (2022)) because potential measurement error is muted in the press release (which focuses on the communication of the actual policy decision itself and – unlike the subsequent press conference – addresses no other topics).

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 change 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

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

[3] We consider the forward rate from the press release window 13:25-13:35 before the press release to the window 14:00-14:10 after it (Altavilla et al., 2019).

[4] We also control for quarterly and annual sums of monetary policy shocks in the robustness check in Table 5.

missing), assuming in the latter case a constant growth rate over periods when actual values are not recorded. On average, firms' sales grow by 2.3 percent during our sample period. This is accompanied by a 0.8-percent decline in investment and a 1.1-percent increase in employment. Price-cost margins have also declined over the sample period, as has firm indebtedness, both in terms of short-term and long-term debt. On the other hand, sales growth over the sample period has increased at an annual rate of 2.8 percent.

Turning to the main explanatory variables, we find that more than half (53.9 percent) of firms in the dataset are micro firms. A further 33.6 percent of firms are defined as small, and 9 percent are medium. Only 3.5 percent of the firms in the dataset are large. We designate the firm size bins using a standard SME classification whereby micro firms have less 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.

In terms of macro variables, changes in monetary policy have on average pointed to easing over 6-month periods, but to tightening over shorter and longer periods. GDP growth in the countries in the dataset has been 1.4 percent on average. Finally, the average region in the dataset exhibits a bank branch concentration of 6.5 branches per 100,000 population.[5]

3 Empirical strategy

Our main econometric model focuses on the relationship between firm-level measures of growth and exogenous measures of changes in the monetary policy stance. While we also estimate local projections[6] for a glimpse into the longer horizon (Jordà, 2005), our baseline specification assumes the following data generating process:

$$\Delta Sales_{f,s,c,t} = \sum_{k=m,s,l} 1[j \in k](\alpha_k + \beta_k \Delta MP_{t-1}) + \gamma_{c,s} + \mu_{c,t} + \phi_{s,t} + \varepsilon_{f,s,c,t}, \tag{1}$$

[5]These data are calculated as the number of physical bank branches in a NUTS-3 regions, from SNL, divided by the region's population. We thank Glenn Schepens for sharing his bank-branch data with us.

[6]See Section A.2.

On the left-hand side of Equation 1, $\Delta Sales_{f,s,c,t}$ denotes the change in firm-level sales over the past 12 months. 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 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 different periods. In the main analysis, we aggregate these shocks over the past 6 months, but in robustness tests we also do so for 3 and 12 months. 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 financial circumstances 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 other 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 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 also include interactions of country, sector, and year dummies, which allows us to hold constant a number of unobservable background forces. $\gamma_{c,s}$ is a matrix of country-sector dummy interactions. These control for any unobservable factors that are mostly fixed over time (e.g., technology differences between firms in Construction in Germany and firms in Construction in Spain). The term $\mu_{c,t}$ is an interaction of country and year-month, which absorbs any time-varying varying variation in business conditions that is common to all sectors in a country. The term $\phi_{s,t}$ is an interaction of 2-digit NACE sectors and year-month dummies, which absorbs any time-varying shocks to demand or technology that are common to a sector across all countries. Finally, $\varepsilon_{f,s,c,t}$ is the idiosyncratic error term.

We do not include the variables ΔMP_{t-1} on its own, because its independent effect is absorbed by the interaction of country and time dummies $\mu_{c,t}$. The coefficients of interest are β_m, β_s, and β_l. 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 firms).

Finally, all models are based on panel data and are estimated using Ordinary Least Squares (OLS). Section A.2 provides a panel local projection specification for extended horizons to yield IRFs of the effect of monetary policy. In all application, we cluster the standard errors at the country-sector level, to account for potential correlation among firms in the same country and sector.

4 Empirical evidence

4.1 Headline result

In Table 2, we present the main results of the paper whereby we take equation 1 to the data. We report four different versions of equation 1, where we introduce various controls gradually. In column (1), we do not include any of the fixed effects, which allows us to control for the independent effect of the variable ΔMP_{t-1}. We find that on average, sales growth increase in firm size, with average sales growth lower by 4.2 percentage points for micro firms and by 1.4 percentage points for small firms, but higher by 2.2 percentage points for large firms, relative to medium firms. Importantly, we also find that changes in the monetary policy stance have an intuitive and expected effect. Namely, monetary easing (i.e., higher values of ΔMP_{t-1} in the past six months) is associated with an increase in sales growth for all types of firms over the course of the following year. The point estimate is significant at the 1-percent statistical level.

At the same time, we find that the effect of monetary policy shocks is heterogenous across firm size classes. The point estimates on the interaction variables suggest that after monetary easing, and relative to medium firms, sales growth by small firms increases, and sales growth by large firms declines. This effect is significant at the 1-percent and at the 5-percent statistical level, respectively. The evidence thus strongly suggests that monetary easing (tightening) is associated with an increase (decline) the market share of small firms, and a decline (increase) in the market share of large firms. In this sense, the results suggest that monetary easing (tightening) is associated with an increase (decline) in market competition.

The rest of Table 2 confirms that the main results are robust to estimating them using models which control for a number of possible unobservable confounding forces. In column (2), we add a time trend, defined as year-month dummies. We can no longer estimate the independent effect of monetary policy, nevertheless, we continue obtaining a significant heterogeneous effect of monetary policy shocks across firm size classes. In column (3), we find that the main result of the paper continues to obtain when we include an interaction of country and sector dummies, which control for the effect of time-invariant heterogeneity in demand or technology across sectors in the same country.

Finally, in column (4) we estimate our preferred specification which includes sector trends and country trends. The R-squared of the regression increases to 0.06. In this specification, we find that relative to medium ones, not only small but also micro firms grow faster, while large firms' sales growth rates decline, following monetary easing. However, the latter effect is no longer significantly different from zero at any conventional statistical level.

The numerical effect describing the heterogeneous effect of monetary policy on growth by firm size is substantial. Take the preferred specification in column (4). The point estimate on the interaction of monetary policy shocks with the small firm dummy is 0.0007. This implies that a monetary easing that corresponds to two standard deviations in the sample increases sales growth of small firms by 0.56 percentage points more than the sales growth of large firms. This corresponds to a non-negligible 24 percent of the sample mean sales growth. Our results thus strongly support the notion that accommodative monetary policy in the euro area has been conducive to higher market competition. We also note that the main result is attained when controlling for country $\times$ time, country $\times$ sector, and sector $\times$ time dummies. Thereby, we make sure that our estimates are not biased by omitted factors that are common to all sectors in a country over time, as well as to country-specific and sector-specific trends in demand or technology.

The main result is illustrated in Figure 1 which shows local projections of the monetary policy shock into sales growth, by firm size bin, for a 1-standard deviation monetary easing. A falling elasticity of sales growth to monetary policy shock by firm size is readily apparent.[7]

[7] See Appendix A.2 for details. There we also discuss the macroeconomic implications of our micro evidence, in terms of market competition

4.2 Robustness

To make sure that our results are not driven by particular empirical choices, we now report results from a number of robustness tests where we employ alternative models, samples, monetary policy shocks, and measures of competition.

4.2.1 Robust model

In Table 3, we report estimates from models where we employ an alternative model. In column (1), we control for the independent effect of the business cycle on the heterogeneity of firm growth. We do so by including an interaction of GDP growth with the three firm-size dummies. In practice, we estimate the following equation:

$$\Delta Sales_{f,s,c,t} = \sum_{k=m,s,l} 1[j \in k](\alpha_k + \beta_{1k}\Delta MP_{t-1} + \beta_{2k}\Delta GDP_{c,t-1}) + \gamma_{c,s} + \mu_{c,t} + \phi_{s,t} + \varepsilon_{f,s,c,t}, \tag{2}$$

The structure of the regression equation now allows us to control for the impact of changes in real economic activity on industrial concentration. This is important because even though the monetary policy shocks we use are high-frequency identified and orthogonal to economic activity, such economic may have an important independent effect on market competition. We find that this is indeed the case: micro and small firms grow relatively faster, ad larger firms relatively more slowly, following an expansion in economic activity. Importantly, the main result of the paper – that small firms are most sensitive to monetary policy shocks, resulting in a higher (lower) market share for small (large) firms – survives this stricter specification.

In column (2), we control for the independent effect of other firm-level characteristics that may affect sales growth independently of firm size, in response to monetary policy shocks. The literature has zeroed in onto factors, such as dependence on bank credit (Crouzet (2021); Holm-Hadulla & Tuerwachter (2021)), age (Cloyne et al. (2023); Durante et al. (2022)), leverage (Ottonello & Winberry (2020)) and liquidity (Jeenas (2019)) to explain heterogeneous responses to changes in the monetary policy stance. We note that the former margin is already subsumed in the analysis because we require all firms included in the final dataset to have at least one banking relationship. We now account for the potential role of the latter three factors by including lagged empirical proxies capturing the respective theoretical mechanisms. In practice, we estimate the following equation:

$$\Delta Sales_{f,s,c,t} = \sum_{k=m,s,l} 1[j \in k](\alpha_k + \beta_{1k}\Delta MP_{t-1}) + \beta_{2k}\Theta_{f,t-1} + \gamma_{c,s} + \mu_{c,t} + \phi_{s,t} + \varepsilon_{f,s,c,t}, \tag{3}$$

Here, $\Theta_{f,t-1}$ is a matrix which includes: the natural logarithm of total sales, to control for convergence effects; firm age; the natural logarithm of the sum of long- and short term-debt, divided by total assets, to control for the effect of leverage; and the ratio of cash to total assets, to control for the effect of liquidity. All these variables are 1-period lagged. The evidence presented in column (2) of Table 3 strongly suggests that controlling for a host of relevant firm-level characteristics does not change the main result of the paper – namely, that small firms are more likely to increase (reduce) their sales when monetary policy becomes looser (tighter).

One final concern is related to unobservable firm heterogeneity. In practice, a lot of the observed variation may be cross-sectional and time-invariant, and be a feature of the data even in the absence of any time-series variation. To address this concern, we now estimate the following version of Equation 1:

$$\Delta Sales_{f,s,c,t} = \sum_{k=m,s,l} 1[j \in k](\alpha_k + \beta_{1k}\Delta MP_{t-1}) + \gamma_f + \mu_{c,t} + \phi_{s,t} + \varepsilon_{f,s,c,t}, \tag{4}$$

Relative to Equation 1, we now control for firm fixed effects as opposed to country-sector fixed effects. We note that in this specification, we do not control for the firm-level characteristic included on the right-hand side of equation (3) because they are very slowly moving and potentially collinear with firm fixed effects. The evidence, which we present in column (3), continues to support the notion that smaller (both micro and small) firms are significantly more sensitive to changes in the monetary policy stance than medium and large firms.

4.2.2 Robust measure of sales growth

Recall that in our main regressions, we calculate sales growth as the year-on-year change in firm sales, including non-adjacent observations when an observation is missing. In the latter case, we assumed constant growth during years with missing observations. In column (1) of Table 4, we run a more restricted regression based on observations where sales growth are calculated only for non-missing adjacent observations. In this way, we lose about 7.9 percent of all observations. The results are fully consistent with the estimates reported in column (4) of Table 2, as well as very similar in terms of statistical significant and numerical effect.

4.2.3 Robust sample

In column (2) of Table 3, we include observations from those euro area countries, or countries whose currency is pegged to the euro, which we excluded from the analysis because of poor coverage. These countries are Belgium, Cyprus, Denmark, Ireland, and Luxembourg. The sample increases by less than 0.4 percent, and the main results remain qualitatively and quantitatively unchanged.

4.2.4 Robust monetary policy shocks

In Table 5, we employ other time horizons to calculate the relevant monetary policy shock. Recall that in the main specification, we aggregate the monthly shocks from Altavilla et al. (2019) over the 6 months before the relevant time period. We now repeat this procedure over 3 months (column (1)) and over 12 months (column (2)). We find that the choice of aggregation period matters economically, but not qualitatively. In both cases, small firms grow relatively faster in response to monetary easing. At the same time, they are the only ones to respond when monetary policy shocks are aggregated over shorter horizons (column (1)). In contrast, we find that micro firms respond forcefully and significantly when monetary policy shocks are aggregated over longer horizons (column (2)).

These results point to an important nuance regarding the length of the period over which monetary policy affects into responses by firms. Importantly, they also continue to support the main conclusion of our analysis – that monetary easing (tightening) is associated with an increase (decline) in market competition, proxied by the share of small firms in sales.

4.2.5 Alternative measures of performance

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 alternative measures of firm performance, such as profitability and cash flow. For a start, there is a large literature that has looked into issues related to the price-cost margins (De Loecker et al., 2020; Hall, 2018). In column (1) of Table 6, we replicate Equation 1, where now the dependent variable is the change in the firm's profit margin, instead of its sales growth. We calculate profit 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 (De Loecker & Scott, 2016; De Loecker & Warzynski, 2012; Diez et al., 2019).

The point estimates suggest that following monetary policy easing (tightening), the price-cost margin of micro and small firms increases (declines), relative to medium firms. For large firms, the effect goes in the opposite direction. Tabel 5 thus provides another piece of evidence that competition increases in the wake of looser monetary policy, as proxied by a relative increase in small firms' profit margins.

In column (2), we look at changes in cash flow at the firm level. Once again, we estimate Equation 1, but this time the dependent variable is the year-on-year growth in cash flow. We find that relative to medium firms, and following monetary easing, cash flow growth declines in the case of micro and large firms, with the effect being barely significant at the 10-percent level in the first case. However, cash flow increases strongly for small firms, and this effect is significant at the 1-percent statistical level. The effect is economically meaningful, too. The point estimate is 0.001 and it implies that a monetary easing that corresponds to two standard deviations in the sample increases cash flow growth of small firms by 0.8 percentage points more than the sales growth of large firms. This corresponds to a non-negligible 30 percent of the sample mean cash flow growth.

The evidence presented in Table 6 thus suggests that small firms do not only benefit from accommodative monetary policy in the sense of increases their market share in sales, but they also benefit in terms of relative profitability.

4.3 Placebo test

Another potential criticism with our approach is that changes in the ECB's monetary policy is 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 that typically respond more forcefully 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 European countries whose currency during the sample period was neither the euro, nor was it pegged to the euro. 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 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 also require that this sample has satisfactory coverage in `Orbis`. In all, we end up with six countries: Croatia, Hungary, Great Britain, Macedonia, Romania, and Switzerland.

The estimates from this placebo test are reported in Table 7. The data broadly fail to reject the hypothesis that monetary policy shocks affect the differential growth rate of firms in these non-euro-area countries. At the same time, the coefficient on the interaction between monetary policy shocks and the small-firm dummy is marginally significant at the 10-percent statistical level. This suggests that even though the countries in our placebo sample neither use the euro nor peg their currencies to it, they may still be to some extent affected by changes in the ECB's stance. This is plausibly due to their economic and financial integration with the euro area countries.

We therefore conclude that the headline result presented in Table 2 and confirmed in Tables 3-6 is consistent with a direct link in the euro area between the monetary policy stance and changes thereof, on the one hand, and the extent of local market competition, on the other hand.

5 Mechanisms

8 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 change in firm-level investment or employment. In practice, we estimate the following regression equations:

$$\Delta Investment_{f,s,c,t} = \sum_{k=m,s,l} 1[j \in k](\alpha_k + \beta_k \Delta MP_{t-1}) + \gamma_{c,s} + \mu_{c,t} + \phi_{s,t} + \varepsilon_{f,s,c,t}, \tag{5}$$

and

$$\Delta Employment_{f,s,c,t} = \sum_{k=m,s,l} 1[j \in k](\alpha_k + \beta_k \Delta MP_{t-1}) + \gamma_{c,s} + \mu_{c,t} + \phi_{s,t} + \varepsilon_{f,s,c,t}, \tag{6}$$

Once again, we use firm-level data from `Orbis`. As in the case of sales, whenever an observation is missing, we calculate growth rates using the closest non-missing observations and assuming constant growth rates.

The point estimates reported in Table 8 strongly suggest that changes in sales growth are mirrored by changes in investment and employment. In particular, small firms reduce (increase) investment in response to monetary tightening (easing), and large firms react in the opposite way (column (1)). In terms of employment, the effect is similar, but it is only significantly different from zero in the case of large firms (column (2)).

The data thus provides some evidence to suggests that the increase in market share for small firms in the wake of monetary easing is accompanied by complementary firm decisions in terms of the main inputs in production.

6 Firm debt and credit access

What is the main mechanism whereby small firms increase investment relatively more than large firms when market funding conditions improve, following monetary accommodation? One obvious candidate are adjustments in firm borrowing. 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 total debt, as well as on short-term and long-term debt. We calculate changes in the three types of debt in the same way in which we calculate changes in sales, investment, and employment. Subsequently, we re-run Equation 1 using growth rates in the three types of 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 form these tests are reported in Table 9. We find no appreciable heterogeneity in the effect of changes in monetary policy on total debt (column (1)). However, this appears to be accompanied by important reallocation across different types of debt. Micro and small firms increase (reduce) their long-term debt in response to monetary easing (tightening), while large firms do the opposite (column (2)). At the same time, for micro and small firms, the evolution of short-term debt follows an inverse patter (column (3)). The evidence thus suggests that when monetary policy loosens, small firms increase their investment, employment, and sales, and this is 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, for small firms, supports the notion that the liability structure responds to the cost of external finance. The fact that small firms decrease short-term debt when monetary policy tightens, and that this decrease is mirrored by a decline in investment and sales, is consistent with theories where short-term debt imposes lower debt overhang than long-term debt (e.g., Diamond & He (2014)).

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 calculate, for each region in our sample, the extent of bank competition and credit access. To do so, we use `SNL` to calculate the number of physical branches in a region, sum them up, and then divide by population. We then split 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.

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 and small firms increases (declines) significantly after monetary easing (tightening) (column (1)). At the same time, the effect in the case of small firms is quantitatively stronger in regions with relatively higher bank branch density (column (2)). Moreover, in such regions sales growth declines (increases) for large firms in the wake of monetary easing (tightening). Our results suggest 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 bank lending channel is more potent.

7 Interpretation

7.1 Why is Europe different? The role of credit markets

The evidence presented in the paper runs contrary to the main insight in Liu et al. (2022) and Kroen et al. (2021). These papers argue that by creating funding advantage to incumbent firms, accomodative monetary policy allows them to grow relatively faster, keeping 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 accommodative monetary policy is due to higher relative growth by small firms, and that an increase in the policy rate increases industrial concentration, especially in a low-for-long environment.

Our estimates, and in particular the evidence in Tables 8 and 9, suggest that in the case of the euro area, the mechanism at play is different, and as a result, the effect is reversed. Liu et al. (2022) argue that when market funding conditions improve, large firms are better placed than small firms to reap these funding-cost benefits thanks to capital markets. At the same time, in the euro area, small firms may be more likely to benefit from more accommodative monetary policy (Gertler & Gilchrist (1994)). Monetary tightening, on the other hand, leads them to reduce borrowing, and as result they invest less and grow at a lower rate. This fact is then reflected in higher market competition.

The natural candidate to explain the difference between the two economic areas 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.

7.2 A stylized model

We now present a simple model with constraints on firm borrowing to formalize the microeconomic evidence with macroeconomic implications 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 Cobb-Douglas production function:

$$y_t = A_t k_{t-1}^{\alpha} n_t^{\alpha-1}, \tag{7}$$

and its price is normalized to 1. $\alpha \in (0,1)$ is the share of capital in production. A_t denotes productivity at time t. The firm's earnings flow, or operational profit, is denoted as π_t and is defined as

$$\pi_t = y_t - w_t n_t. \tag{8}$$

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

$$k_t = (1-\delta)k_{t-1} + [1 - \Psi_t(\tfrac{i_t}{i_{t-1}})]i_t, \tag{9}$$

where δ is the depreciation rate. The term $\Psi_t(\frac{i_t}{i_{t-1}})$ introduces investment adjustment costs. Following Christiano et al. (2005) and Smets & Wouters (2007), we assume that $\Psi_t(1) = 0$, $\Psi_t'(1) = 0$, and $\Psi_t''(1) > 0$. The term $[1 - \Psi_t(\frac{i_t}{i_{t-1}})]$ is commonly referred to as "investment margin" (see, e.g., Drechsel (2023)). The presence of investment adjustment costs will lead to variations in the market value of capital.

Debt financing can take place in the form of two alternative one-period bonds, $b_{\pi,t}$ and $b_{k,t}$, where $b_{\pi,t-1}$ and $b_{k,t-1}$ are predetermined at the beginning of period t.

The flow of funds constraint of the firm in units of the consumption good can be written as

$$i_t + b_{\pi,t} + b_{k,t} = y_t - w_t n_t + (1-\delta)k_{t-1} + \tfrac{b_{\pi,t}}{1+r_{\pi,t}} + \tfrac{b_{\pi,t}}{1+r_{k,t}}, \tag{10}$$

where $r_{\pi,t}$ and $r_{k,t}$ are the respective market interest rates received by lenders.

Finally, given the two types of borrowing, we formulate the following two types of borrowing constraints:

$$\tfrac{b_{\pi,t}}{1+r_{\pi,t}} \leq \theta_\pi \pi_t \tag{11}$$

and

$$\frac{b_{,t}}{1+r_{k,t}} \leq \theta_k p_{k,t+1}(1-\delta)k_t. \tag{12}$$

where $p_{k,t+1}$ is the expected value of the capital stock net of depreciation in the next period.

The parameters $\theta_\pi < 1$ and $\theta_k < 1$ capture the exogenous tightness of the constraints. As in much of the literature, borrowing constraints reflect the fact that the ability of a borrower to issue debt is limited due to an underlying friction such as information or enforcement limitations. A collateral constraint can emerge as the 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)). An earnings-based constraint can emerge for a number of different reasons: because the firm is able to directly pledge its earnings stream rather than an asset in return for obtaining access to debt funding; because the borrower has the ability to divert funds, in which case the lender can seize and operate the firm; or because regulation requires that lenders engage in different risk treatment of loans that feature different earnings-to-debt ratios.

In this fashion, the model provides useful intuition for why firm investment – 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.[8] 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, too. 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. Alternatively, monetary policy can affect firm investment by regulating the pool of funds available to bank-dependent borrowers. This is reflected in the level of interest rates that lenders receive.

This discussion suggests that extending the model to a world where the constraints θ_π and θ_k

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

depend heterogeneously on firm size would yield predictions in line with the principal evidence in our paper. Monetary policy induced fluctuations in firm profits, in the value of capital available to firms, in banks' ability to extend loanable funds given regulatory requirements on how to treat loan risk, 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, smaller firms borrow relatively more and grow faster than larger firms, and this is ultimately reflected in a declining share of large firms in overall sales and investment, and in a higher degree of product market competition.

We note one final nuance. In our tests, and in line with our discussion, smaller firms are on average more sensitive to monetary policy shocks than medium and larger firms. At the same time, in most of our tests (with the notable exception of column (3) of Table 3), micro firms (i.e., firms with fewer than 10 employees) are less sensitive to monetary surprises than small firms (i.e., firms with between 10 and 50 employees), a regularity well illustrated in Figure 1. This suggests that θ_π and θ_k increase non-linearly with firm size. In terms of our stylized framework, this non-linearity can for example be modeled as $\theta_{\pi,small} <= \theta_{\pi,micro}$ and $\theta_{k,small} <= \theta_{k,micro}$. This would make investment by small firms more sensitive to changes in the cost of external finance than investment by micro firms. One way to micro-found this assumption is by noting that micro firms are too risky and too collateral-poor. As a result, such firms often have no access to credit markets whatsoever, an observation endemic to much of the empirical literature on microcredit (for a review of the microfinance literature, see, for instance, Banerjee (2013)). In this case, monetary policy-induced changes in the cost of external finance will have no effect.

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).[9]

[9] 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)).

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), Estrada et al. (2013), 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 take this question to the euro area experience since the introduction of the euro in 1999. We employ firm-level data from `Orbis` for 12 euro area economies during the 19 years after the introduction of the euro (1999–2017). We also employ recent high-frequency identified monetary policy shocks by Altavilla et al. (2019) to circumvent concerns that monetary policy may respond endogenously to the business cycle, and thus be driven by rather than drive the changes in market competition.

Our main finding is that looser monetary policy is associated with higher sales growth by small firms, relative to medium and large firms. Numerically, a monetary easing that corresponds to two standard deviations in the sample increase sales growth of micro and small firms by up to 0.56 percentage points more than the sales growth of large firms. This corresponds to a non-negligible 24 percent of the sample mean sales growth in the sample. Importantly, not only sales growth, but only investment, employment, and profit margins, increase relatively more for small firms in the wake of monetary loosening. 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 Liu et al. (2022). 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 confirmation of this conjecture, we show that the underlying mechanism is one whereby smaller firms increase their levels of debt in response to monetary easing, and that the main result of the paper is stronger in regions that are better served by banks.

Our results 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. They also serve as a cautious reminder that tightening the monetary policy stance after a protracted period of low interest rates can have real economic effects through the channel of reduced market competition.

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Table 1: Summary statistics

Variable	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**
sales growth	5,589,751	.023	.314	-1	1
tangibles growth	5,042,626	-.008	.403	-1	1
employees growth	5,048,519	.011	.278	-1	1
price-cost margin growth	4,838,554	-.003	.116	-1	1
cash flow growth	4,855,018	.028	.543	-1	1
total debt growth	3,462,264	-.020	.522	-1	1
long-debt growth	3,046,569	-.054	.520	-1	1
short-debt growth	2,072,225	-.008	.584	-1	1
micro firms	6,650,339	.539	.498	0	1
small firms	6,650,339	.336	.472	0	1
medium firms	6,650,339	.090	.286	0	1
large firms	6,650,339	.035	.183	0	1
$\mathrm{MP}_{3\mathrm{m}}$	6,185,228	-.455	3.474	-11.35	6.6
$\mathrm{MP}_{6\mathrm{m}}$	6,168,807	.664	3.932	-13.5	8.483
$\mathrm{MP}_{12\mathrm{m}}$	6,133,073	-.348	4.414	-19.9	9.25
GDP growth	6,650,339	.014	.026	-.151	.127
bank branch density	3,281,033	6.501	7.648	.003	36.048

Notes: This table presents summary statistics for the variables used in the empirical tests. All statistics are based on annual frequency. '*Sales growth*' is the dependent variable in the main regressions and denotes the change in sales at firm-level which includes non-adjacent observations (we assume a constant growth rate of sales between 2012 and 2014, where sales are missing in 2013). '*tangibles growth*' denotes the firm-level change in tangible fixed assets and, similarly, '*employees growth*' denotes the firm-level change in number of employees. '*price-cost margin growth*' is the firm-level measure for profit margin growth. '*cash flow growth*' is the firm-level measure for growth in cash flow. '*Short-term debt growth*' denotes the change in aggregate 'current liabilities' at firm-level at time t. '*Long-term debt growth*' denotes the change in aggregate 'non-current liabilities' at firm-level. '*total debt growth*' denotes the change in aggregate liabilities at firm-level. '*micro / small / medium / large firms*' are dummy variables equal to 1 for firms with <10 | 10-49 | 50-249 | 250+ workers at time t, and zero otherwise. '$MP_{3m\ /\ 6m\ /\ 12m}$' is the MP shock based on 3-month | 6-month | 12-month averages of the changes in the OIS rate with 2 year maturity, respectively. '*GDP growth*' is the annual percentage change in GDP per country. '*bank branch density*' denotes the number of physical bank branches in a region per 100,000 inhabitants.

Table 2: Monetary policy shocks and firm growth: Headline results

	(1) Sales growth	(2) Sales growth	(3) Sales growth	(4) Sales growth
micro*MP_{t-1}	0.0007	0.0005	0.0004	0.0005*
	(0.0005)	(0.0004)	(0.0004)	(0.0003)
small*MP_{t-1}	0.0015***	0.0016***	0.0012***	0.0007***
	(0.0005)	(0.0004)	(0.0004)	(0.0002)
large*MP_{t-1}	-0.0010**	-0.0012***	-0.0010**	-0.0002
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
micro	-0.0425***	-0.0408***	-0.0304***	-0.0315***
	(0.0051)	(0.0040)	(0.0034)	(0.0031)
small	-0.0142***	-0.0154***	-0.0083***	-0.0094***
	(0.0017)	(0.0017)	(0.0015)	(0.0012)
large	0.0222***	0.0228***	0.0189***	0.0235***
	(0.0029)	(0.0032)	(0.0034)	(0.0034)
MP_{t-1}	0.0040***			
	(0.0003)			
Time FE	No	Yes	Yes	Yes
country*sector FE	No	No	Yes	Yes
sector*time FE	No	No	No	Yes
country*time FE	No	No	No	Yes
N	5,371,560	5,371,559	5,371,552	5,369,995
R^2	0.01	0.03	0.04	0.06

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 (AT, DE, EE, ES, FR, GR, LT, LV, MT, NL, PT, and SI). Regressions include fixed effects as specified, standard errors clustered at the country-sector level appear in parentheses. The ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 3: Monetary policy shocks and firm growth: Robust model

	(1) Sales growth	(2) Sales growth	(3) Sales growth
micro*MP_{t-1}	-0.0000	0.0000	0.0011***
	(0.0003)	(0.0002)	(0.0003)
small*MP_{t-1}	0.0005**	0.0009***	0.0004*
	(0.0002)	(0.0002)	(0.0002)
large*MP_{t-1}	0.0001	-0.0002	0.0007*
	(0.0004)	(0.0004)	(0.0004)
micro	-0.0369***	-0.2284***	-0.1065***
	(0.0031)	(0.0245)	(0.0119)
small	-0.0112***	-0.1103***	-0.0652***
	(0.0013)	(0.0118)	(0.0069)
large	0.0238***	0.1399***	0.1468***
	(0.0036)	(0.0136)	(0.0165)
$\log(\text{sales})_{t-1}$		-0.0575***	
		(0.0074)	
firm age		-0.0013***	
		(0.0002)	
$\log(\text{leverage})_{t-1}$		0.0017***	
		(0.0003)	
cash holdings_{t-1}		-0.0284*	
		(0.0152)	
micro*GDP gr._{t-1}	0.4704***		
	(0.0527)		
small*GDP gr._{t-1}	0.1387***		
	(0.0252)		
large*GDP gr._{t-1}	-0.0792		
	(0.0514)		
firm FE	Yes	Yes	Yes
country*time FE	Yes	Yes	Yes
country*sector FE	Yes	Yes	Yes
sector*time FE	Yes	Yes	Yes
N	5,369,997	3,335,048	5,247,699
R^2	0.06	0.11	0.21

Note: The dependent variable in all columns is firms' sales growth. In column (2), we additionally control for GDP growth. We only include euro area countries with good coverage (AT, DE, EE, ES, FR, GR, LT, LV, MT, NL, PT, and SI). '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. In column (2), '$log(sales)_{t-1}$' denotes the log of (lagged) sales; '*age*' stands for firm age at time t; '$log(leverage)_{t-1}$' is the log of the (lagged) leverage; '$cashholdings_{t-1}$' are the (lagged) firm-level reported cash holdings. Regressions include fixed effects as specified, standard errors clustered at the country-sector level appear in parentheses. The ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 4: Monetary policy shocks and firm growth: Robust measure of sales growth

	(1) Sales growth	(2) Sales growth
micro*MP_{t-1}	0.0006**	0.0005*
	(0.0003)	(0.0003)
small*MP_{t-1}	0.0007***	0.0007***
	(0.0002)	(0.0002)
large*MP_{t-1}	-0.0001	-0.0001
	(0.0004)	(0.0004)
micro	-0.0298***	-0.0316***
	(0.0033)	(0.0032)
small	-0.0087***	-0.0095***
	(0.0013)	(0.0013)
large	0.0234***	0.0229***
	(0.0035)	(0.0034)
country*time FE	Yes	Yes
country*sector FE	Yes	Yes
sector*time FE	Yes	Yes
N	4,946,366	5,374,422
R^2	0.06	0.06

Note: The dependent variable in column (1) is firms' sales growth calculated only for adjacent annual observations. In column (2) the dependent variable is firms' sales growth which includes non-adjacent observations. In column (2), we additionally control for GDP growth. We only include euro area countries with good coverage (AT, DE, EE, ES, FR, GR, LT, LV, MT, NL, PT, and SI). '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. Regressions include fixed effects as specified, standard errors clustered at the country-sector level appear in parentheses. The ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 5: Monetary policy shocks and firm growth: Robust monetary policy

	(1) Sales growth	(2) Sales growth
micro*$MP_{t\text{-}1\,(3m)}$	0.0004	
	(0.0003)	
small*$MP_{t\text{-}1\,(3m)}$	0.0005*	
	(0.0003)	
large*$MP_{t\text{-}1\,(3m)}$	0.0004	
	(0.0004)	
micro	-0.0309***	-0.0311***
	(0.0030)	(0.0030)
small	-0.0086***	-0.0087***
	(0.0011)	(0.0012)
large	0.0235***	0.0232***
	(0.0036)	(0.0035)
micro*$MP_{t\text{-}1\,(12m)}$		0.0009***
		(0.0002)
small*$MP_{t\text{-}1\,(12m)}$		0.0007***
		(0.0001)
large*$MP_{t\text{-}1\,(12m)}$		-0.0004*
		(0.0002)
country*time FE	Yes	Yes
country*sector FE	Yes	Yes
sector*time FE	Yes	Yes
N	5,385,179	5,337,103
R^2	0.06	0.06

Note: The dependent variable denotes the change in sales at firm-level at time t. '$MP_{t\text{-}1\,(3m)}$' is the (lagged) 3-month average EA-wide MP shock based on changes in OIS with 2 year maturity. '$MP_{t\text{-}1\,(1y)}$' is the (lagged) 12-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 EA countries with good coverage (AT, DE, EE, ES, FR, GR, LT, LV, MT, NL, PT, and SI). Regressions include fixed effects as specified, standard errors clustered at the country-sector level appear in parentheses. The ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 6: Monetary policy shocks and firm profitability

	(1) Price-cost margin growth	(2) Cash flow growth
micro*MP_{t-1}	0.0003***	-0.0007*
	(0.0001)	(0.0004)
small*MP_{t-1}	0.0001**	0.0010***
	(0.0001)	(0.0003)
large*MP_{t-1}	-0.0001*	-0.0006
	(0.0001)	(0.0005)
micro	0.0003	-0.0115***
	(0.0003)	(0.0023)
small	0.0000	-0.0072***
	(0.0002)	0.0014
large	0.0003	0.239***
	(0.0003)	(0.0039)
country*time FE	Yes	Yes
country*sector FE	Yes	Yes
sector*time FE	Yes	Yes
N	4,679,774	3,667,407
R^2	0.01	0.03

Note: The dependent variable is the firm-level price-cost margin growth (column (1)) and the firm-level cash flow growth (column (2)). '$MP_{t\text{-}1}$' 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 EA countries with good coverage (AT, DE, EE, ES, FR, GR, LT, LV, MT, NL, PT, and SI). Regressions include fixed effects as specified, standard errors clustered at the country-sector level appear in parentheses. The ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 7: Monetary policy shocks and firm growth: Placebo test

	(1) Sales growth
micro*MP_{t-1}	-0.0005
	(0.0006)
small*MP_{t-1}	0.0007*
	(0.0004)
large*MP_{t-1}	-0.0010
	(0.0008)
micro	-0.0357***
	(0.0033)
small	0.0047*
	(0.0025)
large	0.0005
	(0.0041)
country*time FE	Yes
country*sector FE	Yes
sector*time FE	Yes
N	1,273,805
R^2	0.03

Note: 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. Countries included are Croatia, Hungary, Great Britain, Macedonia, Romania, and Switzerland. '*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. Regressions include fixed effects as specified, standard errors clustered at the country-sector level appear in parentheses. The ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 8: Monetary policy shocks, investment, and employment

	(1) Investment growth	(2) Employment growth
micro*MP_{t-1}	0.0001	0.0003
	(0.0003)	(0.0003)
small*MP_{t-1}	0.0004**	0.0003
	(0.0002)	(0.0002)
large*MP_{t-1}	-0.0009**	-0.0007**
	(0.0003)	(0.0003)
micro	-0.0539***	-0.0597***
	(0.0030)	(0.0038)
small	-0.0121***	-0.0080***
	(0.0014)	(0.0015)
large	0.0347***	0.0294***
	(0.0042)	(0.0033)
country*time FE	Yes	Yes
country*sector FE	Yes	Yes
sector*time FE	Yes	Yes
N	4,830,253	4,899,022
R^2	0.03	0.03

Note: The alternative dependent variables are the investment growth and employment growth at the firm-level at time t. '$MP_{t\text{-}1}$' 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 EA countries with good coverage (AT, DE, EE, ES, FR, GR, LT, LV, MT, NL, PT, and SI). Regressions include fixed effects as specified, standard errors clustered at the country-sector level appear in parentheses. The ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 9: Monetary policy shocks and firm debt

	(1) Total debt growth	(2) Long-term debt growth	(3) Short-term debt growth
micro*MP_{t-1}	0.0003	0.0020***	-0.0017***
	(0.0007)	(0.0004)	(0.0005)
small*MP_{t-1}	-0.0001	0.0024***	-0.0004
	(0.0003)	(0.0004)	(0.0003)
large*MP_{t-1}	0.0003	-0.0018***	-0.0005
	(0.0005)	(0.0005)	(0.0006)
micro	-0.0544***	-0.0392***	-0.0291***
	(0.0038)	(0.0037)	(0.0028)
small	-0.0176***	-0.0191***	-0.0081***
	(0.0022)	(0.0026)	(0.0017)
large	0.0198***	0.0290***	0.0159***
	(0.0035)	(0.0034)	(0.0037)
country*time FE	Yes	Yes	Yes
country*sector FE	Yes	Yes	Yes
sector*time FE	Yes	Yes	Yes
N	3,302,651	2,967,096	1,984,977
R^2	0.02	0.02	0.01

Note: The dependent variable in column (1), (2), and (3) are the firm-level total, long-term ("Non-Current Liabilities"), and short-term ("Non-Current Liabilities") debt growth rates at time t, respectively. '$MP_{t\text{-}1}$' 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 EA countries with good coverage (AT, DE, EE, ES, FR, GR, LT, LV, MT, NL, PT, and SI). Regressions include fixed effects as specified, standard errors clustered at the country-sector level appear in parentheses. The ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

Table 10: Monetary policy shocks and firm growth: Bank branch density

	(1) Sales growth, low bank branch density	(2) Sales growth, high bank branch density
micro*$MP_{t\text{-}1}$	0.0008***	0.0006
	(0.0003)	(0.0005)
small*$MP_{t\text{-}1}$	0.0008***	0.0017***
	(0.0002)	(0.0005)
large*$MP_{t\text{-}1}$	0.0002	-0.0020***
	(0.0004)	(0.0007)
micro	-0.0195***	-0.0543***
	(0.0021)	(0.0068)
small	-0.0056***	-0.0227***
	(0.0011)	(0.0023)
large	0.0238***	0.0362***
	(0.0043)	(0.0087)
country*time FE	Yes	Yes
country*sector FE	Yes	Yes
sector*time FE	Yes	Yes
N	1,333,015	1,285,257
R^2	0.06	0.08

Note: The dependent variable is sales growth. 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. '$MP_{t\text{-}1}$' 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 (AT, DE, EE, ES, FR, GR, LT, LV, MT, NL, PT, and SI). Regressions include fixed effects as specified, standard errors clustered at the country-sector level appear in parentheses. The ***, ** and * denote statistical significance at the 1%, 5% and 10% level, respectively.

A Appendix

A.1 Macro-level analysis

What is the aggregate effect of this heterogeneous response of firm growth, in terms of market competition? We note that one accepted metric of market competition is the Herfindahl-Hirschman Index (HHI). The HHI is defined as the squared sum of each firm's market share, and so it moves between 0 (perfect competition) and 1 (perfect concentration). Calculating the HHI based on firm's market share in sales, we find that over the course of 5 years, a monetary easing that corresponds to two standard deviations in the sample reduces the sales-based HHI from 0.191 to 0.189, or by about 1 percent (results available upon request). However, the HHI is a rather inadequate measure for the exercise at hand because granularity is lost through the construction of the index. we therefore suggest focusing the analysis on the relative effects of monetary policy on smaller versus larger firms. Furthermore, because the HHI is based on slow moving market shares, it is not well-suited for a high-frequency analysis, and is in addition an indirect measure of market power. We thus focus on measures that relate more directly to evolving market power, such as markups and profitability.

A.2 Local projections

Above we provide panel regression tables with interaction terms that capture the various factors that may explain the cross-firm size heterogeneity. They allow us to control for multiple possible dimensions of heterogeneity simultaneously (including industry and country-specific) as well as to account for formal tests of statistical significance of the heterogeneity. It is clear from the regression outputs above that the across-size class differences are statistically significant.

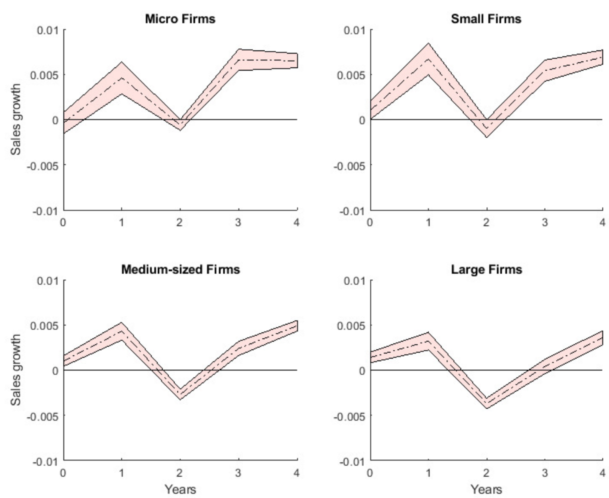
However, we also perform a set of estimations in a local projections framework (Jordà, 2005) in order to plot impulse response functions separately by size class. This allows us to understand better how a firm's sales growth responds to monetary policy shocks conditional on the firm size category over horizon $j > 0$, and to compute the corresponding impulse responses (Plagborg-Møller & Wolf, 2021). The data generating process is depicted by the following equation:

$$sales_{f,t+h,s,c} = \alpha_{f,h} + \beta_h MP_t + \Gamma_h' X_{f,t-1} + \epsilon_{f,t+h,s,c} \tag{13}$$

Similar to Equation 1, $sales_{f,t+h,s,c}$ denotes the sales growth rate of firm f at time t in industry s and country c in Equation 13. β_h are the coefficients of interest that measure the impact of the EA-wide monetary policy shock MP_{t+h} for every horizon. $\alpha_{f,h}$ are firm fixed effects. $X_{f,t-1}$ is a vector of firm-specific and macro-economic controls. It contains $cash\ holdings_{f,t+h-1}$, $log(leverage)_{f,t+h-1}$, $log(sales)_{f,t+h-1}$, $firm\ age$ and $GDP\ growth_{c,t+h-1}$. $\epsilon_{f,t+h,s,c}$ denotes the error term.

Figure 1 displays the non-cumulative impulse response function of sales growth by size class in percentage points to a one basis point monetary easing shock over a horizon of 4 years. While the on-impact reaction on sales is small and close to zero across all size classes, the response after one year is highly significant and pronounced, especially for micro and small firms. After 2 years the effect becomes insignificant for micro and small firms, and significantly negative for medium-sized and large firms. Overall, the results from the local projections confirm that micro and small firms increase their sales total much more compared to large firms when monetary policy becomes more accommodative.

Figure 1: Firm-level Sales Growth Response to Monetary Easing



Notes: The figure shows the differential responses to a one standard deviation monetary policy tightening shock in sales growth at firm-level. We plot 95 percent pink confidence bands calculated from standard errors clustered at the industry and country-level.