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Tightening monetary policy and investment dynamics in the European Monetary Union: Firm- and country-level heterogeneity

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ABSTRACT

We employ firm-macro matched data on small and medium-size enterprises in the European Monetary Union to study the investment response to tight monetary policy shocks. We show that firms with higher leverage and longer debt maturity are more negatively responsive to monetary restrictions. Capital structure significantly interacts with monetary policy transmission: a leverage ratio one percentage point larger than average is associated with a semi-elasticity of investment to a nominal interest rate hike approximately 8 % higher two years following the monetary shock. Firm-level heterogeneity proves to be more pronounced in the presence of long-term—rather than short-term—indebtedness. We further argue that the investment response to monetary contractions is heterogeneous not only with respect to the firm-level financial structure but also in relation to the country-specific financial and productive conditions. Specifically, we show that the investment semi-elasticity to rate hikes significantly increases in countries characterized by higher frictions in accessing the credit market and in countries featured by either a larger share of small-size firms or a larger share of intangible assets.

1. Introduction

This paper examines the role of firm- and country-level heterogeneity in shaping the investment channel of a tightening monetary policy stance in the European Monetary Union (EMU)—of the type recently enforced by the European Central Bank (ECB) to curb the revival of inflationary pressures originating in 2021. To this end, we assemble a large-scale firm-macro matched dataset of non-listed firms in the Euro Area. Working with firm-level data as opposed to purely aggregate data enables us to explore the case for a heterogeneous investment response due to tight monetary policy shocks—dependent upon different levels of debt exposition and debt cost among firms. Thus, overall, we are able infer whether and to what extent the investment channel of monetary policy transmission varies systematically with the financial structure employed by firms. Working with currency-area data as opposed to single-country data enables us to further investigate whether and to what extent the investment response to monetary contractions is heterogeneous not only in relation the firm-level financial structure but also with respect to the country-level financial and productive systems.

The observed rapid increase in business indebtedness—by about 20 percentage points as a ratio to the GDP in the last fifteen years

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(Schularick, 2021)—is a salient feature of the EMU and is further visible in several advanced and emerging economies (e.g., Abraham et al., 2020; Goodhart and Pradhan, 2020; Jordà et al., 2022). The roots of this escalation have been well established. The financial turmoil and the sovereign debt crisis that erupted in 2007 and 2009 have depressed the euro area economy, causing a credit crunch in countries affected by higher risk, amplifying the unemployment rate, and decreasing aggregate investment. To rule out below-target inflation and sustain economic activities in the presence of strict fiscal rules, the ECB has put in place a number of unconventional monetary policies, shifting the nominal interest rate down into a negative territory, easing credit conditions, and using the debt channel as a target for purchase programs.[1] Such a monetary easing has stimulated a significant recourse to indebtedness by both the public sector and the private sector—households and firms (Hannoun, 2014). In addition, to offset the pandemic crisis, the ECB has strengthened existing programs, increasing asset purchases and fostering further credit easing conditions.[2] As a result, firms' debt exposition has shown constantly increasing dynamics in the aftermath of the lockdown (Nicoletti et al., 2022).

A key question that emerges is, therefore, whether the monetary tightening currently in place to stamp out above-target inflation could amplify the business debt overhang problem, thus distorting investment decisions taken by highly indebted firms and, in turn, over-affecting the investment channel for the transmission of nominal interest-rate variations. A second central question that arises is whether the transmission mechanism of ECB's monetary policy is country specific—crucially dependent, in particular, upon the country-level risk and market structure. The present study is an effort to empirically evaluate these issues. We create an EMU firms macro-based dataset by merging firm-level financial data obtained by Bureau-Van Dijk Amadeus with macroeconomic data obtained from the ECB. Our firm-level data include information from European small and medium enterprises (SMEs). The advantages of focusing on SMEs are twofold. First, SMEs account for the largest share of operating firms in Eurozone countries and represent the greatest part of value-added. Second, our data pertain to the SMEs' capital structures, thus enabling us to infer the role of financial heterogeneity for the transmission of monetary policy and the resulting impact on investment decisions.

To estimate the effect of contractionary monetary policy shocks, we use the high-frequency surprise in the 3-month Overnight Index Swap (OIS) changes around the monetary policy meetings of the ECB Governing Council. We match our dataset with the public available Euro Area Monetary Policy Event-Study Database (EA-MPD) provided by Altavilla et al. (2019).[3] Consistently with Durante et al. (2022), we compute the annual basis shock using the 12-month moving sum of the monetary policy shock. Using this procedure, we can match the closing date of the balance sheet for each firm with the related shock. Thus, we are able to account for as much temporal variation as possible.

We use local projections (LP) (Jordà, 2005) to perform a dynamic analysis. The monetary policy shock interacts with the financial expenses-to-EBITDA ratio and with several firm's debt exposition specifications (that is, overall leverage, short-term leverage, long-term leverage, high and low level of firms' indebtedness). We obtain the estimated investment reactions for a period of up to four years after a shock.[4]

Our results reveal that firms with higher financial leverage are more negatively responsive to contractionary monetary policy. We find that exhibiting a leverage ratio one percentage point larger than average is associated with a semi-elasticity of firm investment with respect to a nominal interest-rate hike 7.67 % higher two years following the shock. Specifically, in response to contractionary monetary policy shock by one standard deviation (7.94 basis points), firms bearing one percentage point larger leverage reduce the investment rate by additional 1.23 basis points after two years, from 16.04 to 17.27 basis points.

Financial heterogeneity proves to be significantly more pronounced by controlling for the debt maturity structure. We find that exhibiting a long-term leverage one percentage point larger than average is associated with a semi-elasticity of investment with respect to a nominal interest rate hike 31.90 % higher three years following the shock and, overall, at least one year more persistent. Specifically, in response to a contractionary monetary policy shock by one standard deviation, firms with one percentage point larger long-term indebtedness show a reduction in the investment rate by 3.20 basis points greater after three years.

Taking stock, the above findings provide empirical evidence that the investment channel of monetary policy transmission varies significantly across SMEs and is closely associated with corporate financial structure. Financial constraints are linked to a stronger negative investment response to monetary policy restrictions for firms with relatively high leverage and longer debt maturity.

A second key point developed in our paper is to argue, however, that country-level heterogeneity also plays a central role in determining the investment channel of ECB's monetary policy. First, we show that the transmission of tight monetary shocks varies

[1] The ECB's Asset Purchase Programme (APP) was part of a package of non-standard monetary policy measures that also included targeted longer-term refinancing operations. This program started in mid-2014 to support the monetary policy transmission and provide the policy accommodation aimed to sustain the economic activity and ensure, at the same time, price stability in a context of below-target inflation. The APP included four different programs, i.e., the third covered bond purchase programme (CBPP3), the asset-backed securities purchase programme (ABSPP), the corporate sector purchase programme (CSPP), and the public sector purchase programme (PSPP). See for details Andrade et al. (2016) and Rostagno et al. (2019).

[2] In March 2020, the ECB has implemented the pandemic emergency purchase programme (PEPP), involving a total envelope of 1850 billion of euro. All asset categories eligible under the existing APP have been remaining eligible under the PEPP. Details can be found on the ECB's PEPP webpage (https://www.ecb.europa.eu/mopo/implement/pepp/html/index.en.html).

[3] Following the seminal paper of Gurkaynak et al. (2005) and Swanson (2017), the dataset of Altavilla et al. (2019) includes sovereign yields, stock prices, exchange rates and OIS price changes for different maturities (1-month, 3-months, 6 months, 1-year and 2-years) around the ECB Government Council meetings. The dataset is updated from the ECB at monthly frequency and can be downloaded at https://www.ecb.europa.eu/pub/pdf/annex/Dataset_EA-MPD.xlsx.

[4] By focusing on non-listed, non-financial corporations, our dataset uses micro data concerning the firms' financial statement at yearly frequency. We set an estimation period after the shock following Durante et al. (2022) and Hong et al. (2021).

depending on country-specific risk factors. Within countries considered "stressed"—Greece, Italy, Ireland, Spain and Portugal—we find that, following a nominal interest-rate hike by one standard deviation, firms with one percentage point larger leverage exhibit a decrease in the investment rate by 1.64 basis points greater two years after the shock—56.06 % higher than within "non-stressed" countries. Using country-level data on two central risk indicators of the financial system—the cost of borrowing for a firm and the loan-to-deposit ratio for the banking sector (Altavilla et al., 2016)—we also find that higher frictions in accessing the credit market result in a significantly larger underinvestment following a monetary restriction.

Second, we show that the transmission of tight monetary shocks varies depending on the country-specific market structure. A different distribution of SMEs does interact with the degree of effectiveness of the monetary policy transmission. Specifically, we find that in countries characterized by a larger share of micro-SMEs firms tend to be significantly more sensitive to contractionary monetary policies. In addition, the collateral channel does matter for the propagation of the monetary shock. Specifically, we find that a market characterized by a larger share of intangible assets proves to be significantly associated with an increase in the semi-elasticity of investment to a nominal interest-rate hike, for the lower collateral value makes firms more financially constrained.

An important caveat to our analysis concerns the time period under investigation. Our sample, from 2011 to 2021 spans major macroeconomic disruptions, most notably the European Sovereign Debt Crisis and the Covid-19 pandemic. These episodes may confound the identification of monetary policy effects, particularly given the annual frequency and the relatively short time dimension of our dataset.

To address this issue, beyond including time-by-sector fixed effects aimed to absorb common macroeconomic dynamics, we perform a key robustness exercise by restricting the estimation sample to the 2013–2019 period. This shorter time window excludes the peak of the sovereign debt crisis as well as the onset and aftermath of the Covid-19 shock, thus reducing the risk of contamination from large concurrent macroeconomic shocks.

Our main results on the heterogeneous investment response to monetary tightening remain stable in this restricted sample, lending support to the reliability of our conclusions. Nonetheless, we recognize that—due to data limitations—it remains empirically challenging to fully disentangle the dynamic effects of monetary policy from other overlapping macroeconomic influences. We therefore encourage readers to interpret our estimates as capturing the transmission of monetary policy within a broader macro-financial environment.

Our paper is closely connected to the empirical studies examining the role of firms' financial structure in shaping the investment channel of monetary policy in the European Monetary Union. Durante et al. (2022) provide significant evidence of the importance of both the credit and interest rate channels of monetary policy. Auer et al. (2019) show the case for a nonlinear association between corporate leverage and industrial production. Deng and Fang (2022) find that firms that hold more long-term debt are less responsive to monetary policy shocks. Ciccarelli et al. (2013) argue that financial fragility of sovereigns, banks, firms and households has amplified the effects of monetary policy over the financial crisis erupted in 2007–2008, especially in countries experiencing increased sovereign financial distress. Kalemli-Özcan et al. (2022) further show that firms entering the global financial crisis—exacerbated in the EMU by the 2010–2012 sovereign debt crisis—have reduced their investment more than in the aftermath of the crisis, with stronger effects for firms holding more short-term debt in countries characterized by a weak banking system, due to sovereign stress. Compared to these works, our study provides novel empirical evidence both at the firm- and country-level along two important dimensions. First, we show that the largest part of firm-level financial heterogeneity in shaping the investment channel of ECB's monetary policy is associated with long-term leverage. Differently from Deng and Fang (2022) and Kalemli-Özcan et al. (2022), we find strong evidence that long-term—rather than short-term—indebtedness is associated with larger responsiveness of firms' investment to monetary policy. This result gives sound empirical support to the view that debt overhang—the more pronounced decline in investment in response to monetary tightening, due to the associated increase in the real burden of outstanding nominal long-term debt and hence in the default risk—is significantly operative for small and medium-sized firms within the European Monetary Union. Second, in our contribution we show that the investment response to monetary policy is heterogeneous not only with respect to the firm-level financial structure but also in relation to the country-specific financial and productive conditions. From this perspective, on the one hand we complement the event studies of Ciccarelli et al. (2013) and Kalemli-Özcan et al. (2022) by providing more general evidence on both firm- and country-level heterogeneity. On the other hand, we find novel evidence that firms' investment is more responsive to monetary policy in countries featured by a larger share of small-size firms, due to their heightened vulnerability to debt overhang, and by a larger share of intangible assets, to the extent that a lower collateral value renders firms more financially constrained. Thus, our work supports the hypothesis that not only financial but also productive conditions at the country level—in relation to the market structure and the firms' asset composition—play a crucial role in the transmission of monetary shocks.

The reminder of the paper is organized as follows. Section 2 reviews the related literature. Section 3 describes the dataset used in this study. Section 4 specifies the econometric model and presents the central empirical results, highlighting the role of firm-level heterogeneity. Section 5 addresses how the country-level heterogeneity matters for the transmission of monetary policy. Section 6 develops robustness analyses. Section 7 concludes.

2. Literature review

The present study is related to four strands of theoretical and empirical research. First, the paper is connected to the financial accelerator literature (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; Bernankee et al., 1999), according to which balance sheet variables play a key role in propagating and amplifying economic shocks—thereby deepening the response of investment activity to monetary policy. Our contribution strongly supports the hypothesis that financial frictions are associated with a larger negative response of investment to nominal interest-rate hikes for firms characterized by high leverage and longer debt maturity.

Second, the study is linked to the corporate finance literature that studies the interrelations between firms' capital structure and investment. This literature analyzes the determinants of capital structure (Myers and Majluf, 1984; Titman and Wessels, 1988; Harris and Raviv, 1991) and focuses on the role of debt maturity in investment decisions (Barclay and Smith Jr, 1995; Backer et al., 2003; Faulkender, 2005; Almeida et al., 2012; Diamond and He, 2014). Our study is strictly related to the literature strand on the impact of corporate debt on the firms' ability to undertake profitable growth opportunities. Seminal contributions of Myers (1977) and Myers and Majluf (1984) delve into the conflict between existing and potential new stakeholders in companies with extremely high debt levels. Their theoretical framework has been extended by Hennessy (2005) and Hennessy et al. (2007), who provide empirical evidence on the investment distortion caused by debt overhang. A wide plethora of empirical studies have focused on the investment-debt relationship with particular attention to the growth option effects. Lang et al. (1996), Johnson (2003) and Barclay and Morellec (2006) show a negative relationship between debt exposure and firm growth opportunities. Kalemli-Özcan et al. (2022) and Popov et al. (2020) analyze the connection between debt-overhang phenomenon and banks' financial position. The firsts examine the role of financial crises and the banking sovereign debt exposure, while the latter find negative relation between indebtedness and investment activity during banking crises. Lamont (1995) explores the debt-overhang problem from a macroeconomic perspective. Following his seminal contribution, several studies deepen further the macroeconomic theory of debt overhang. Specifically, Occhino and Pescatori (2015) explore the countercyclical dynamics of financial frictions, while Philippon (2009) studies how the occurrence of debt overhang in different markets can amplify shocks and even lead to multiple equilibria. Jordà et al. (2013) concentrate on the role of credit expansion as possible driver for financial instability in a period of monetary policy tightening. The macroeconomic implications of debt overhang are experiencing a renaissance due to the credit easing measures implemented in the post-financial and post-pandemic crises to sustain the economic activity, as demonstrated by the recent works by Jordà et al. (2022), Brunnermeier and Krishnamurthy (2020) and Crouzet and Tourre (2021). Crouzet and Tourre (2021), in particular, provide a partial equilibrium model describing the efficiency of corporate credit market interventions related to the joint state of the business cycle and the financial market conditions. Based on these results regarding the relevance of macroeconomic debt overhang, we contribute to the literature by testing the occurrence of debt overhang in an interest-rate hike context.

Third, this study relates to the literature on the propagation mechanisms of monetary policy shocks. Starting from the seminal contribution by Gertler and Gilchrist (1994), who focus on the differential responsiveness of firms according to their size, from an aggregate perspective Cristiano et al. (2005) explore the economy's responsiveness to a monetary policy shock. Several studies examine the key role played by the corporate balance sheet positions in the monetary policy transmission. Ottonello and Winberry (2020), Jeenas (2018), Cesa-bianchi et al. (2019) and Cloyne et al. (2023) focus on the United States and the United Kingdom, while Auer et al. (2019) and Durante et al. (2022) concentrate on Europe. Jeenas (2018) finds that monetary policy shocks create larger reactions in fixed capital formation, inventories, and sales growth for firms with high leverage and low liquid assets. Ottonello and Winberry (2020) study the firms' capital accumulation responses to monetary policy shocks conditional on leverage, credit ratings, and a "distance to default." They find that firms with higher default risk, including higher leverage, are less responsive to monetary policy shocks. Auer et al. (2019) further explore the interaction between capital structure and monetary shocks, highlighting that, at low leverage levels industries adjust their aggregate output more than at higher levels of indebtedness. Other studies explore the real effects of monetary policy shocks in the presence of different debt maturity across firms (Ippolito et al., 2018; Bustamante, 2020; Jungherr and Schott, 2022; Jungherr et al., 2024; Deng and Fang, 2022; Fabiani et al., 2020). Ippolito et al. (2018) find that firms with floating-interest rate loans adjust investment more strongly in response to monetary policy shocks relative to firms with fixed-rate debt. Contrary to Deng and Fang (2022), who show that the long-term exposed firms as less responsiveness to monetary shocks, Gomes et al. (2016), Bustamante (2020), and Jungherr et al. (2024) provide empirical evidence of the amplified role of long-term debt in the transmission of monetary policy. While short-term debt constrains roll-over risk due to maturing debt at the time of the shock, a longer exposition creates a debt overhang problem, increasing future leverage and default risk. Cloyne et al. (2023), Bahaj et al. (2022)

Table 1
Descriptive Statistics.

Variable	Obs.	Mean	Std. Dev.
Main Variable			
Investment rate	891,517	0.062	0.314
Leverage	912,532	0.182	0.192
Coverage ratio	840,413	0.155	0.189
Short-term debt	939,233	0,077	0.116
Long-term debt	956,421	0.167	0.192
Control Variables			
Current Asset	988,991	0.661	0.257
Asset	988,995	9.913	1.402
Sales growth rate	809,971	0.066	0.175
Firm age	1,028,655	26.541	19.231

Descriptive statistics for the variables included into the model specification. For each variable, the table highlights the number of observations, mean and standard deviation.

and Durante et al. (2022) emphasize the explanatory power of firms' age in capital investment responsiveness, finding that investments in young firms that have not recently paid dividends are the most responsive to monetary policy shocks. Focusing on the responsiveness of the labor market to monetary policy shocks, Bahaj et al. (2022) find that younger and more leveraged firms show larger employment responses to monetary policy. In contrast to this strand of literature, we explore whether heterogeneity *both* in the financial positions of Euro Area small and medium enterprises *and* in the financial and productive systems of Euro Area member countries critically interacts with the transmission of monetary shocks.

Finally, the paper is connected to the literature emphasizing that the unfold effects of monetary policy decisions in the Euro area are heterogeneous among member countries, depending on both the underlying financial (Georgiadis, 2015; Ciccarelli et al., 2013; Altavilla et al., 2016) and productive (Scharfstein and Sunderam, 2015; Aghion et al., 2019; Duval et al., 2021; Ferrando et al., 2021, 2023)[5] systems. Our study contributes to this literature by concentrating on the determinants of the investment channel of ECB's monetary policy and by providing empirical evidence using firm-level data.

3. Dataset and main statistics

3.1. Firm variables

We draw a rich firm-panel dataset from Amadeus (Bureau van Dijk), which includes yearly balance sheet information on non-listed Eurozone firms from 2011 to 2021.[6] Focusing on non-financial corporations (NFCs), banks and other financial firms are excluded.[7] Compared to previous studies (Cloyne et al., 2023; Ottonello and Winberry, 2020; Anderson and Cesa-Bianchi, 2024), our dataset differs along two crucial dimensions. First, we consider non-listed firms, which account for a significant portion of the EMU non-financial corporate sector. Additionally, non-listed firms are typically more subject to severe financial constraints and, thus, more responsive to changes in monetary policy. Second, non-listed firms represent a larger share of businesses operating in the Eurozone and provide a greater share of value added and employment compared to the United States (Auer et al., 2019).

Following the procedure proposed by Kalemli-Ozcan et al. (2015), we drop firm-year observations when total, fixed, or intangible assets take missing or zero values. We also omit firms reporting zero or negative number of employees. The resulting dataset encompasses 130,313 non-listed firms.

Table 2 gives an overview of the distribution of enterprises in 19 European countries, focusing on three main categories: medium-sized enterprises, micro-small enterprises and SMEs (combined micro, small and medium-sized enterprises). Column 1 shows the countries considered, while columns 2 and 3 report the total number of observations and the percentage of observations relative to the total, respectively. Columns 4–6 give the percentage of medium-sized, micro-small and SMEs in the total, respectively. Italy dominates the dataset, accounting for 26.32 % of total observations, followed by France (21.39 %) and Germany (16.27 %). Firms operating in these countries represent 77.6 % of whole sample (and account for 75 % to the Euro area GDP composition). SMEs represent the majority in almost all countries, ranging from 63.26 % in Luxembourg to 98.93 % in Italy. Not only does Italy have the highest percentage of SMEs, but it also has a significant share of micro-small enterprises (52.47 %), higher than that of other countries. In contrast, countries such as Austria and Malta have lower percentages of SMEs—66.24 % and 66.10 %, respectively, mainly due to a higher presence of medium-sized enterprises.

The comparison with the European Commission's[8] Annual Report on European SMEs reveals notable similarities between our dataset and the distribution of enterprises it provides, underscoring the robustness and representativeness of our sample. Both sources emphasize the dominance of SMEs in the European economy, along with significant heterogeneity in their composition across countries.

Our table highlights a consistent pattern where SMEs account for most firms in each country—a finding that aligns with the report's assertion that SMEs comprise over 99 % of businesses in the EU. For instance, Italy, Spain, and Greece exhibit particularly high shares of SMEs in both datasets, reflecting the structural characteristics of these economies, where micro and small enterprises play a pivotal

[5] The literature on the role of market structure for monetary policy design is, however, scant. The main contributions focused on the role of market concentration for the transmission of monetary policy. Scharfstein and Sunderam (2017) explore the relationship between product market power and interest rate pass-through in the U.S. mortgage industry, finding that high concentration in mortgage lending reduces the impact of QE. Aghion et al. (2019) point out the role of liquidity constraints and competition in sectoral and firm growth after a monetary policy shock. Duval et al. (2021) and Ferrando et al. (2021, 2023) also study the transmission of monetary policy conditioned by firm's markups, emphasizing that firms with high markups respond less to monetary policy shocks.

[6] The choice to start the analysis in 2011 is dictated by data availability and quality constraints, not by authors' discretion. Time-varying financial variables are sparsely available before 2011, particularly for SMEs, and the sample size diminishes significantly when earlier years are considered (e.g., from 85,593 firms in 2010 to 996 in 2007). Additionally, most pre-2011 firms are publicly listed and excluded from our sample, with further reductions following the data-cleaning procedure of Kalemli-Ozcan et al. (2015). Thus, the dataset represents the best possible balance given these limitations.

[7] We use four-digit NACE code to identify financial firms: all firms that showed a NACE code belonging to the range from 64.1.1 to 66.3.0 are dropped from the dataset. To ensure that all financial firms are excluded, we also control for the four-digit SIC sector code. The firms with the SIC code belonging to the range 60.0.0–64.1.1 are excluded.

[8] To validate the good representativeness of our dataset, we compare the distribution of SMEs in our dataset with the distribution provided by the Annual Report on European SMEs provided by the European Commission. We compare the distribution stemming from our dataset with the recent European Commission's reports (2015–2021).

role. Similarly, our data aligns with the report's observation that countries like Luxembourg and Austria have slightly lower proportions of SMEs, which can be attributed to the higher presence of medium-sized or larger firms in these economies.[9]

We also provide a similar comparison at the level of economic sectors. Table 3 shows the firms' distribution among economic sectors according to NACE Rev.2. The manufacturing sector (NACE: C) stands as the largest, accounting for 30.18 % of the total sample. Of this, 25.59 % are micro-small firms, while 57.85 % are medium-sized firms, indicating a significant presence of medium-sized enterprises in this sector. Similarly, the Wholesale and Retail Trade sector (NACE: G) accounts for 28.63 % of the total, with 48.78 % being micro-small and 35.87 % medium-sized enterprises. This reflects the predominance of smaller firms in this sector, consistent with the broader European economy. The Construction sector (NACE: F) also shows a notable share of 65,744 firms (6.21 % of the total), with a distribution of 35.46 % micro-small firms and 47.53 % medium-sized firms, suggesting a relatively even spread of small and medium-sized enterprises.

Other sectors, such as Accommodation and Food Services (NACE: I) and Real Estate Activities (NACE: L + M + N), exhibit similarly high proportions of SMEs, with 75.16 % and 64.21 % of firms, respectively, aligning with the Commission's report, which highlights the significant role of SMEs across diverse economic activities.

The distribution of enterprises across economic sectors in our dataset closely mirrors the findings from the Annual Report on European SMEs, highlighting the consistency and robustness of our sample. The EU Commission emphasizes the predominance of micro-enterprises across various sectors, a pattern also observed in our dataset, particularly in wholesale, retail, and accommodation. Furthermore, the report confirms that certain sectors, such as Wholesale and Retail Trade and Construction, tend to have a higher proportion of smaller enterprises, while industries like Manufacturing and Real Estate typically host more medium-sized firms. These patterns are evident in our dataset as well, with Manufacturing showing a higher concentration of medium-sized firms compared to the more micro-small-oriented Wholesale and Retail Trade. The strengths of our data lie in its granular sectoral breakdown, which offers a comprehensive understanding of the SME landscape across multiple industries. The close alignment with the Annual Report on European SMEs lends further credibility to the robustness of our sample. Additionally, the sectoral relevance of our dataset's, which spans key sectors such as Manufacturing, Wholesale Trade, and Construction, provides an accurate representation of SMEs' role in the European economy.

Our central variables are the investment rate and changes in debt exposure. The investment rate is defined as the percentage change in tangible assets between years *t* and *t-1*. The change in debt exposure is defined as the change in total debt over total debt. We delve into changes in long-term and short-term debt maturity, defined as changes in long-term debt and short-term debt over total debt, respectively. To measure the effect of capital structure, we also compute two key control variables to highlight the effects of companies' indebtedness: leverage (Ottonello and Winberry, 2020; Deng and Fang, 2022) and standardized financial expenses (Hong et al., 2021). Leverage is defined as the firm's debt-to-asset ratio. Debt is referred to the sum of long-term financial debt and short-term financial debt. We use the ratio between financial expenses and EBITDA to capture the effects of cost of debt on investment decisions.

Table 1 provides summary statistics of the main companies' variables used in the analysis. All variables from the balance sheet are winsorized to reduce the impact of outliers. We winsorize each variable at the percentage level needed so that the distribution of the variable has a kurtosis below 10. See Appendix A for more detailed information.

3.2. *Macroeconomic variables*

The firm-based dataset obtained by Amadeus is enhanced with yearly-frequency macroeconomic data for each Eurozone country. Inspired by Ottonello and Winberry (2020) and Deng and Fang (2022), we control for the GDP growth rate and the inflation rate, which are collected by ECB Statistical Warehouse. Therefore, we are able to account for likelihood effects due to the business cycle on firm investment activity not tracked by financial account. For more detailed information, Table 4 provides summary statistics for the main used variables.

3.3. *Identification of the monetary shock*

A high-frequency identification approach is employed to identify monetary policy shocks (Gurkaynak et al., 2005; Gertler and Karadi, 2015; Jarocinski and Karadi, 2020). Specifically, by using the Euro Area Monetary Policy Event-Study Dataset developed by Altavilla et al. (2019)—henceforth EA-MPD—we construct a monetary shock observing the changes in the Overnight Index Swap price around the three European monetary policy events (Jarocinski and Karadi, 2020). In particular, EA-MPD provides the price's variation

[9] One of the key strengths of our table is its granular breakdown of firm size categories, allowing for a clear distinction between medium, micro-small, and overall SME contributions. This level of detail facilitates direct comparisons and provides valuable insights into the structural composition of enterprises. Furthermore, the application of stringent data-cleaning procedures enhances the reliability of our sample, ensuring that it reflects a high-quality subset of firms that are truly representative of the SME landscape. Although minor differences in percentages exist. These are likely due to methodological factors, such as the exclusion of publicly listed firms in our dataset and the specific definitions or periods of reference adopted. Nonetheless, the overall alignment between the two sources strengthens the credibility of our dataset, confirming that it effectively captures the fundamental characteristics and distribution of SMEs across Europe.

referred to 1-month up to 12-month OIS contract around three monetary events from January 1999 to October 2022.[10] Fig. B.1 in Appendix B shows the timing of ECB's monetary announcement.

According to Auer et al. (2019), Durante et al. (2022) and Jarocinski and Karadi (2020), the series is constructed by measuring the reaction in the 3-month EONIA swaps in a 30-min window around press statements and a 90-min window around press conferences. Fig. 1 shows the dynamics of 3-month OIS around the three different announcement's time-window. To match the different time frequency of the monetary policy shock and the financial statement closing date, we follow the procedure provided by Cloyne et al. (2023), Deng and Fang (2022) and Durante et al. (2022). That is, the matching of firm financial data and monetary shock frequency is based on the 12-month moving sum of monthly monetary shocks series. More specifically, the matching procedure is based on the closing month of the firms' financial account. We rely on the 12-month moving sum because a firm's annual investment is unlikely to be impacted exclusively by the monetary policy shock in the specific month when the accounts are reported.

We apply the 12 moving sum including the shock at the month (m) in which firm (j) closed its financial account during each year (t) by summing the 11 previous monthly shocks. In detail, the 12-month moving sum of the monetary policy shock for firm i at year t is defined as $\Delta MP_{j,t}^{m} = \sum_{k=0}^{11} \epsilon_{m_{j,t}-k}$. Therefore, we obtain a yearly aggregate monetary shock for each firm-year observation. Fig. B.2 in Appendix B illustrates the 12 month moving sum series of the monetary policy shock, while Fig. B.3 shows the average monetary policy shock across firms per year.

The advantage of this procedure is twofold. First, by using a 12-month moving sum we are able to capture the more accurate effect of the monetary policy shock on the annual change in investment in the presence of year-fixed effects. Indeed, it is more reasonable that firms' investment could be affected by the aggregate interest shock during the last 12 months than the sole shock at the time of closing account. The aggregate shock becomes more important in estimating heterogeneous effects of monetary policy on firm investment, especially for non-listed firms, which are less sensitive to market movements. Second, by matching the 12-month moving sum of monetary policy at "closing date" for each firm in each country we are able to capture more time variation. As a result, two firms closing their accounts in the same year but in different months will have been exposed to varying sequences of previous shocks.

Therefore, the aggregate monetary shock at the balance sheet "closing date" accounts for a greater heterogeneity in the shock across firms, years, and countries. As regards to heterogeneity at country-level, Table 5 presents summary statistics of the resulting monetary shock linked to firms for each country included in the sample. Table 5 indicates that monetary policy shock is not homogenous among

Table 2
European countries included into the sample.

Country	Freq.	% on Total	% Medium Firms	% Micro-Small Firms	% SMEs
Austria	36,017	3.40 %	46.96 %	19.28 %	66.24 %
Belgium	50,018	4.73 %	43.80 %	43.39 %	87.19 %
Cyprus	918	0.09 %	60.53 %	32.86 %	93.38 %
Estonia	6535	0.62 %	42.56 %	28.08 %	70.65 %
Finland	31,026	2.93 %	48.73 %	31.89 %	80.63 %
France	226,275	21.39 %	38.56 %	27.94 %	66.49 %
Germany	172,146	16.27 %	51.76 %	20.04 %	71.80 %
Greece	16,887	1.60 %	51.43 %	38.35 %	89.78 %
Ireland	6819	0.64 %	50.35 %	28.26 %	78.61 %
Italy	278,521	26.32 %	46.46 %	52.47 %	98.93 %
Latvia	5842	0.55 %	55.99 %	24.77 %	80.76 %
Lithuania	10,075	0.95 %	56.28 %	19.52 %	75.80 %
Luxembourg	3549	0.34 %	42.81 %	20.45 %	63.26 %
Malta	846	0.08 %	44.83 %	21.28 %	66.10 %
Netherlands	17,856	1.69 %	46.61 %	20.85 %	67.47 %
Portugal	28,698	2.71 %	56.87 %	32.05 %	88.92 %
Slovakia	14,376	1.36 %	52.98 %	19.79 %	72.77 %
Slovenia	9937	0.94 %	60.10 %	33.87 %	93.97 %
Spain	141,682	13.39 %	51.59 %	40.01 %	91.60 %
Total	1,058,023	100			

Sample composition by Eurozone countries. Column 1 highlights the observation for each country, while Column 2 provides the observation in percentage terms. Column 3 provides the % distribution of medium-sized firms for each country. Column 4 shows the distribution of micro-small sized firms for each country. Finally, column 5 gives the total destitution at country level of SMEs as the sum of columns 3 and 4. Source: our own elaboration.

[10] The three monetary policy events are the Press Release, Presse Conference and the Monetary Event. For each event, we focus on the exact time window to observe the OIS rate change, i.e., *i*) the change in the median quote from the window 13:25–13:35 before the press release to the median quote in the window 14:00–14:10 after press release, *ii*) the change in the median quote from the window 14:15–14:25 before the press conference to the median quote in the window 15:40–15:50 after Press Conference, and *iii*) the change in the median quote from the window 13:25–13:35 before the press release to the median quote in the window 15:40–15:50 after the press conference.

Table 3
Sample distribution across European NACE codes.

NACE's division	Description	Freq.	% on total	% Micro-Small Firms	% Medium Firms	% SMEs
A	Agriculture, forestry and fishing	13,651	1.29	48.46 %	40.21 %	88.67 %
B	Mining and quarrying	4754	0.45	39.96 %	40.19 %	80.14 %
C	Manufacturing	319,268	30.18	25.59 %	57.85 %	83.43 %
D + E	Electricity, gas, steam and air conditioning supply Water supply, sewerage, waste management and remediation activities	44,495	4.21	38.69 %	35.20 %	73.89 %
F	Construction	65,744	6.21	35.46 %	47.53 %	82.99 %
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	302,899	28.63	48.78 %	35.87 %	84.66 %
H + J	Transportation and storage Information and communication	106,862	10.10	27.23 %	48.58 %	75.81 %
I	Accommodation and food service activities	20,614	1.95	26.69 %	48.47 %	75.16 %
L + M + N	Real estate activities Professional, scientific and technical activities Administrative and support service activities	113,938	10.77	23.39 %	40.82 %	64.21 %
P + Q + R + S + T	Education Human Health and Social Work Activities Arts, Entertainment and Recreation Other Service Activities Activities of Households as Employers; Undifferentiated Goods and Services Producing Activities of Households for Own Use	64,874	6.13	33.75 %	38.14 %	71.89 %
Total		1,057,023	100			

Sample composition by NACE Rev. 2. Source: our own elaboration. Column 1 provides the main division of NACE sector considered in our sample. Column 2 gives a brief description of the main NACE divisions. Columns 2 and 3 provide the number of observation and the percentage distribution of companies in each division, respectively. Columns 4 and 5 provide the distribution in % of micro-small and medium SMEs for each NACE division. Lastly, Column 6 shows the total distribution in % of SMEs in each sector.

countries: firms operating in different countries experience monetary policy shocks with different magnitude (see the *mean* and *std* columns).[11] We discuss the effects on short-term interest rates and the implications of the zero-lower bound in Appendix C.

3.4. Response of aggregate investment to the monetary policy shock

Before describing the main econometric model employed in our study, we discuss the effect of monetary policy shocks on aggregate investment. Inspired by Durante et al. (2022), we collect the quarterly time series of aggregate investment for the main Eurozone countries by ECB Datawarehouse as a measure of aggregate investments. We focus on Gross Fixed Capital Formation (henceforth GFCF).[12]

Panel (a) of Fig. D.1. in Appendix D presents a preliminary comparative descriptive analysis showing the dynamic trend of GFCF at the Eurozone level and the trend of the fixed asset investment rate derived from the dataset. Table D.1 shows a correlation over the 80 % between the GFCF and the fixed asset investment rate. This result reinforces the validity of our dataset, as the fixed asset investment rate mirrors the dynamics of aggregate investments, thereby highlighting the good representativeness of our dataset with respect to the Eurozone scenario. The same result is obtained when comparing the fixed asset investment rate for Italian, French, German, and Spanish firms (see Table D.1 in Appendix D). To estimate the GFCF's response to monetary shock we employ a local projection (Jordà, 2005) as follows:

[11] Unlike Durante et al. (2022), who focus on Germany, France, and Italy, our study considers the entire Eurozone. This table represents an extension of their contribution by highlighting the average monetary policy shock for each country of Eurozone over the period under consideration. Furthermore, focusing on the table provided by Durante et al. (2022), it is evident that their mean and standard deviation of the shock for Germany, France, Italy, and the pooled sample are very close to those defined in this study, despite the differing timespan. This is an additional result that strengthens the validity of our findings.

[12] As highlighted by Durante et al. (2022), a dedicated aggregate investment series exclusively for non-financial firms is not available for Euro area countries. Therefore, we rely on the existing national accounts data for total investment, which encompasses government investment and residential investment by households. In the terms of national accounts, this measure is referred to as Gross Fixed Capital Formation, expressed in chain-linked volume. The time series provided by the ECB does not include all nineteen countries but only a limited group. Unlike Durante et al. (2022), we include Germany, France, Italy, Spain, Portugal, and the Netherlands.

$$log(GFCF)_{j,q+h} - log(GFCF)_{j,q-1} = \alpha^h{}_j + \beta^h \epsilon_q + \varphi^h \ Macro\_Event + u_{j,q+h} \tag{1}$$

where j refers to the country and $h = (0,1, \ldots,24)$ to the horizon. The coefficient β^h defines the GFCF changes in percentage points (p. p. henceforth) after a one standard deviation increase in the monetary shock. The coefficient α_j^h is the country fixed effect. Unlike Durante et al. (2022), we include the *Macro_Event* dummy variable to capture potential macroeconomic shocks that could influence the response of aggregate investments. Specifically, *Macro_Event* is a dummy variable taking value one during European sovereign debt crisis (2010Q1-2012Q4) and Covid-pandemic (2020Q1-2022Q2). φ^h is the coefficient capturing the effect of macroeconomic events at horizon h.

Figure 2 shows the estimated IRFs given by the sequence of estimates $\widehat{\beta}^0$, $\widehat{\beta}^1, \ldots, \widehat{\beta}^{24}$. An increase by one standard deviation in the short-term nominal interest rate is associated with a significant decrease in aggregate investment. Specifically, we observe a 0.20 p.p. drop in GFCF starting from the fifth quarter. The negative effect persists until the fourth year following the monetary policy shock, after which it is fully absorbed starting from twentieth quarters. The fact that the expected sign is respected—that is, a monetary tightening is followed by a decrease in investments (Cristiano et al., 2005; Bernanke and Gertler, 1989)—confirms that we are using a good proxy for monetary policy. We will compare this result with the evidence obtained from microeconometric analyses in the subsequent sections.

4. Econometric approach and results

4.1. Empirical specification

To show the dynamics of firms' investment following a monetary policy shock, we estimate impulse response functions (IRFs) by employing Jordà (2005)-style local projections. We set our dynamic model as follows:

Table 4
Descriptive statistics of macroeconomic variables.

Variable	Obs.	Mean	Std. Dev.	Min	Max
GDP growth rate	1,058,023	0.715	3.297	-11	7
Inflation rate	1,058,023	1.199	1.036	-1	4

Descriptive statistics for the variables included into the model specification. For each variable, the table highlights the number of observations, mean and standard deviation.

Table 5
Descriptive statistics of 12 month moving sum of the monetary policy shock matched with the firm level dataset.

Country	Obs	Mean	Std. Dev.
1-month OIS	1,044,639	2.484	7.080
3-month OIS	1,044,639	3.648	7.942
6-month OIS	1,044,639	3.606	7.305
Country			
Austria	34,796	3.416	8.010
Belgium	49,497	3.831	8.129
Cyprus	918	4.003	6.492
Estonia	6504	4.150	7.942
Finland	30,265	4.139	8.164
France	221,467	3.552	8.165
Germany	170,704	2.834	7.397
Greece	16,839	3.633	7.894
Ireland	6551	5.029	7.999
Italy	276,813	3.908	8.050
Latvia	5796	4.191	8.146
Lithuania	10,022	5.336	7.311
Luxembourg	3500	4.220	7.951
Malta	840	3.467	6.517
Netherlands	17,666	4.396	8.013
Portugal	28,575	4.130	7.952
Slovakia	14,258	4.384	8.073
Slovenia	9937	3.897	8.014
Spain	139,691	3.636	7.808

The table provides the main statistics regarding the monetary surprise estimated by Jarocinski and Karadi (2020)'s framework. According to Durante et al. (2022)'s approach, the high frequency data are matched with annual balance sheet data by month of closing of the accounts of firms i in year t. The 12-month moving sum of the monetary policy shock for firm i at year t is defines as $\Delta MP_{j,t}^m = \sum_{k=0}^{11} \epsilon_{m_{j,t}-k}$. Source: our own elaboration.

$$\log k_{j,t+h} - \log k_{j,t-1} = \alpha_j + \alpha_{t,s} + \gamma_{j,h}\Delta MP^m_{j,t} + \beta_{j,h}\left(x_{j,t-1} - E_j\left[x_{j,t}\right]\right) + \delta_{j,h}\Delta MP^m_{j,t}\left(x_{j,t-1} - E_j\left[x_{j,t}\right]\right) + \theta_{j,h}\left(x_{j,t-1} - E_j\left[x_{j,t}\right]\right)Z_{c,t-1,t-2} + \Gamma_{1,h}X_{j,t-1} + \Gamma_{2,h}Z_{c,t-1,t-2} + \Gamma_{3,h}X_{j,t-1}\Delta MP^m_{j,t} + \Gamma_{4,h}Z_{c,t-1,t-2}X_{j,t-1} + u_j \quad (2)$$

where t, j and c respectively refer to years, firms and country, respectively. We include firm fixed effects, α_j, and year-sector fixed effects, $\alpha_{t,s}$, in order to capture unobservable heterogeneity that could distort the estimate of the monetary policy effect. The firm fixed effects account for permanent differences in investment behavior across firms, while the sector-by-quarter fixed effects capture any systematic variation across sectors each year, mitigating the risk of bias from unobserved sector-year-specific factors.[13]

We use the cumulative response in the investment rate as the dependent variable.$\Delta MP^m_{j,t}$ represents the standardized monetary policy shock. Specifically, one standard deviation hike is equal to a 7.94 basis point increase in 3-month OIS.[14] Despite the use of year-sector fixed effects, the aggregate monetary shock may still capture additional differences in the firm's investment response, as it varies by year, sector, country, and firm.

Vector x includes the main explanatory variables, which refer to the financial position, i.e., leverage and the cost of financial debt. Leverage is defined as the sum of financial debt over total assets (Ferrando and Mulier, 2015; Kalemli-Özcan et al., 2022; Popov et al.,

Table 6
Country distribution among country risk factors.

Factors	Countries
Country's risk factors	
(a) Stressed vs. *Non-Stressed*	
Stressed countries	Greece, Italy, Ireland, Spain, Portugal
Non-Stressed countries	Belgium, Cyprus, Latvia, Lithuania, Malta, Slovenia, Germany, Estonia, Austria, Finland, Luxembourgh, Netherlands, Slovakia, France
(b) Loan to deposit	
<33rd pc.	Belgium, Cyprus, Italy, Latvia, Lithuania, Malta, Slovenia
>33rd pc.- < 66th pc.	Germany, Estonia, Greece, Portugal
>66th pc.	Austria, Finland, Ireland, Luxembourgh, Netherlands, Slovakia, Spain, France
(c) Cost of borrowing	
<33rd pc.	Austria, Germany, Finland, France, Italy, Portugal, Slovakia
>33rd pc.- < 66th pc.	Belgium, Cyprus, Spain, Lithuania, Luxembourg, Netherland
>66th pc.	Estonia, Greece, Ireland, Latvia, Malta, Slovenia
Country's market structure	
(d) Micro SMEs	
<33rd pc.	Austria, Germany, Finland, Ireland, Luxembourgh, Latvia
>33rd pc.- < 66th pc.	Estonia, France, Lithuania, Malta, Netherland, Slovenia
>66th pc.	Belgium, Cyprus, Greece, Spain, Italy, Portugal, Slovak Rep.
(e) Medium SMEs	
<33rd pc.	Cyprus, Greece, Spain, Italy, Portugal, Slovak Rep.
>33rd pc.- < 66th pc.	Austria, Belgium, France, Lithuania, Netherland, Slovania
>66th pc.	Germany, Estonia, Finland, Ireland, Luxembourgh, Latvia, Malta
(f) Intangibles intensive countries	
<33rd pc.	Austria, Germany, Lithuania, Latvia, Slovenia, Slovakia
>33rd pc.- < 66th pc.	Belgium, Estonia, Spain, Greece, Italy, Luxembourgh
>66th pc.	Cyprus, Finland, France, Ireland, Malta, Netherland, Portugal

The table provides the allocation of countries among the different country factors. Each panel refers to a different factor. In panels (a)-(c), the table shows the country distribution according to country risk factors. In panel (a), the table reports the stressed and non-stressed countries. In panel (b), the countries are clustered following the terciles of the loan-to-deposit distribution. In panel (c), the countries belonging to the terciles of cost of borrowing are exhibited. In panel (d)-(f), the table shows the country distribution according to the countries' market structure factors. In panel (d), we cluster the countries according to the terciles of employment's rate related to Micro SMEs, whereas in panel (e) countries are clustered on the basis of the terciles of the employment rate of Medium SMEs. Finally, panel (f) highlights the countries divided by terciles of the intangible ratio by country.

[13] Differently from Durante et al. (2022) who do not include year-fixed effects in their empirical specification, we include a year-sector fixed effects. In addition to the theoretical justification for including time-fixed effects, most contributions investigating monetary shocks on firm activity do incorporate time fixed effects. Specifically, these studies include time (year/quarter) fixed effects interacted with sector (SIC/NACE) fixed effects (e.g., Ottobello and Winberry, 2021; Deng and Fang, 2022; Jeenas, 2018; Anderson and Cesa-Bianchi, 2024; Jungherr et al., 2024). Moreover, following the same approach to compute the aggregate monetary shock proposed by Durante et al. (2022), we do not include the closing-date fixed effects. Closing-date fixed effects are dropped by collinearity because they fully overlap with firm and year-sector fixed effects.

[14] Comparing our findings with other studies focused on Eurozone, we obtain a standard deviation close to metrics obtained by Durante et al. (2020). These authors split the statistics by the four treated countries (Germany, France, Italy, Spain). Our estimation based on the 19 Eurozone countries is close to the average of Durante et al. (2022)'s statistics.

2020). To estimate the effect of the cost of borrowing on investment decisions, we include the firm's cost of funding (McGowan et al., 2018; Hong et al., 2021; Banerjee and Hofmann, 2022). We use the standardized cost of debt, i.e., firms' financial expenses over EBITDA.

We use demeaned measures of leverage and the cost of debt to ensure that firms' response to the monetary shock is not driven by permanent heterogeneity across firms (Ottonello and Winberry, 2020; Deng and Fang, 2022).[15] Specifically, $\left(FE_{j,t-1} - E_j\left[FE_{j,t}\right]\right)$ is referred to the demeaned financial expenses to EBITDA, while $\left(Lev_{j,t-1} - E_j\left[Lev_{j,t}\right]\right)$ is referred to the demeaned value of firm's leverage.

The main coefficients of interest are γ_h and δ_h, which provide the impulse response at forecast horizon $h \in [0, 1, \ldots, 4]$. The coefficient γ_h capture the effects of the monetary policy shock on investment activity in each horizon h. The coefficient δ_h measures how the semi-elasticity of investment i_{jt} with respect to monetary shocks $\Delta MP^m_{j,t}$ interacts with the within-firm variation in financial positions $\left(x_{j,t-1} - E_j\left[x_{j,t}\right]\right)$.

Controlling for capital accumulation over years, a broad set of control variables are included in eq. (2). X is the vector of firm control variables, i.e., the sales growth rate (*Sales growth*), the logarithm of total assets (*Asset*), cash flow (CF) and firm's age (*Age*). *Asset* is defined as the logarithm of total asset. *Sales growth* is computed as the sales annual change over sales in previous year. *Age* is used to capture the effect of the firm's financial friction (Hadlock and Pierce, 2010; Bahaj et al., 2022; Cloyne et al., 2023). All firm control variables are lagged at *t-1*. *Z* is a vector of macroeconomic control variables, i.e., the country's GDP growth rate and inflation rate. One

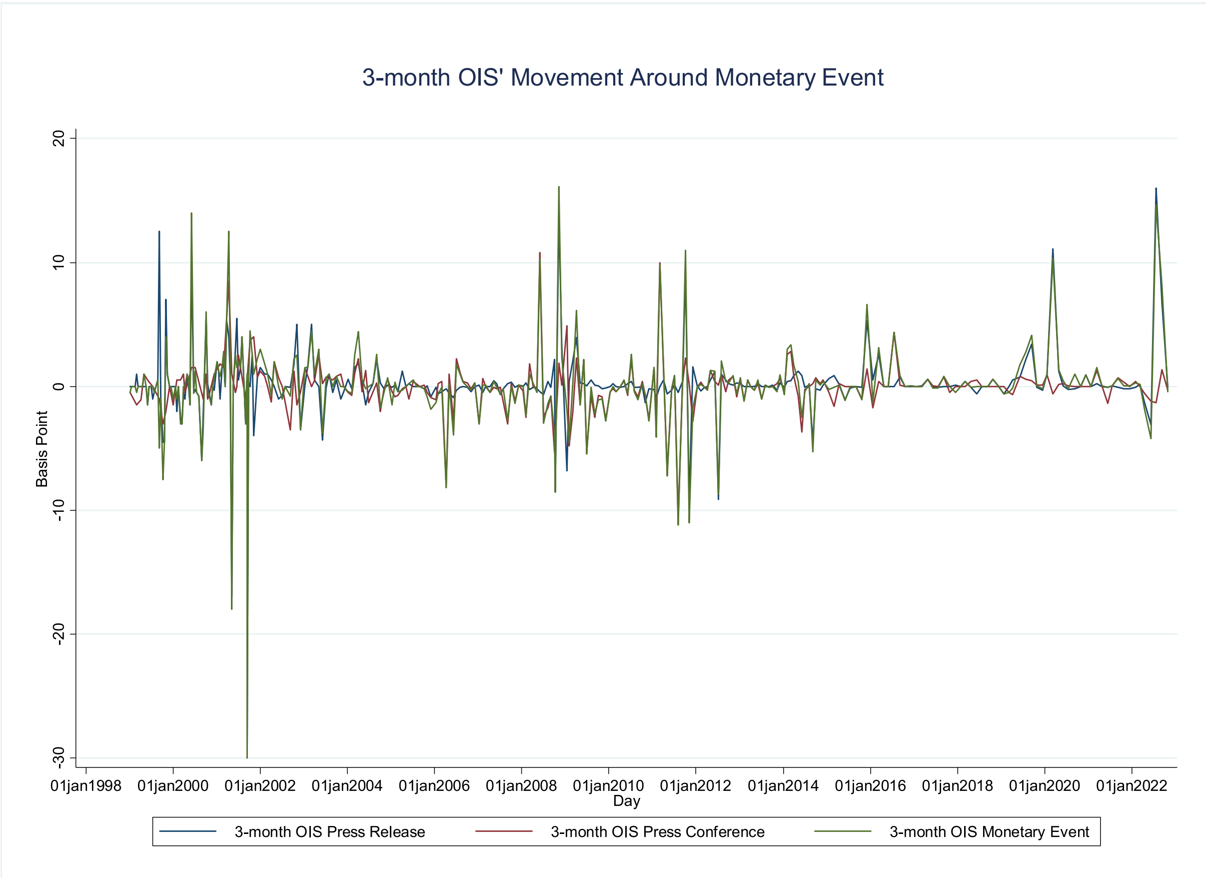

Fig. 1. 3-month OIS movements around Press Release Window, Press Conference Window and Monetary Event Window. Source: Euro Area Monetary Policy event study Database (EA-MPD).

[15] This choice is motivated by the Ottonello and Winberry (2020)'s economic model, in which firms are ex-ante homogenous. In contrast, firms in the data may be ex-ante heterogeneous in how they respond to monetary policy according to their financial position. For example, firms operating in high debt level markets may be permanently more exposed to interest-rate fluctuations and permanently more exposed to debt overhang. By demeaning financial position within firms, $\left(x_{j,t-1} - E_j\left[x_{j,t}\right]\right) \Delta MP^m_{j,t}$, our estimates are instead driven by how a given firm responds to monetary policy when it has higher or lower debt or cost of debt than usual.

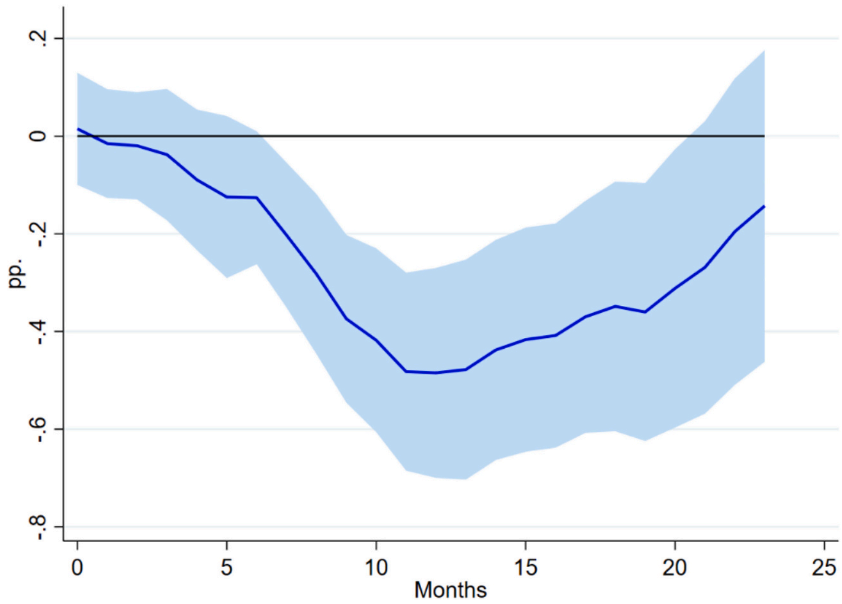

Fig. 2. Response of GFCF of monetary policy shock. Note: The figure plots the coefficient β for each quarter *h*. The blue line is the coefficient in each quarters, whereas the shaded band reports 95 % confidence band. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

year lagged and two year lagged macroeconomic control variables are included to capture the effect of the economic cycle on the firm's asset accumulation.

Consistently with Jungherr et al. (2024), we extend the empirical model specification to include the interaction between firm's company variables with both macroeconomic controls ($Z_{c,t-1,t-2}X_{j,t-1}$) and the monetary policy shock ($X_{j,t-1}\Delta MP^{m}_{j,t}$). The inclusion of wide set of control variables allows us to control for further firm characteristics or other time-varying observables that could be related to the investment response.

The standard errors are clustered by the firms' level. Table A.1 in Appendix A resumes all variables used in the analysis.

4.2. Empirical results

4.2.1. The investment response to the monetary policy shock

In this subsection we provide the empirical results from our dynamic specification. Each graph exhibits the results of five panel fixed effect regressions ($h = 0, \ldots, 4$) and shows the estimated IRFs given by the sequence of estimates $\widehat{\beta}^0$, $\widehat{\beta}^1, \ldots, \widehat{\beta}^4$.

Figure 3 shows the impulse response function up to 5 years without controlling for the firm-level financial position. Detailed information on the estimation is provided in Appendix E in Table E.1. The monetary policy shock is significantly correlated with the investment capacity since the time of the shock and persists up to the third year after. In $h = 4$ the shock is fully absorbed. The magnitude of the shock increases over time starting from $h = 0$ with a decrease of 7.47 ($\gamma_1 \cdot 100 \cdot 7.942$) basis points (bps). The trend continues until $h = 3$, where the decrease reaches 12.71 bps, peaking at $h = 2$ with a reduction in investment by 14.70 bps.

Our findings also emphasize the timing of the monetary shock's propagation. The shape of the dynamic response is broadly consistent with the U-shaped impulse response function presented by Durante et al. (2022). However, compared to the evidence provided by Durante et al. (2022), our shock has a smaller effect on the reduction of capital but a larger persistence. This may be due to the different composition of the sample. In fact, the Durante et al. (2022) consider only three countries (Germany, Italy, France), while in our work we consider all the member countries of the Eurozone. A key feature of our analysis is the consistency between the results of the aggregate analysis and the micro-level analysis, despite differences in the countries considered and the data frequency: a monetary policy shock is associated with a reduction in investment reaching the peak between two and three years after the shock. Thus, the alignment between firm-level micro responses and aggregate data offers a valuable benchmark for exploring further the varied impacts across firms.

4.2.2. Macroeconomic events during 2011–2021

An important limitation of our analysis concerns the time period under investigation. Our sample spans the years 2011–2021—a decade marked by major macroeconomic disruptions, notably the European Sovereign Debt Crisis and the Covid-19 pandemic. Given the annual frequency of the data and the relatively short time span, fully isolating the dynamic effects of monetary policy shocks from other concurrent macroeconomic events remains empirically challenging. While our baseline specification includes sector-by-year fixed effects and a rich set of firm- and macro-level controls, we acknowledge that these measures may not fully absorb broader

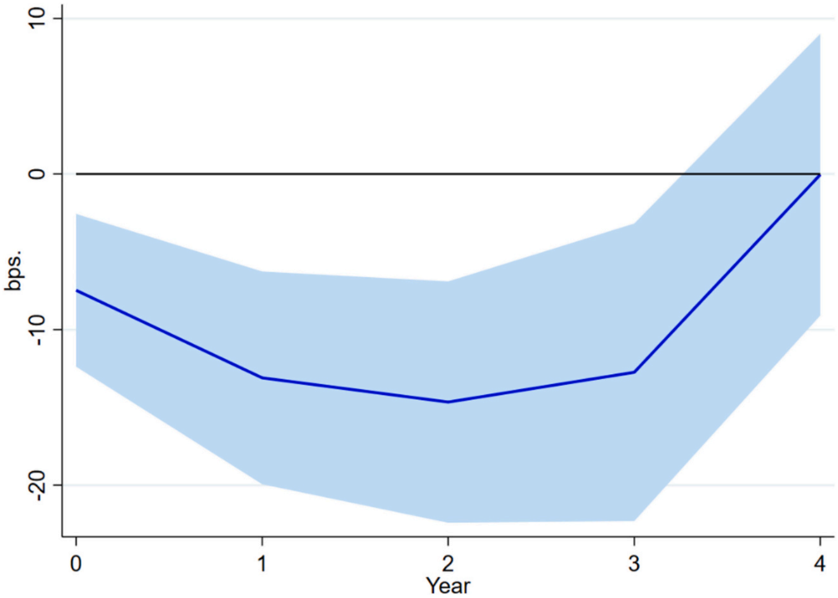

Fig. 3. Dynamics of differential response to the monetary shock. Note: Dynamics of the monetary policy shock coefficients over time. The figure reports the coefficient γ_h over years h. All variables are defined in Section 4. Shaded bands report 95 % confidence bands.

macroeconomic variation. In response to this concern, we carry out additional robustness checks, as described in subsection 6.1. Specifically, we re-estimate our main specifications on a restricted sample covering the period 2013–2019, thereby excluding the peak years of the sovereign debt crisis and the initial phase of the pandemic. These alternative estimates yield results that are both statistically and economically consistent with our baseline findings. This robustness lends support to our core conclusions. However, we stress that some residual influence from overlapping macroeconomic shocks may remain. Accordingly, our estimates should be interpreted as reflecting the interaction between monetary policy and firm- and country-level heterogeneity within a complex and evolving macro-financial environment.

4.2.3. Asymmetries and non-linearities of monetary policy shock

We further test our baseline empirical model by examining: *i*) the potential asymmetry between tightening and loosening shocks, and *ii*) nonlinearities arising from different magnitudes of the monetary shock. See Appendix F for details on empirical models and a description of the results. Our evidence suggests that an expansionary monetary policy shock is not simply the mirror image of a contractionary shock. Furthermore, our findings on the non-linear effects of monetary shocks align with the arguments discussed in the literature.

4.2.4. The capital structure channel in the transmission of the monetary policy shock

To assess formally the debt overhang condition following a contractionary monetary shock, we include financial expenses and leverage and in eq. (2). The regression results are provided in Table E.2 and Table E.3 in Appendix E, respectively.

Panel (a) of Fig. 4 shows the response of investment to the combining effect of tightening monetary policy and the cost of debt. The coefficient γ_h is significant, following the same pattern observed in the previous section, with its peak effect at $h = 2$. Similarly, the increase in financial costs aligns with expectations, as higher debt expenses reduce firms' cash flows, limiting resources for investment. However, the combined effect is not statistically significant.

Radically different results are obtained when we estimate the heterogeneity in the investment response with respect to an upward debt exposure when the tightening shock occurs. Panel (b) of Fig. 4 shows the dynamics of δ_h, that is, the interaction term between monetary policy and firm's leverage. Firms with higher leverage tend to exhibit a stronger decline in investment following a contractionary shock, with the difference in response being most pronounced between $h = 0$ until $h = 3$. The peak differential effect is reached in the horizon of two years. Specifically, in response to contractionary monetary policy shock by one standard deviation, bearing a leverage ratio one percentage point higher than average is associated with an additional decrease in investment by 1.23 ($-0.155 \cdot 7.942$) bps in $h = 2$, from 16.04 to 17.27 bps. This corresponds to an increase in the investment semi-elasticity to a nominal interest rate hike by 7,67 %. After $h = 2$, the magnitude of the interaction coefficient δ_h decreases till to turn on positive in the last horizon.

Therefore, we are led to infer that higher debt exposition is associated with a worsening in the investment capacity of European non-listed firms when the monetary shock unfolds effects. Moreover, we find that highly leveraged firms, especially those in the top quartile of indebtedness, experience a significant reduction in investment following a tightening monetary shock. This decline is most pronounced in the second year after the shock and persists for an extended period, although with diminishing effects. See Appendix G

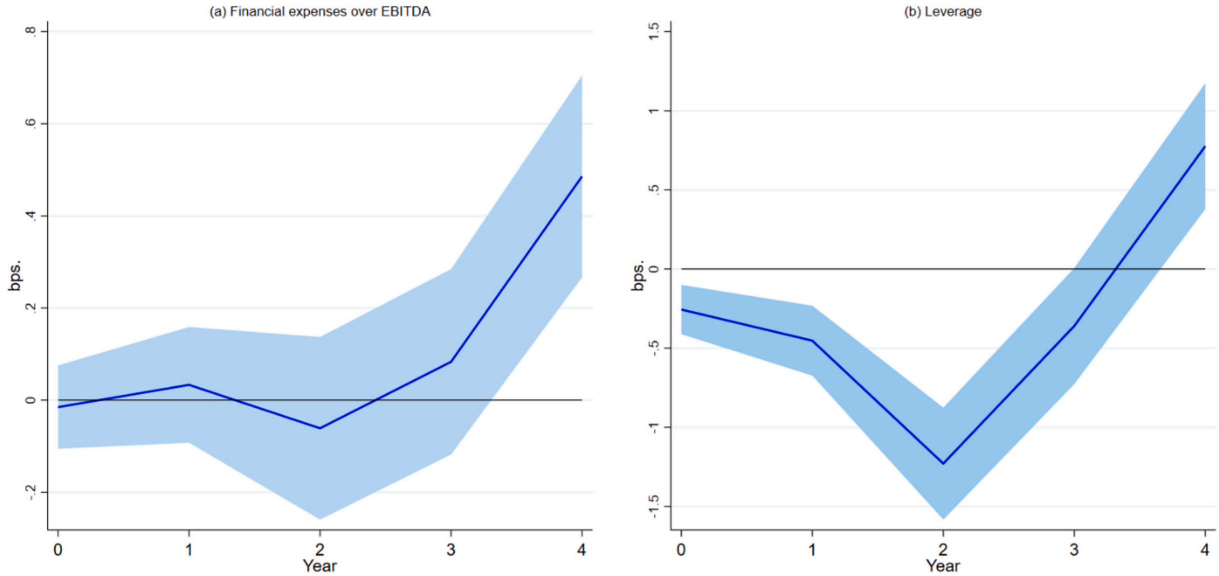

Fig. 4. Dynamics of the differential response of investment to the interaction between the monetary policy shock and the firm financial position. Note: The figure reports the coefficient δ_h over years h. All variables are defined in Section 4. Panel (a) shows the firm's investment response to an increase in financial expenses when the tight shock occurred. Panel (b) shows the firm's investment response to an increase in leverage when the tight shock occurred. Shaded bands report 95 % confidence bands.

for detailed information on the asymmetry of leverage.

As previously discussed, one key limitation of our empirical strategy concerns the difficulty of fully isolating monetary policy effects from concurrent macroeconomic shocks. This concern also extends to the results presented in this section. To address this issue, Section 6.1 tests the robustness of the estimated interaction coefficient δ_h by re-estimating the baseline specification on a restricted time sample (2013–2019), which excludes the peak of the sovereign debt crisis and the initial impact of the Covid-19 pandemic. While the patterns remain consistent across this alternative specification, some residual influence from broader macroeconomic developments cannot be ruled out.

Overall, elevated debt levels are associated with a worsening of the debt overhang problem, constraining highly indebted firms from pursuing profitable investment opportunities. In Appendix H we perform the same econometric exercise demeaning leverage and financial expenses by the NACE's mean. The empirical results corroborate confirm the evidence argued in this section.

4.3. Corporate debt structure and heterogeneous investment response

In this section, we investigate the different investment responses to the monetary policy shock according to different debt maturities. The impact of debt maturity on debt overhang can affect the incentive to invest in future profitable projects. The theory of corporate finance offers two perspectives on the relationship between debt maturity and investment. Myers (1977) suggests that long-term debt can worsen the overhang cost of indebtedness. The rationale behind this argument is that short-term debt is less responsive to changes in the firm's value, so that new investment provides a smaller benefit. If debt matures before the investment decision, then the company can make investment decisions like an all-equity firm, avoiding the agency costs of debt, which can discourage investment. Conversely, Diamond and He (2014) propose that shorter debt maturity may increase the debt overhang. They argue that risky short-term debt can lead to an even greater overhang problem than long-term debt, since short-term debt carries a lower repayment risk with equity over time. Short-term debt is paid earlier than long-term debt due to reduced uncertainty, potentially increasing the transfer of value from equity to debt holders.

Tables E.4 and E.5 in Appendix E give the estimates including the interaction of the monetary policy shock with short-term (*ST_Lev*) and long-term leverage (*LT_Lev*).[16] Fig. 5 shows the estimated coefficients of interaction for each horizon h. Panel (a) focuses on the investment response to an increase in short-term debt when monetary policy shock occurs. Although a short-term debt exposure one percentage point larger than average is per se significantly and strongly associated with a persistent negative effect on investment rate, this relationship is not statistically following a monetary tightening: the estimated interaction terms the estimated interaction terms δ_h remain insignificant across all horizons.

Panel (b) of Fig. 5 shows the investment response to the monetary policy shock when firms bear an increase in long-term debt. A

[16] *LT_Lev* is defined as the debt-to-asset ratio which is the sum of debt maturing in more than one year. *ST_Lev* is defined as the debt-to-asset ratio, which is the sum of debt maturing within one year. The long-term and short-term exposition are demeaned by the firm's average to obtain results that are not driven by permanent heterogeneity in responsiveness across firms.

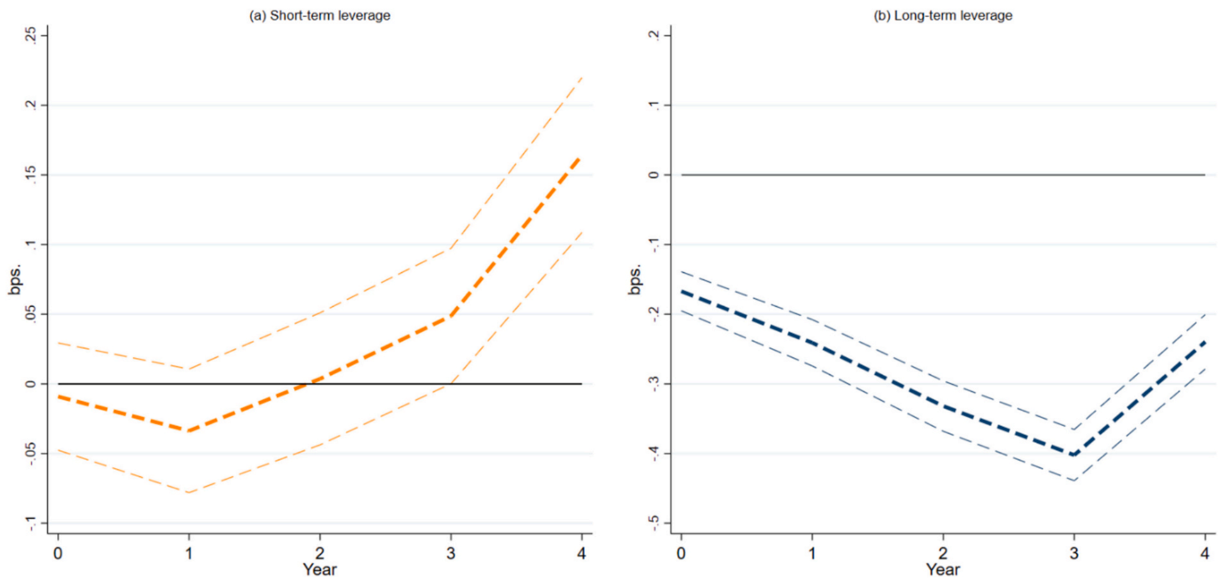

Fig. 5. Dynamics of the differential response of investment to the interaction between the monetary policy shock and debt maturity. Note: Dynamics of coefficient measuring the interaction between maturity of debt exposure, i.e., short-term and long-term debt, and the monetary policy shock over time. The figure reports the coefficient δ_h over years h. All variables are defined in Section 4. Panel (a) shows the investment firm's response to short-term debt when the tight shock occurred. Short-term debt is the sum of short-term financial debt to total assets. Panel (b) shows the investment firm's response to long-term debt when the tight shock occurred. Dashed bands report 95 % confidence bands.

long-term debt exposure one percentage point larger than average is also per se significantly and strongly associated with a persistent negative effect on investment rate. Nevertheless, differently from the case of short-term exposure, now the interaction coefficient δ_h is significantly negative from the year of the shock until the last year of projection ($h = 4$). Specifically, a one percentage point larger long-term debt is associated with a decrease in investment by 1.33 bps following a monetary restriction by one standard deviation in $h = 0$. This trend persists till $h = 3$, where the jointly increase in interest rate and worsening in long-term debt exposure is related to a contraction of the investment activity by 3.20 bps, with an increase in semi-elasticity by 31.90 %. The negative association between leverage and investment continues to be statistically significant until the fourth period, although its magnitude declines over time. Overall, the finding that long-term debt, rather than short-term debt, is associated with higher sensitivity of firms' investment to monetary policy provides strong empirical evidence for the argument that debt overhang—characterized by a more pronounced decline in investment in response to monetary tightening due to the increased real burden of outstanding nominal long-term debt and the associated rise in default risk—is significantly at play for small and medium-sized firms operating within the European Monetary Union.

5. Heterogeneity among country-level factors in the monetary policy transmission

In this section, we investigate whether heterogeneity among EMU member countries significantly modifies the impact of corporate debt on the investment semi-elasticity to a monetary policy shock. We consider two categories of country-specific characteristics, that is, the country-specific risk factors and the country-specific market structure. For each macro-class, eq. (2) is estimated to examine how heterogeneity among countries may shape the sensitivity of investment to monetary policy in the presence of varying levels of firm indebtedness. Subsections 5.1 and 5.2 discuss the empirical results concerning the country-risk factors and country market structure, respectively.

5.1. *The role of country-risk factors*

In this subsection, we examine whether the sensitivity of investment to monetary policy shocks differs between firms operating in *stressed* and *non-stressed* countries, as defined by Ferrando et al. (2021), in relation to their leverage levels.[17] Greece, Italy, Ireland, Spain and Portugal are included in the sample of stressed countries. The rest of the Eurozone members are included in the non-stressed countries group.

[17] According to Ferrando et al. (2021), countries that have benefitted more by a lowered cost of borrowing after the OMT announcement are defined as stressed. Differently from Ferrando et al. (2021), we include Ireland and Greece. From our perspective, these countries were typically more vulnerable during the financial turmoil (2011–2013).

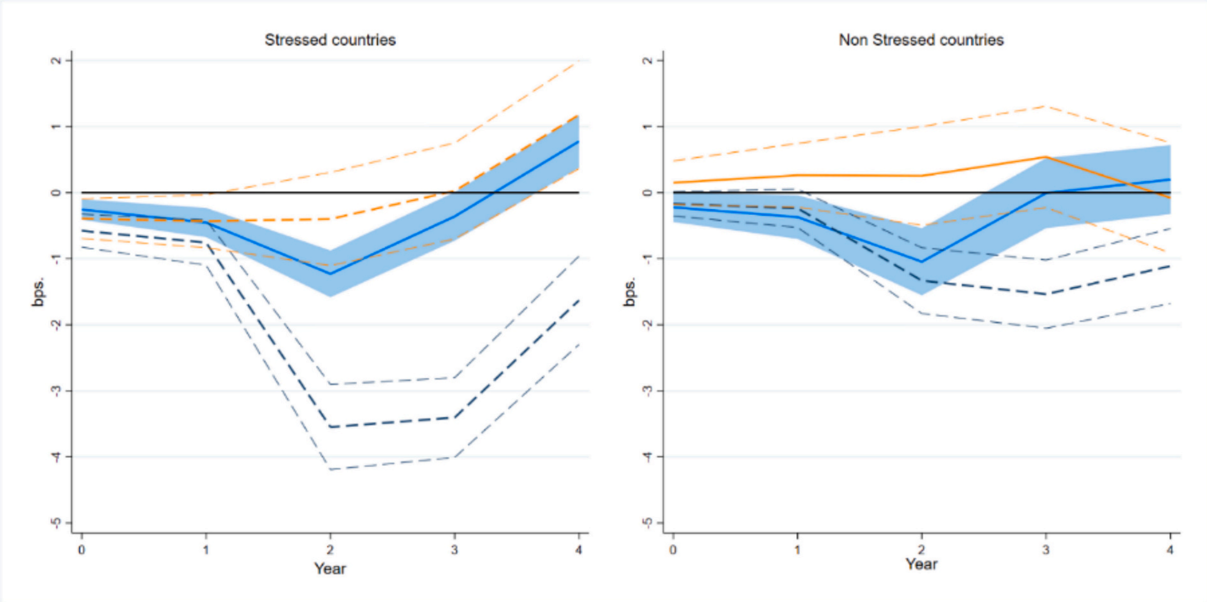

Fig. 6. Dynamics of the differential response of investment to the interaction between the monetary policy shock and corporate leverage in stressed and non-stressed countries. Note: The figure reports the coefficient δ_h over years *h*. All variables are defined in Section 4. The blue line shows the coefficient δ_h over year *h* when the monetary shock is interacted with leverage. The navy-dashed line shows the coefficient δ_h when monetary shock is interacted with long-term leverage, whereas the orange dashed line sows the dynamics of coefficient δ_h when monetary shock is interacted with short-term leverage. Panel (a) gives the investment response if only firm operating in stressed countries are included. Panel (b) gives the investment response if only firm operating in non-stressed countries are included. Dashed bands report 95 % confidence bands. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Figure 6 displays the interaction coefficients obtained from estimating eq. (2) and clustering by stressed (panel (a)) and non-stressed countries (panel (b)). In each figure, the coefficients δ_H are presented by estimating eq. (2) separately for each debt specification: leverage (blue line), short-term debt (orange dashed line), and long-term debt (green dashed line). Details on the coefficients are provided in Table E.6 in Appendix E.

In *stressed countries*, a one-percentage-point higher leverage is associated with a significantly stronger decrease in investment following contractionary monetary policy shocks. The interaction coefficient shows an immediate negative effect on investment, reaching the maximum magnitude at $h = 2$, with a further reduction of 1.64 bps. In terms of persistence, the interaction is associated a significant and negative effect on investment till three periods after the shock. In contrast, firms operating in non-stressed countries experienced a reduction in investments one year and two years after the shock.

When we focus on different debt maturities, the differences in the amplification of the shock become even more evident. In stressed countries, the coefficient associated with long-term debt indicates a further, highly persistent reduction in investments (from $h = 0$ to $h = 4$), with a magnitude significantly greater than the effect of total leverage. Specifically, a one-percentage-point increase in long-term debt is associated with an additional reduction in investments following the shock of 3.55 bps at $h = 2$ and 3.41 bps at $h = 3$. Conversely, an increase in short-term debt exposure is associated with a reduction in investments only at the time of the shock, which is absorbed starting from $h = 1$.

In contrast, for firms in non-stressed countries, an increase in short-term debt is not significantly associated with a reduction in investments. Moreover, the coefficient associated with long-term debt becomes significant two periods after the shock and persists until $h = 4$. However, as shown in Fig. 6, long-term debt exposure is related to a stronger reduction in investment following monetary shocks in both groups of countries, although the extent of this relationship differs between stressed and non-stressed contexts.

To better understand how country risk shapes the transmission of the monetary shock, we employ two additional risk indicators. Specifically, in the spirit of Altavilla et al. (2016), we use the cost of borrowing (*CoB*) and the loan-to-deposit ratio (*LtD*) as proxy for the level of bank rigidity. We cluster our sample in three terciles according to *CoB* and *LtD* distribution in 2021.[18] Panels (a) and (b) of Table 6 exhibit the countries' distribution for the two considered country risk measures. Fig. 7 shows the investment response to the monetary shock when debt exposure (leverage, and short- and long-term leverage) worsens. In Appendix E, Table E.6 provides details

[18] We expand our dataset including country-level data on the firm cost of borrowing and the loan-to-deposit ratio, both provided by the ECB. The annual country-level data of cost of borrowing borne by non-financial corporation is collected by ECB Statistical Data Warehouse (https://sdw.ecb.europa.eu/browse.do?node=bbn4935). The annual time-series of loan-to-deposit for the Eurozone countries are obtained by Euro Area Statistics (https://www.euro-area-statistics.org/banks-balance-sheet- loans?cr=eur&lg=en&page=3&template=1).

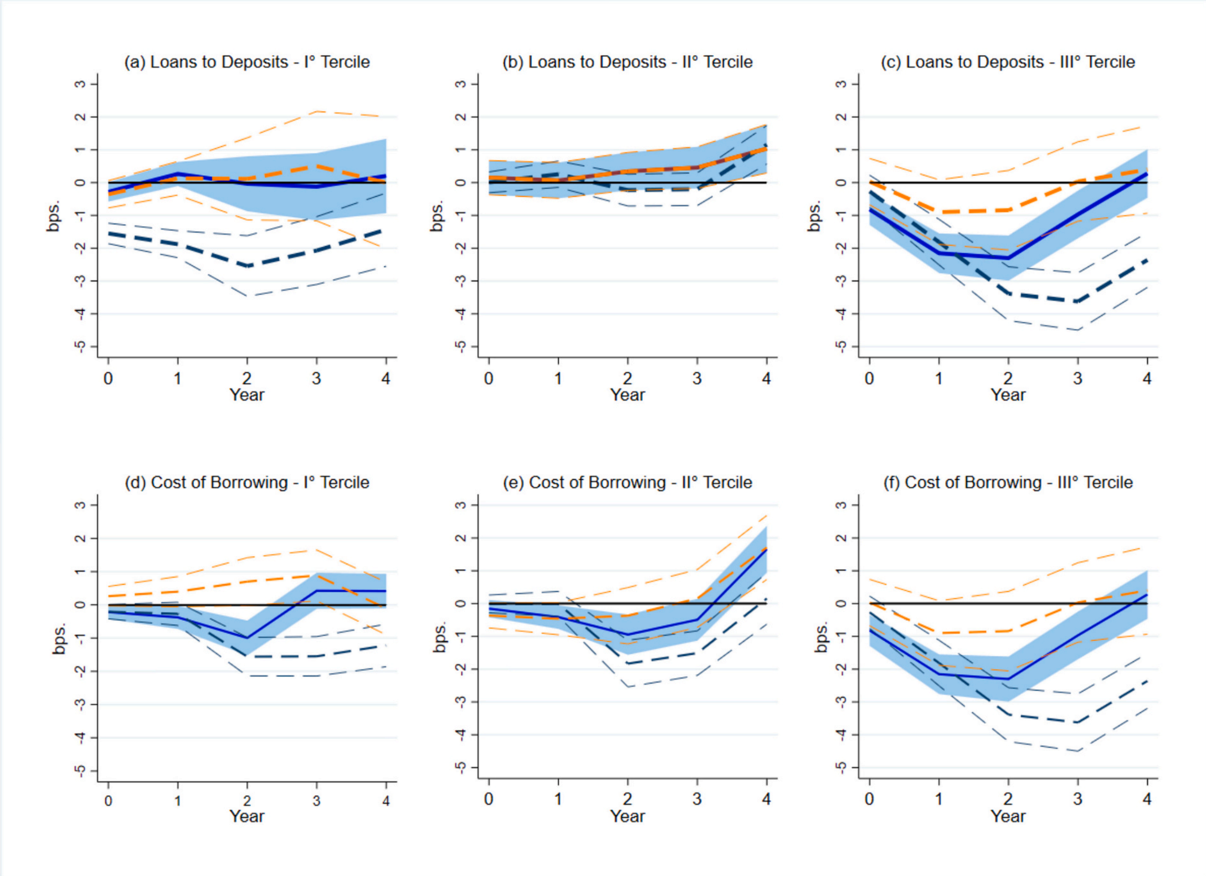

Fig. 7. Dynamics of the differential response of investment to the interaction between the monetary policy shock and corporate leverage according to the cost-of-borrowing and loans-to-deposit distribution at country level. Note: The figure reports the coefficient δ_h over years *h*. All variables are defined in Section 4. The blue line shows the coefficient δ_h over year *h* when the monetary shock is interacted with leverage. The navy-dashed line shows the coefficient δ_h when the monetary shock is interacted with long-term leverage, whereas the orange dashed line shows the dynamics of coefficient δ_h when the monetary shock is interacted with short-term leverage. Panels (a)-(c) give the investment response if sample is clustered according to terciles of the loans-to-deposits' distribution. Panels (d)-(f) give the investment response if the sample is clustered according to terciles of the cost-of-borrowing distribution. Dashed bands report 95 % confidence bands. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

on the estimated coefficients.

Our results reveal that firms operating in countries characterized by high frictions in accessing credit (i.e., high cost of borrowing) and a rigid banking system (i.e., high loan-to-deposit ratio) tend to exhibit a stronger association between debt exposure and the investment response to an interest rate hike. As shown in Fig. 7, higher long-term debt levels are correlated with more pronounced reductions in investment following monetary tightening.

Concentrating on the 66th percentile (panel (c) and panel (f)), our estimations show that the interaction coefficient δ_h is significant since the time of the shock for total leverage and long-term debt, reaching the maximum effect in $h = 2$ and $h = 3$, respectively. This pattern is maintained when the sample is clustered according to *LtD* and *CoB* distribution. For both specifications, the δ_H coefficient remains negative till three periods after shock.

In sum, our findings indicate that countries most severely affected by economic distress during the sovereign debt crisis exhibit increased sensitivity of investment to leverage when subjected to contractionary monetary policy. Firms in stressed countries, characterized by greater barriers to accessing credit markets, display a more pronounced response to monetary policy shocks. Higher borrowing costs and more rigid banking systems are typically associated with tighter financial conditions, under which the correlation between rising interest rates and weaker investment activity tends to be stronger.

The effects of monetary tightening differ across debt maturities. In stressed countries, long-term debt exposure is associated with more persistent and pronounced reductions in investment compared to short-term debt. Specifically, higher levels of long-term debt correlate with weaker investment performance from the time of the shock and over the following four periods. By contrast, short-term debt appears to be associated with investment adjustments that are more limited in both size and duration, with declines mainly concentrated in the immediate aftermath of the shock. The effects of monetary tightening differ across debt maturities. In stressed countries, long-term debt exposure is associated with more persistent and pronounced reductions in investment compared to short-term debt. Specifically, higher levels of long-term debt correlate with weaker investment performance from the time of the shock and over the following four periods. By contrast, short-term debt appears to be associated with investment adjustments that are more limited in both size and duration, with declines mainly concentrated in the immediate aftermath of the shock. For firms in non-stressed countries, short-term debt levels are not statistically associated with subsequent changes in investment, while higher long-term debt levels show a statistically significant correlation with lower investment starting two periods after the shock, with this relationship persisting until the fourth period.

The different effects of debt maturity may also be influenced by varying strategies employed by banks. Stricter borrower pre-selection practices could mitigate the system's vulnerability to the combined effects of monetary tightening and heightened debt levels. Such practices may reduce the amplification effect of long-term debt, as more selective lending policies could lead to higher-quality debt portfolios. Although this factor lies beyond the scope of the current analysis, it presents an important avenue for future research.

5.2. *The role of the market structure*

This subsection investigates how higher debt exposure is related to differences in the investment response to a monetary shock across different market structures. We analyze market composition along two dimensions. First, we show the empirical evidence on the SMEs' distribution. Then we concentrate on intangible intensity.

5.2.1. *Differences between country-based Micro and medium SMEs*

Our hypothesis is that variations in the distribution of SMEs across countries may be associated with differences in the transmission of monetary policy. In 2020 SMEs accounted for 61.7 % of the Euro Area non-financial business economy workforce and around 50.1 % of value added. Employing the SMEs' employment rate index provided by European Commission (2023),[19] we stratify the sample according to terciles of employment rates for micro and medium-sized SMEs.[20] Panel (c) and (d) of Table 6 depict the countries distribution across the three terciles for each SMEs size. The central role of micro-SMEs in the transmission of monetary policy shocks is highlighted by Fig. 8. Panels (a)-(c) display the δ_H coefficients based on the distribution of micro-SMEs, while panels (d)-(f) present the δ_H coefficients for medium-SMEs. Further details on estimated coefficients are shown in Table E.7 in Appendix E.

The centrality of micro-SMEs in Eurozone countries allows us to capture an increase in the speed of propagation for the over-indebtedness firms. The results suggest that in countries with a larger presence of micro-SMEs, the investment response to increased debt exposure following a monetary tightening tends to be quicker and more marked. Indeed, under monetary tightening, investment adjustments to rising debt exposure seem to occur more rapidly and with greater intensity as the share of micro-SMEs increases. Our results also confirm the heterogeneity across different specifications of capital structure.

In each tercile, the combined effect of increased short-term debt exposure and monetary shocks is not significantly associated with investment responses. In the second and third terciles, a one-percentage-point increase in leverage corresponds to an additional reduction in investments of 2.25 and 1.24 basis points at $h = 2$, respectively. Furthermore, increased long-term debt exposure is linked to a stronger negative association with investment declines following rising interest rates. This association is roughly two to three times greater than that observed for total leverage at the point of maximum effect ($h = 2$). Specifically, at $h = 2$, a one percentage point increase in long-term debt is associated with an additional investment decrease of nearly 4 basis points in the second and third terciles.

We corroborate the previous evidence on the role of micro-SMEs in the transmission of European monetary policy by focusing on the medium SMEs. Panels (d)-(f) show findings that mirror those presented in panels (a)-(c). The investment reduction is not noticeably larger with higher leverage in countries where the share of medium-sized SMEs is significant. Conversely, in countries where the employment share of medium-sized SMEs is below the 33rd percentile, firms' investment appears more responsive: a one-percentage-point increase in debt exposure is associated with a stronger negative investment response following the shock, lasting up to three periods. The pattern of differing effects across debt maturities remains consistent, though with some slight variations. In economies with a higher proportion of medium-sized firms, worsening debt exposure is not significantly associated with a stronger investment response to the monetary shock. However, in relation to the increase in long-term debt, the dynamics and magnitude mirror the earlier findings: the peak effect occurs two years after the shock, with a further reduction in investments of about 4 bps.

These findings offer a novel perspective on how investment decisions respond to monetary policy shocks, particularly in the context of debt overhang, as outlined by Myers (1977). When companies' debt levels exceed a sustainable threshold, our results show a notably larger and more persistent association with reduced investment, particularly as the share of micro-SMEs increases. This pattern suggests that micro-SMEs, due to their greater vulnerability to debt overhang, tend to exhibit a stronger and more prolonged decline in investment following monetary tightening. The worsening of debt exposure, especially regarding long-term debt, is linked with more

[19] In order to investigate the effect of heterogeneity in the firm's size on the transmission of monetary shocks, we base our estimation on the employment rate in the European micro, small and medium SMEs during the year 2022. These data are hand-collected from the *SME Performance Review Annual Report 2022/2023*. (https://single-market-economy.ec.europa.eu/smes/sme-strategy/sme-performance-review_en). The European Commission provides data for all countries members of European Union. We focus only on Eurozone member countries.

[20] In addition, we include also the employment rate for small SMEs. The results are very close to those obtained by focusing on SMEs. We choose to show only the results concerning the micro and medium SMEs distribution.

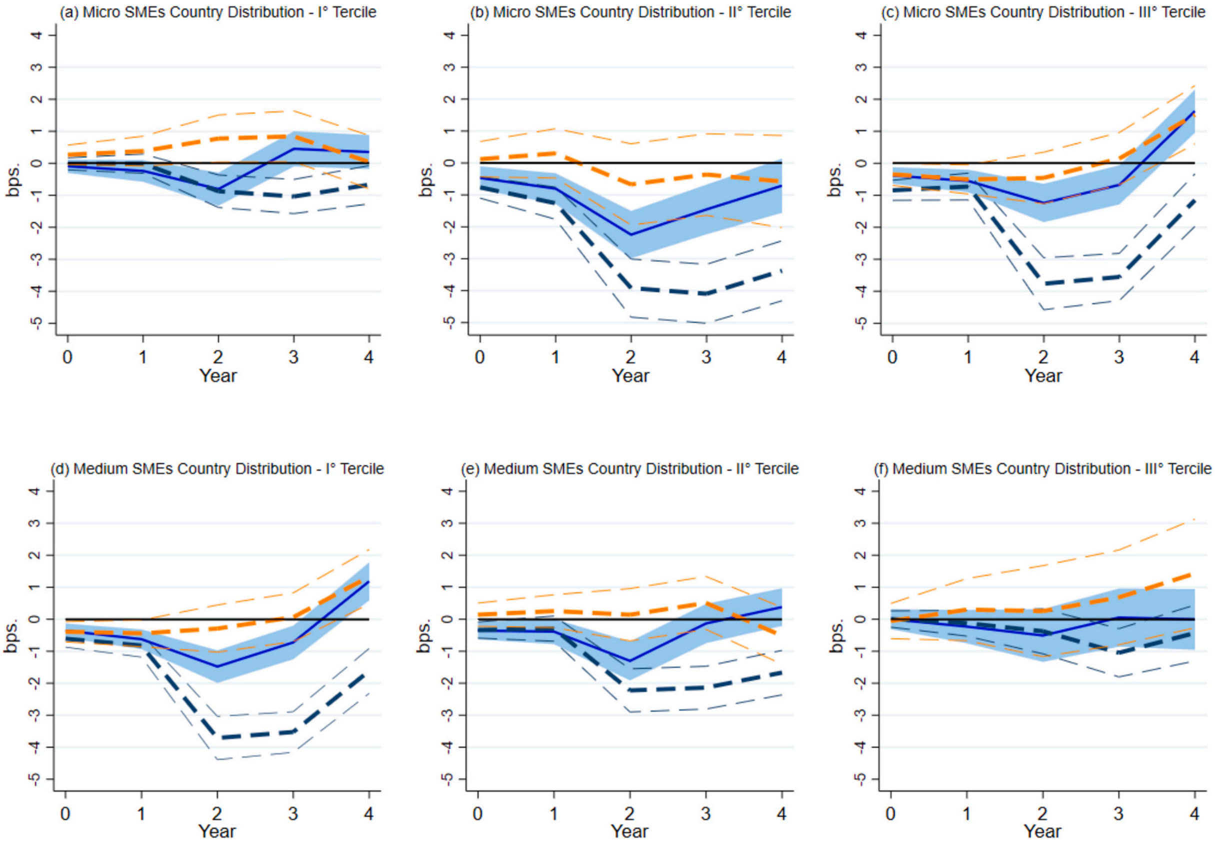

Fig. 8. Dynamics of the differential response of investment to the interaction between the monetary policy shock and corporate leverage according to micro- and medium-SMEs at country level. Note: The figure reports the coefficient δ_h over years *h*. All variables are defined in Section 4. The blue line shows the coefficient δ_h over year *h* when the monetary shock is interacted with leverage. The navy-dashed line shows the coefficient δ_h when the monetary shock is interacted with long-term leverage, whereas the orange dashed line shows the dynamics of coefficient δ_h when the monetary shock is interacted with short-term leverage. Panels (a)-(c) give the investment response if sample is clustered according to terciles of micro-SMEs distribution at country level. Panels (d)-(f) give the investment response if the sample is clustered according to terciles of medium-SMEs distribution at country level. Dashed bands report 95 % confidence bands. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

pronounced financial constraints under rising interest rates, which coincide with greater reductions in investment among micro-SMEs.

Our findings diverge from those of Ferrando et al. (2023). While Ferrando et al. (2023) suggest that market power may cushion the impact of monetary tightening on firms, our results highlight that the vulnerability of SMEs to monetary policy shocks is significantly shaped by the structure of their debt, particularly in the case of micro-SMEs. Our evidence suggests that micro-SMEs, compared to medium-sized firms, tend to show a stronger association between increased debt exposure and larger reductions in investment following monetary policy shocks, reflecting their relatively higher debt burden.

In countries with a higher share of medium-sized firms, the association between worsening debt exposure and investment responses to monetary shocks appears less pronounced. This pattern may reflect that medium-sized firms, relative to micro-SMEs, tend to exhibit greater resilience to monetary policy shocks, potentially due to comparatively better access to credit or more diversified financial structures. In these countries, the association between debt exposure, monetary shocks, and investment changes appears more muted, especially compared to the more pronounced responses observed among micro-SMEs.

5.2.2. The collateral channel

The growing relevance of the intangible assets can be attributed to technological progress and the evolution toward a service-based economy (Corrado and Hulten, 2010), in turn modifying the monetary policy transmission (Caggese and Perez-Orize, 2022) mostly through the credit channel (Dottling and Ratnovski, 2023).

In this subsection, we investigate whether the interaction between monetary shocks and worsening financial exposure is associated with stronger investment responses among firms operating in intangible-intensive economies, which are characterized by lower collateral values and, consequently, greater financial constraints. This is because the greater the share of intangibles, the lower the asset value usable as collateral for lending operation.[21] In detail, we test if the interaction between the interest rate hike and the increase in debt level changes according to different intensity of intangible assets.

Following the approach proposed by Haskel (2020), we split our sample basing on terciles of the distribution of the intangible assets-to-total assets ratio at country level. Table 6 shows the country distribution according to intangible assets-to-total assets ratio at country level. For each tercile, we perform the regression model described in eq. (2). Panel (a)-(c) of Fig. 9 show the estimated interaction coefficient for each tercile. Details on estimated coefficients are reported in Table E.7 in Appendix E.

A notable pattern emerges: there exists a positive correlation between the intensity of intangible assets and the extent of the constraint imposed on investments in response to a restrictive monetary policy. Moreover, we observe that a higher concentration of intangible assets is associated with a quicker investment response following monetary policy shocks. While increases in short-term debt exposure do not significantly alter the negative effects of rising interest rates, the influence of total leverage—especially higher long-term debt exposure—tends to be more pronounced as the share of intangible assets rises. It is worth noting that the cluster characterized by an intangible ratio below the 33rd percentile appears to exhibit insensitivity to the shock.

Conversely, firms operating in intangible-intensive countries (panels (b) and (c)) tend to show a larger decline in investments. The interaction between monetary shocks and higher leverage is associated with more pronounced changes in investment activity in markets where intangible assets are significant. Focusing on the last two terciles, the peak of investment reduction consistently manifests two years after the shock. Therefore, in a tightening monetary environment, a one-percentage-point higher leverage is associated with an investment reduction of 2.14 and 1.09 basis points in the 33rd–66th and above 66th percentile clusters, respectively. Additionally, a higher share of intangible assets appears to shorten the time it takes for these interaction effects to materialize. In markets with a low share of intangibles, firms tend to show a more delayed investment response to rising interest rates when their financial structure worsens. Conversely, in markets characterized by a higher intensity of intangibles, the effect of underinvestment becomes significant without delays compared to the timing of the shock.

When focusing on the increase in long-term debt, the monetary shock is associated with a more pronounced decline in investments. Specifically, the combination of higher long-term debt exposure and a monetary shock corresponds to an immediate reduction in investments at $h = 0$, with these negative effects persisting throughout the projection horizon. This pattern suggests that higher long-term debt is linked to a more persistent response to the interest rate shock. Moreover, as illustrated in Fig. 9, the decline in investments is between 50 % and nearly 100 % more severe than the reduction observed when total leverage interacts with the monetary policy

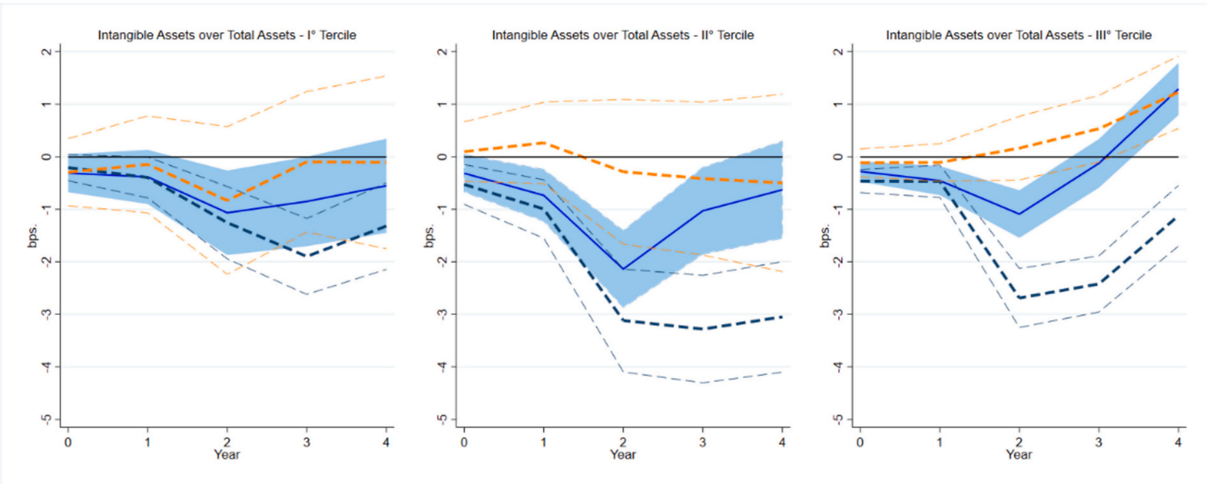

Fig. 9. Dynamics of the differential response of investment to the interaction between the monetary policy shock and corporate leverage according to the intangible-to-asset ratio at country level. Note: The figure reports the coefficient δ_h over years h. All variables are defined in Section 4. The blue line shows the coefficient δ_h over year h when monetary shock is interacted with leverage. The navy-dashed line shows the coefficient δ_h when monetary shock is interacted with long-term leverage, whereas the orange dashed line shows the dynamics of coefficient δ_h when monetary shock is interacted with short-term leverage. Panels (a)-(c) give the investment response if sample is clustered according to terciles of the intangible-to-total asset ratio at country level. Dashed bands report 95 % confidence bands. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

[21] The low collateral value associated to intangible assets due to the difficulty to define their fair value and the high uncertainty on future cash flow led intangible intensive firms to use less debt (Brown et al., 2009; Falato et al., 2020).

shock.

6. Robustness checks

In this section, we present additional empirical results that corroborate and expand upon the previous findings. In subsection 6.1, we examine whether broader macroeconomic shocks might influence firms' investment responses to monetary shocks. In subsection 6.2, we investigate how tight monetary conditions could shape the capital structure of non-listed firms. In subsection 6.3, we explore the ways in which monetary tightening may shape firms' activities. Finally, in subsection 6.4, we assess whether the choice of OIS maturity influences firms' investment responses.

6.1. The effect of macroeconomic shock on investment response to monetary shock

In this section, we test the robustness of our baseline results by assessing whether major macroeconomic shocks—such as the European Sovereign Debt Crisis and the COVID-19 pandemic—could distort the estimated coefficients $\gamma_h$and δ_h. Given the annual frequency of our data and the relatively short sample period (2011−2021), we acknowledge the possibility that our estimates reflect not only the stance of monetary policy, but also concurrent macroeconomic events that may have significantly influenced firms' investment behavior.

Although our baseline specification includes a comprehensive set of firm-level and macroeconomic controls, along with sector-year and firm fixed effects, these adjustments may not fully capture the impact of large, systemic macroeconomic events. To address this concern, we perform a robustness check by estimating our baseline model (Eq. (2)) on a restricted sample that excludes the peak years of the Sovereign Debt Crisis and the initial phase of the COVID-19 pandemic. Specifically, we drop all observations prior to 2013 and after 2019, thereby focusing on a more stable macroeconomic environment.

Figure 11, panel (a), plots the estimated investment response to monetary policy shocks (γ_h) using the restricted sample (red line), and compares it with the baseline estimates (blue line). Panel (b) presents the corresponding results for δ_h, capturing the interaction between monetary policy shocks and firm leverage. While we observe some differences in magnitude—primarily due to the reduced sample size—the dynamic pattern of the effects remains broadly consistent with our baseline findings. This suggests that our core results are not driven by the inclusion of crisis years. The relationship between monetary policy shocks, firm leverage, and investment dynamics remains statistically significant and economically meaningful.

However, as pointed out in Section 4, we emphasize that this robustness exercise cannot fully isolate the effects of monetary policy from broader macroeconomic dynamics. Due to the limited time span, the annual nature of the data, and the overlapping of macroeconomic events, some residual influence from systemic shocks may still affect the estimated relationships. Thus, our results should be interpreted with appropriate caution, acknowledging that firm investment decisions are likely shaped by a broader and more complex macroeconomic context.

6.2. How firm's leverage changes after the monetary restriction

In this subsection, we explore how debt responds to monetary policy. The objective is twofold. On the one hand, we investigate the debt's response to the monetary policies shock. On the other hand, we focus on the firm's financing decision by exploring how firms

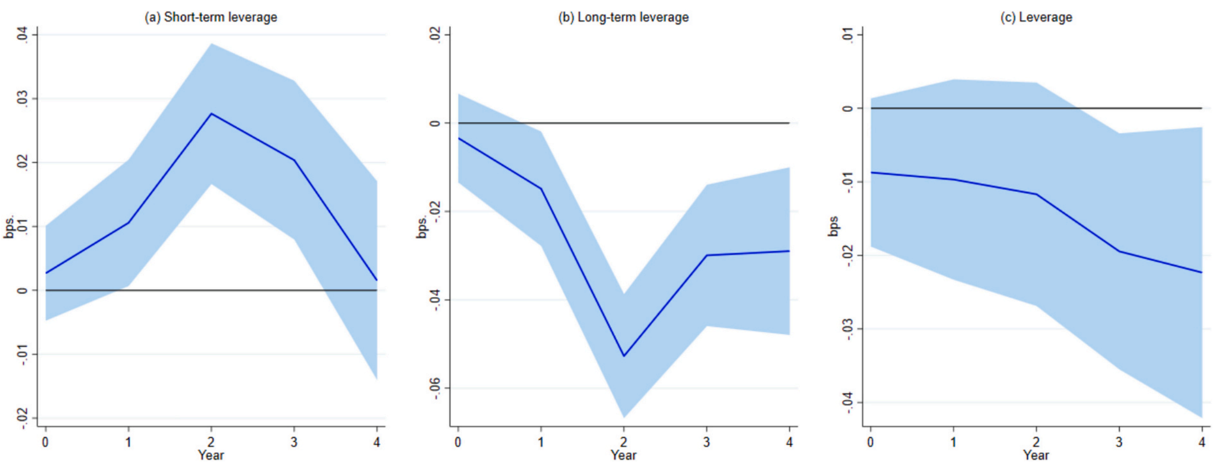

Fig. 10. Dynamics of the differential response of firm's indebtedness to the monetary policy shock. Note: Dynamics of the monetary shock coefficient over time. The figure reports the coefficient γ_h over years h. All variables are defined in Section 4. Panel (a) shows the dynamics of short-term debt in response to monetary shock. Panel (b) shows the dynamics of long-term debt in response to the monetary shock. Panel (c) shows the dynamics of total debt exposure in response to the monetary shock. Shaded bands report 95 % confidence bands.

changes the maturity of debt exposure in the aftermath of monetary policy shock.

To estimate the response of firms' debt to monetary policy, the baseline specification given by eq. (2) is employed. The dependent variable is replaced by the change in total debt exposure. Furthermore, we decompose the change in debt according to maturity, i.e., the change in short-term debt and the change in long-term debt.

Figure 10 shows the coefficient associated with the monetary policy shock in each *h* horizon of projection. Panel (a) displays the dynamics of the total debt change rate when the monetary policy shock occurs. A one-standard-deviation increase in 3-month OIS is not significantly associated with a change rate in total debt over the entire projection period.

Interestingly, we find significant heterogeneity in debt exposure when we separately focus on the two different maturities, i.e., short-term and long-term. Panels (a) and (b) show the monetary policy coefficient capturing the effect on long-term and short-term indebtedness, respectively. Focusing on the long-term debt dynamics, the monetary policy shock coefficient is negative and significant till two years following the tight shock. A one-standard-deviation increase in the monetary policy shock is associated with a 4.44 bps reduction in firms' long-term debt exposure. On the contrary, short-term debt shows an increasing dynamic when tightening monetary conditions occur. A 3-month OIS hike is positively and significantly correlated to an upsurge in short-term debt in $h = 2$ and $h = 3$, resulting almost stable in both estimation periods. Quantitatively, firms increase short-term exposure by 2.04 and 1.88 bps in the second and third period after tightening shock, respectively.

These findings provide useful insights on firms' borrowing behavior. During a contractionary monetary shock, the European firms tend to decrease their long-term exposition and to increase the short-term exposition. Unlike Fabiani et al. (2020), Deng and Fang (2022) and Poeschl (2023), who use an expansionary monetary shock, we show that, following a tightening monetary shock, firms tend to shift toward shorter debt maturities, potentially seeking greater financial flexibility. However, our findings highlight relevant concerns regarding the increase in short-term debt exposure after interest rate hikes. A shorter maturity structure of corporate debt may raise roll-over risk, making firms more sensitive to fluctuations in real interest rates (Jungherr et al., 2024; Bustamante, 2020). As roll-over risk increases, the shorter maturity profile could contribute to amplifying the effects of monetary tightening, with potential implications for financial stability in the European economy.

6.3. The effect of the monetary shock on firm's activity

While the previous section has examined how capital structure responds to monetary policy shocks, this subsection investigates the impact of a contractionary monetary policy shock on key firm-level variables. Following the methodology of Durante et al. (2022) and Jungherr et al. (2024), we estimate eq. (2), replacing the dependent variable with the following variables: sales, employment (measured by both the number of employees and employee costs), cost of goods sold, intangible investments, and working capital.

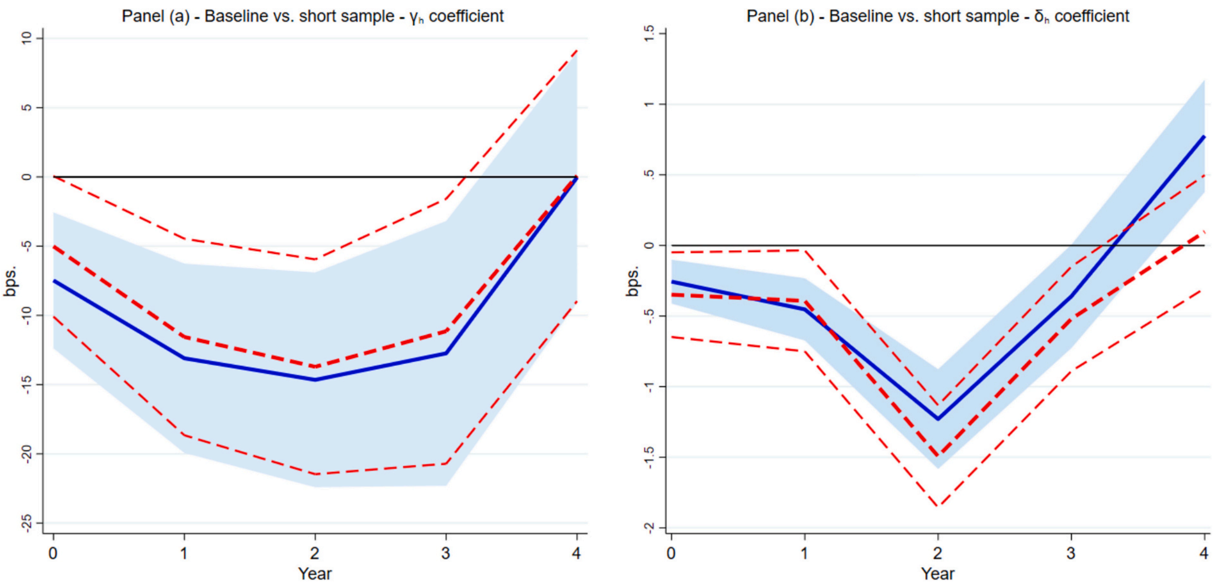

Fig. 11. Dynamics of the differential response of investment to the monetary policy shock: extended sample vs. short sample. Note: In panel (a), the blue line shows the dynamics of the coefficient γ_h when the whole sample is considered (2011–2021). The red line shows the dynamics of the coefficient γ_h limiting the sample to 2013–2019, which excludes the European debt crisis and the Covid pandemic downturn. The figure reports the coefficient γ_h over years *h*. All variables are defined in Section 4. Shaded bands report 95 % confidence bands. In panel (b), the blue line shows the dynamics of the coefficient δ_h when the whole sample is considered (2011–2021). The red line shows the dynamics of the coefficient δ_h limiting the sample to 2013–2019, which excludes the European debt crisis and the Covid pandemic downturn. The figure reports the coefficient δ_h over years *h*. All variables are defined in Section 4. Shaded bands report 95 % confidence bands. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

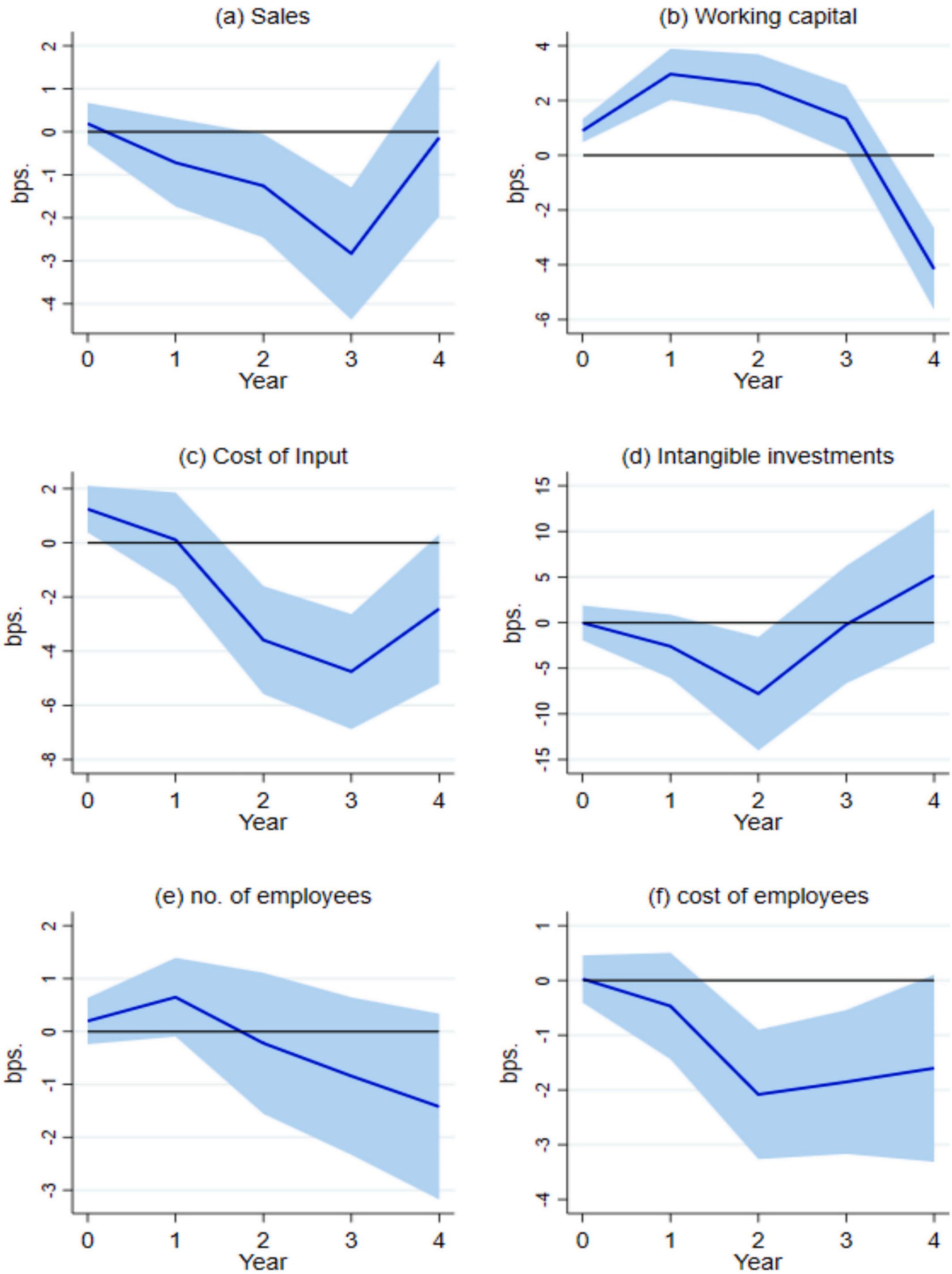

Fig. 12. Key-financial variables in response to the monetary policy shock and a 1 pp. increase in leverage. Note: The figure reports the coefficient δ_h over years h. All variables are defined in Section 4. The blue line shows the coefficient δ_h over year h when the monetary shock is interacted with leverage. Panels (a)-(c) give the response of sales, working-capital and cost of input, respectively. Panels (d)-(f) give the response of intangible investments, the number of employees, and cost of employees. Dashed bands report 95 % confidence bands. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Figure 12 illustrates the response of the foregoing firm-level variables to a one-standard-deviation increase in the monetary policy shock under deteriorating debt conditions. With the exception of the number of employees, higher corporate debt exposure in combination with rising interest rates is associated with a significant decline in all the considered variables over the projection period. These patterns suggest that monetary tightening, when occurring alongside elevated debt levels, tends to coincide with a contraction in firms' productive indicators. In particular, restrictive monetary conditions in highly indebted contexts are related to a simultaneous slowdown in investment activity and a reduction in the demand for production inputs.

A contraction in production not only leads to lower revenues but also decreases firms' demand for labor (as reflected in employee costs) and for production inputs. Indeed, our findings indicate that sales growth rates tend to decline significantly in the third period after the shock, while the combination of monetary tightening and high debt exposure is associated with negative developments in the cost of goods sold, intangible assets, and employee costs starting from the second period. The persistence of the shock is particularly evident in the cost of goods sold: a contraction in sales, coupled with reduced investment, reinforces the previous results.

Finally, a one-standard-deviation increase in the monetary shock combined with a one-percentage-point rise in debt exposure is associated with a significant increase in working capital for up to three years after the shock, peaking one year after the shock. This result aligns with our previous findings and further supports the idea that restrictive monetary policy slows firms' productivity, particularly when debt conditions worsen. The decline in investment allows firms to hold greater cash reserves. Moreover, reduced production activity—evidenced by the negative impact on sales, cost of goods sold, and employee expenses—slows inventory turnover, leading to an accumulation of working capital.

Overall, these findings extend the evidence argued in the previous sections, demonstrating that the combined effect of monetary tightening and increased debt exposure is not limited to a reduction in tangible investments but also contributes to a broader deceleration in firms' economic activity.

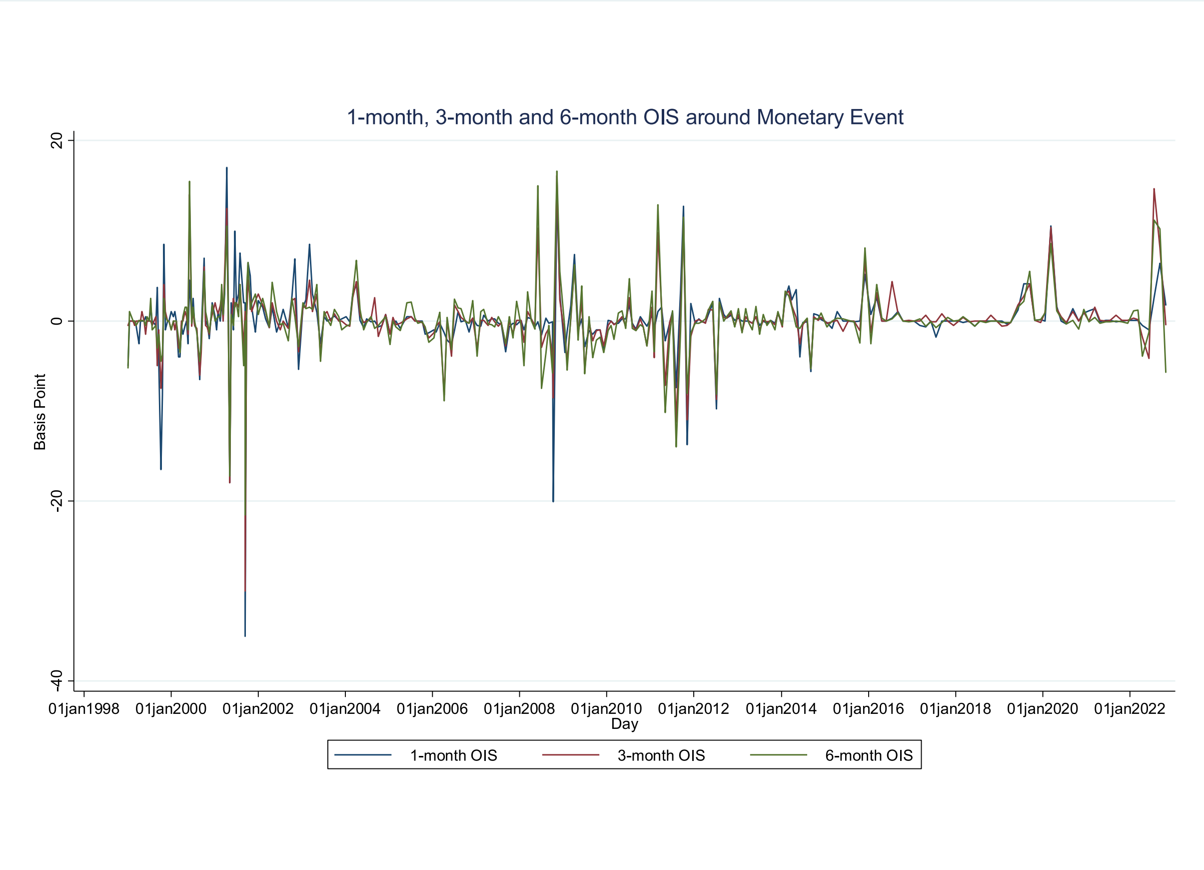

Fig. 13. 1-month, three-month and 6-month OIS around monetary event. Note: The figure shows the dynamics of different OIS swap specifications used as proxy for the monetary surprise in the financial market. The blue line, the red line and the green line are respectively related to 1, 3 and 6 months of maturity. Source: our own elaboration based on EA-MP database (Altavilla et al., 2019). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

6.4. Different horizon expectations for monetary shock variables

In this subsection, different maturities of OIS contract are tested as alternative proxies for the monetary policy shock. Focusing on the basic set-up of eq. (2), a one-standard-deviation increase in the monetary shock is used to define the movement in the interest market. Table 5 shows detailed information regarding the main descriptive statistics of three monetary policy shock proxies. The 3-month OIS is characterized by a greater standard deviation compared to the standard deviation shown by 1-month OIS and 6-month OIS, given by 7.080 and 7.305 basis points, respectively. Fig. 13 shows the movement of three monetary policy shocks, i.e., 1-month, 3-month and 6-month OIS from 1999 to 2021. Fig. 14 shows at each horizon the estimated response of the firm's investment to one standard deviation upward shock. Panels (a) and (b) show the investment response to the monetary shock using 1-month OIS and 6-month, respectively. Panel (a) shows that a one-standard-deviation monetary policy shock is related to a significant investment decline at the time of the shock, reaching its peak intensity in the third period following the shock ($h = 3$). Panel (b) demonstrates a similar pattern for a one-standard-deviation increase in the 6-month OIS.

Upon comparing the effects that various monetary shocks on the investment activity of firms, our findings support the notion that the 3-month OIS is a pivotal proxy variable for capturing the monetary policy shock. By using the 3-month OIS, our findings highlight that the impact of monetary restrictions on investment closely aligns with the empirical evidence provided by Durante et al. (2022).

7. Conclusions

This paper empirically studies the role played by both firm- and country-level heterogeneity in determining the investment channel of ECB's monetary policy. To this end, we combine high frequency monetary policy shocks with panel econometric techniques for micro data to investigate how different firms operating in different countries of the European Monetary Union respond to upward changes in nominal interest rates. We quantify to what extent firms' debt and country-specific financial and productive systems affect monetary policy transmission.

We use a rich dataset given by the combination of detailed firm-level financial data with macroeconomic data synthetizing the economic state of the European Monetary Union. To identify the effect of monetary policy shocks on firms' activity, we have used high-frequency financial assets' data to proxy the implications of the ECB's future decisions. By employing panel local projection estimations, we provide a dynamic test on the effects of tightening monetary policy on the SMEs' investment rate.

Using the 3-month OIS swap as a proxy for monetary surprise, we find that, on average, non-listed firms are sensitive to a one-standard-deviation contractionary shock by decreasing the investment rate via a U-shaped dynamic response over a three-year time horizon, reaching a peak of −14.70 basis points after two years. However, a robust result that emerges from our analysis is that firms with higher debt expositions are more negatively responsive to contractionary monetary policy. Using the leverage ratio as a key dimension of the capital structure, our estimations show that firms bearing one percentage point larger leverage are 7.67 % more responsive two years after the monetary shock. Splitting the total exposure according to debt maturity, a major finding that arises from our empirical model is that investment responses to monetary policy restrictions tend to be stronger in the presence of long-term

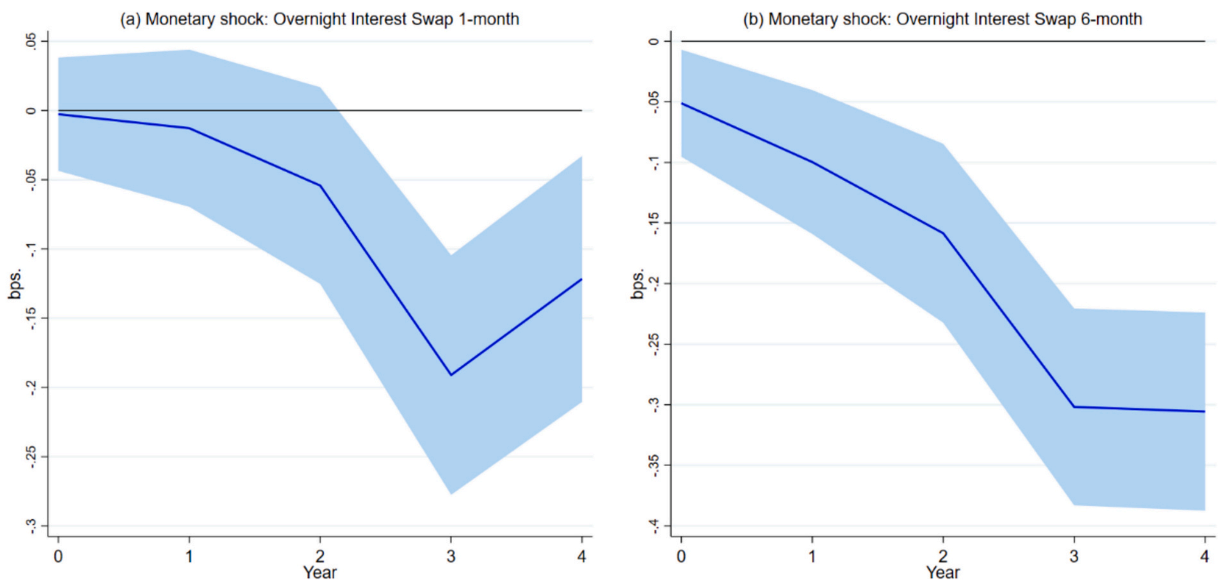

Fig. 14. Dynamics of the differential response of investment to different proxies of the monetary policy shock. Note: Dynamics of the monetary policy shock coefficient over time. The figure reports the coefficient γ_h over years h. All variables are defined in Section 4. Shaded bands report 95 % confidence bands. Panel (a) shows the OIS 1-month effects on investment activity. Panel (b) shows the OIS 6-month effects on investment activity. The shaded areas represent the confidence bands at 95 %.

indebtedness. Specifically, firms featured by one-percentage-point larger long-term leverage are 31.90 % more responsive two years after the monetary shock. This result provides strong evidence that debt overhang plays a crucial role in explaining why small and medium-sized firms in the European Monetary Union experience a sharper drop in investment following monetary tightening. The increase in the real burden of existing long-term nominal debt, and the resulting rise in default risk, appears to be a key factor behind this response.

A second major result of our paper is that not only firm-level but also country-level heterogeneity crucially shapes the investment channel of ECB's monetary policy. Specifically, we provide evidence that the transmission of tight monetary shocks is dependent upon the country-specific risk and market structure. In stressed countries, following a nominal interest rate-hike by one standard deviation, firms exhibiting one percentage point larger leverage show a reduction in the investment rate by 1.64 basis points greater two years after the shock, 56.06 % higher than in non-stressed countries. Employing the cost of borrowing for a firm and the loan-to-deposit ratio in the banking sector as risk indicator of the financial system, tt clearly emerges that higher frictions in accessing the credit market are associated with a larger decline in investments following monetary restriction. Importantly, Our estimations indicate that the monetary policy transmission mechanism varies with the distribution of SMEs and the characteristics of the collateral channel. In countries characterized by a larger share of micro-SMEs firms and by a larger share of intangible assets, the investment semi-elasticity to interest rate hikes significantly rises. This is because micro-SME-dominated economies are particularly vulnerable due to weaker collateral positions and constrained credit access. The foregoing results provide a crucial extension to the existing literature, which has primarily focused on leverage and financial frictions but has overlooked how the asset composition and the country-specific financial and productive structures interact in shaping the investment response to monetary policy.

Our findings carry significant policy implications for the ECB. First, monetary authorities should recognize that monetary tightening has asymmetric effects across firms and countries. Firms with higher long-term debt tend to experience larger reductions in investment, indicating that targeted policies—such as debt restructuring incentives or improved access to alternative financing—may help address these challenges. Second, the more pronounced effects observed in high-friction economies imply that a uniform monetary policy approach might be suboptimal. Credit support measures targeted at firms in financially constrained environments could help buffer the adverse effects of rate hikes. Third, firms in intangible-intensive sectors may require new financial instruments to overcome collateral constraints, as traditional bank lending is less effective in these cases. Finally, macroprudential policies should consider both debt maturity and asset composition, ensuring that interest rate adjustments do not disproportionately harm firms with high long-term leverage and low tangible collateral.

Taking stock, the paper's findings provide strong empirical evidence that the investment channel of monetary policy transmission is markedly heterogeneous and, specifically, associated with both the capital structure employed by firms and the country-specific financial and productive systems. Financial frictions, in particular, are linked to a stronger negative response of investment to upward variations in nominal interest rates. These results open new avenues for research on the intersection between corporate finance and macroeconomic policy, emphasizing the need for a more nuanced approach to monetary transmission in heterogeneous economies.

CRediT authorship contribution statement

Paolo Canofari: Writing – original draft. **Marco Cucculelli:** Writing – original draft. **Alessandro Piergallini:** Writing – original draft. **Matteo Renghini:** Writing – original draft.

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Appendix A. Further informations

Table A.1. Variables description.

Variable	Procedure	Dataset
$I_{i,t}/K_{i,t-1}$	Ln(Fixed Asset t – Fixed Asset t-1)	Amadeus
Leverage	Sum of long-term debt and short-term debt on Total Assets	Amadeus

(continued on next page)

(*continued*)

Variable	Procedure	Dataset
FE/EBITDA	Financial Expense on Ebitda	Amadeus
Monetary Shock		
ΔMP	Change in the median quote from the window 13:25–13:35 before the press release to the median quote in the window 15:40–15:50 after the press conference.	https://www.ecb.europa.eu/pub/pdf/annex/Dataset_EA-MPD.xlsx
Control variables		
Sales	Sales Growth rate	Amadeus
Asset	Earnings on Total Assets	Amadeus
Current Asset	Current Asset on Total Asset	Amadeus
Macro Controls		
GDP growth rate	One 1 and 2 period lagged GDP growth rate	ECB Statistical Warehouse
Inflation rate	One 1 and 2 period lagged inflation growth rate	ECB Statistical Warehouse

Description of the main variables included into the model. Column 1 provides the nomenclature used throughout the paper. Column 2 explains the procedure used to calculate each variable. Column 3 provides the source from which the information are collected.

Appendix B. The 12-month moving sum of the monetary policy shock

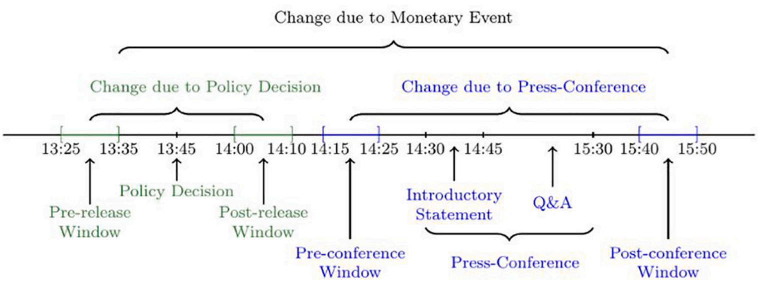

Fig. B.1. ECB policy communication timeline. Source: Altavilla et al. (2019). Measuring euro area monetary policy.

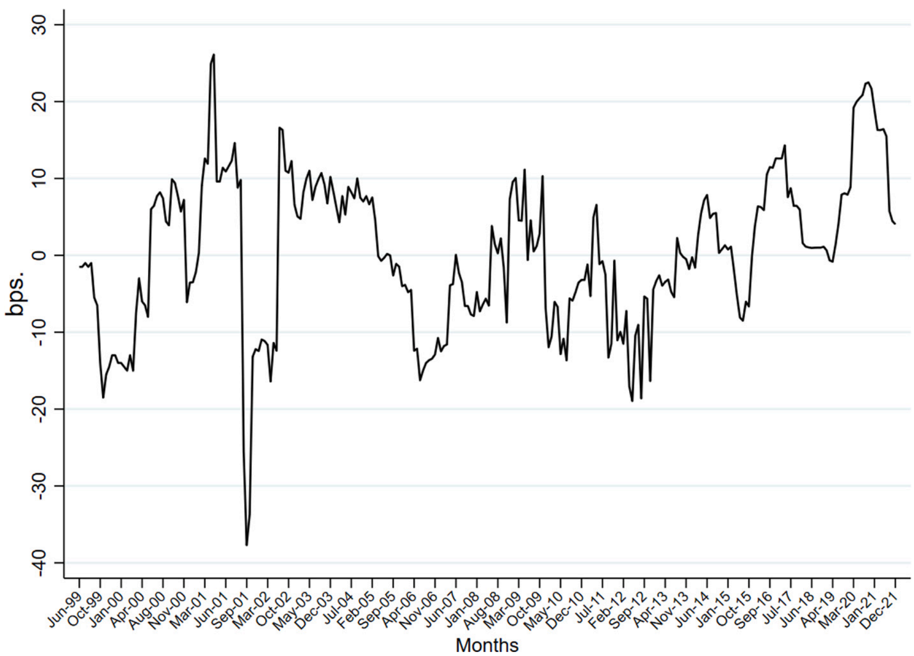

Fig. B.2. 12-month moving sum of the monetary policy shock.

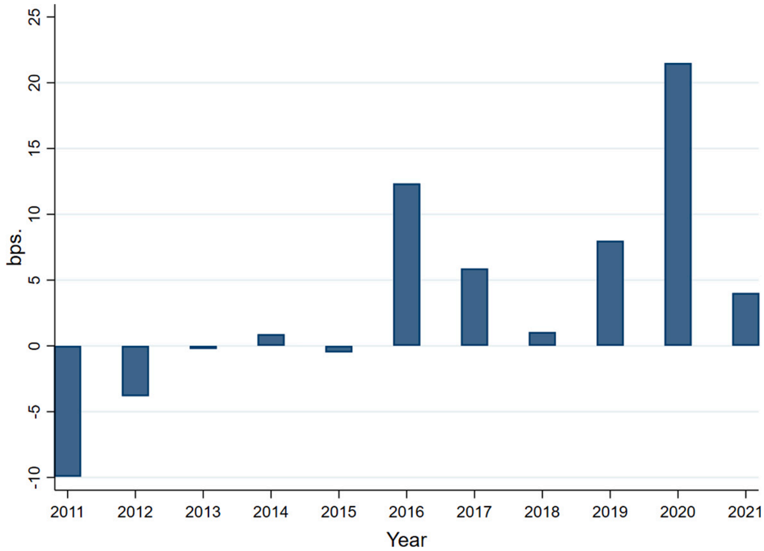

Fig. B.3. The average monetary policy shock across firms per year.

Appendix C. Monetary shock and the short-term interest rate

In this section, we investigate the effect of monetary policy shocks on short-term interest rates in the Eurozone. The importance of this section is twofold. First, comparing the response of short-term rates to the findings in the existing literature can further strengthen the validity of the identified monetary policy shock. Second, comparing the effects between the pre- and post-2014 periods enables an in-depth discussion of the potential implications of the ECB's monetary easing on our results. Consistently with the approach followed by Altavilla et al. (2019), we estimate the impulse response of short-term interest rates to the aggregate monetary shock employing local projections (Jordà, 2005) to

$$Eur\ 3m_{t+h} - Eur\ 3m_{t-1} = \beta_h \Delta MP_t^m + u_t$$

As a proxy for short-term interest rates at the European level, we use monthly time series of 3-month Euribor ($Eur\,3m_t$) from January 2010 to December 2021, which is consistent with the maturity of the 3-month Overnight Index Swap used as the monetary shock. The rationale behind the choice of Euribor is twofold. First, the Euribor is primarily a short-term interest rate used as a benchmark for financing within the Eurozone. Second, it can also be regarded as an indicator of banking sector risk, particularly during periods of financial instability due to its sensitivity to interbank market conditions.

The monetary policy shock is the same as previously discussed in Section 3.3. To ensure consistency, even when using monthly instead of annual data, we note that in this case, a one-standard-deviation increase in the monetary policy shock corresponds to 8.214 basis points (compared to 7.942 basis points used in the main estimates, with a difference of approximately 0.3 basis points). The difference is relatively small and therefore negligible. The coefficient β_h gives the cumulated response of short-term interest rates up to time $t + h$ for $h = 1, \ldots, 12$ to a change in monetary shock at time t.

To examine how unconventional monetary policy measures and the binding effective lower bound on nominal interest rates may have affected the response of Euribor, we estimate the previous model limiting the time sample after the reaching of effective lower bound, e.g., after the 2014. The empirical results are shown in Fig. C.1. The figure shows the estimated coefficients. The β^h coefficients for the monetary policy shock are displayed in blue. Confidence intervals are at the 99th percentile.

A one-standard-deviation increase in the aggregated monetary shock generates a significant rise in short-term interest rates, which persists for up to 6 months after the shock, peaking at period $h = 7$.

However, the scenario appears to be different when we observe the period from 2014 onwards. The increase by one standard deviation in the monetary shock leads to a lasting effect throughout the considered period. Interesting, in times of binding effective lower bound, the effect of the monetary shock on interbank interest rates is, on one hand, marginally more contained, but on the other hand, it generates a more persistent effect, reaching its maximum impact 10 months after the shock.

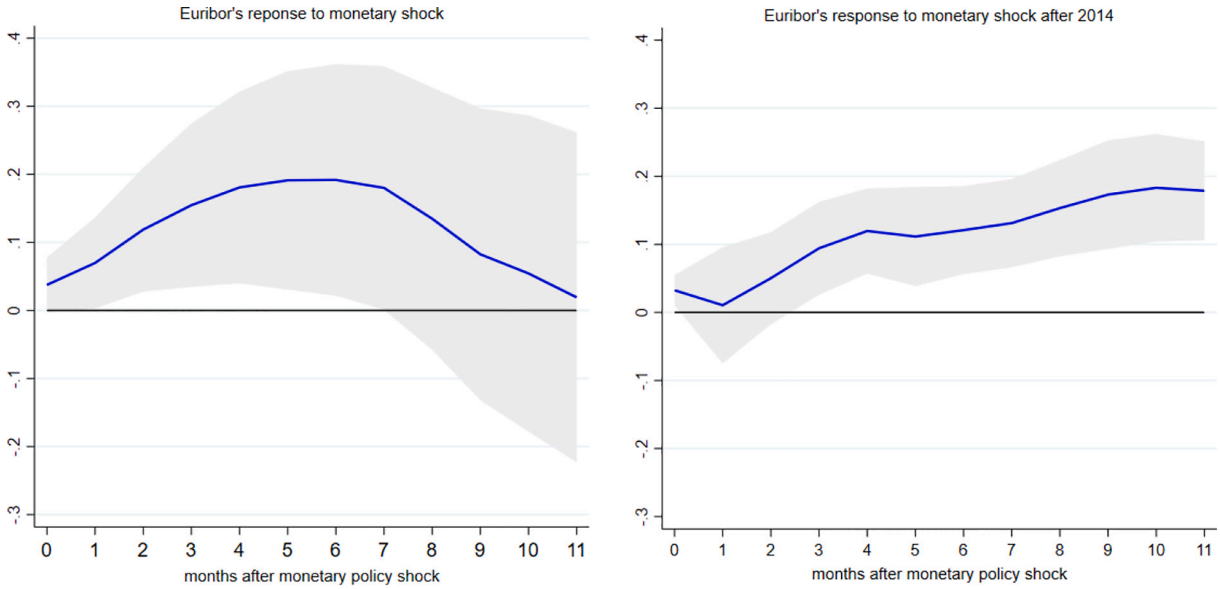

Fig. C.1 Euribor 3-month response to the monetary policy shock before-and after unconventional monetary policy. Note: The figure shows the response of Euribor 3-month to one-standard deviation increase in the monetary policy shock at monthly frequences. Panel (a) shows the response of Euribor 3-month if all time sample, i.e., (2011–2021) is considered. Panel (b) shows the response of Euribor 3-month is time sample is restricted to consider the zero-lower bound period (2014–2019). The shaded areas represent the confidence bands at 95 %.

A central aspect behind the above higher persistence is related to the effects of unconventional monetary policy, which has introduced the structural changes in financial market dynamics following the implementation of non-standard monetary policy measures, such as asset purchase programs and forward guidance. These policies have long-lasting effects on financial market expectations and the behavior of financial intermediaries. Specifically, unconventional monetary policies, by influencing expectations about future interest rates, liquidity conditions, and risk premiums, create a more persistent shift in the term structure of interest rates.

Through asset purchases, for instance, the ECB directly influences the supply and demand for longer-term securities, compressing term premiums and lowering long-term interest rates. This compression results in a spillover effect that affects the entire interest rate structure, including short-term rates. As market participants adjust their expectations about the trajectory of interest rates and inflation, these effects endure longer than those generated by standard monetary policy actions. The persistence of this adjustment is particularly visible when the economy operates near the zero lower bound, where the policy rate is constrained, and the influence of unconventional measures becomes more pronounced.

This longer-lasting impact is further exacerbated by the central bank's forward guidance, which reinforces market expectations about future policy directions, shaping the behavior of financial markets well beyond the immediate shock. These combined effects—originating from both the ECB's actions and the financial market's adaptive expectations—result in a prolonged response of short-term interest rates to monetary policy shocks. The persistence seen in the Eurozone context indicates that unconventional policies, while initially aimed at stimulating the economy, also set in motion deeper changes in market structure, which contribute to the prolonged nature of the shock's effects on short-term rates.

Appendix D. Aggregate investment (GFCF) and firm's investments

Here we validate the robustness of our dataset by presenting evidence on the comparative dynamics of Gross Fixed Capital Formation (GFCF) and the investment growth rate calculated directly from our data. As noted by Durante et al. (2022), an aggregate investment series, specifically for non-financial firms, is not available for Eurozone countries. Therefore, we rely on national accounts data for total investment, which encompasses government and residential household investments and is referred to as Gross Fixed Capital Formation.

In contrast, the investment growth rate sourced from our dataset is defined as the annual growth rate of tangible investments, averaged across Eurozone firms. We acknowledge the inherent limitations in both the calculation of GFCF and the annual variation in tangible assets. Nevertheless, we are confident that the comparison of these two series highlights a significant alignment, supporting the representativeness of our dataset in capturing the investment dynamics of Eurozone firms.

In Fig. D.1., the solid orange line represents the average investment rate of firms considered in our sample, while the dashed blue line shows the GHFC investment rate for the Eurozone. The two variables are highly correlated. Table D.1. shows a correlation of 85 % between Eurozone GFCF and aggregate firm investments. At the country level, France (92.66 %) and Germany (81.39 %) exhibit particularly high correlations, reflecting the dataset's strong alignment with investment trends in these major economies, which collectively account for a substantial portion of Eurozone GDP. Similarly, the correlation for the "Rest of the Eurozone" (84.06 %) demonstrates good representativeness for smaller economies. However, Italy presents a significantly lower correlation (50.35 %), potentially highlighting structural differences in its economy. Factors such as the predominance of small and medium-sized enterprises (SMEs) or sector-specific characteristics might contribute to this divergence. Further investigation is required to assess whether the dataset adequately reflects the Italian corporate investment landscape or if methodological adjustments are necessary.

The correlation analysis presented in Table B.1 between Gross Fixed Capital Formation (GFCF) and the growth rate of corporate investments derived from our dataset offers meaningful insights into its representativeness of the Eurozone economy.

Thus, even when comparing the investment rate of European firms with the macro-level investment rate, the dynamics of the two variables seem to move in tandem, with a high correlation rate (above 80 %). This evidence further supports the validity of our dataset: both in terms of firm distribution and investment dynamics, our sample provides a robust representation of the SMEs landscape in the Eurozone.

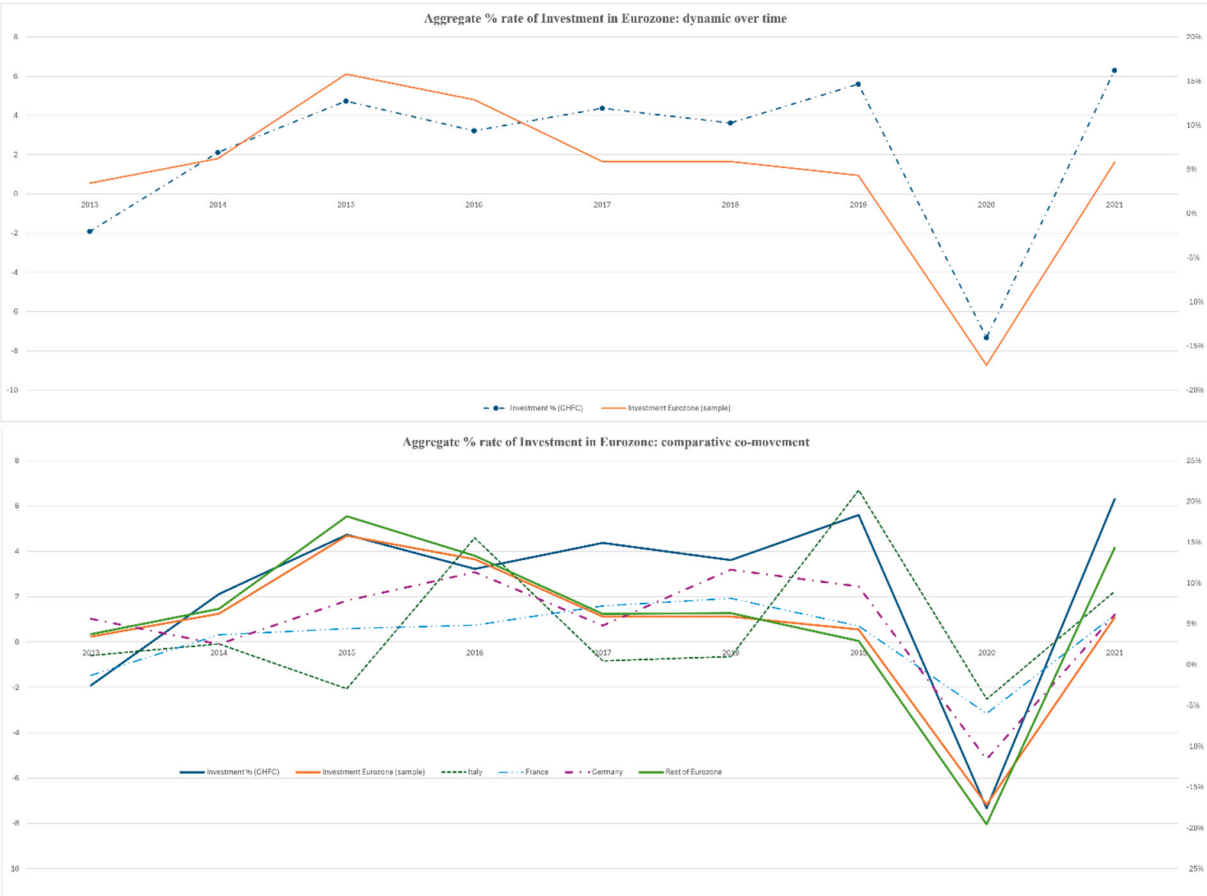

Fig. D.1. Compared dynamics of GFCF and firms' aggregate investment from our data set. Note: Panel A exhibits the comparison between Eurozone's GFCF (blue dashed-line) *vis-à-vis* with aggregate investments computes at yearly frequence from our data set (orange line). Panel B adds to the previous panel the dynamics of firm's aggregate investment related to Italy, France, Germany and the rest of Eurozone. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table D.1. Correlation between aggregate investment (GHFC) and Eurozone corporate investments.

Relation	Macro-Eurozone	Macro-Italy	Macro-France	Macro-Germany	Macro-Rest Eurozone
Correlation	84.61 %	50.35 %	92.66 %	81.39 %	84.06 %

The table provides the pairwise correlation between GFCF and the Eurozone corporate investment in column 1. Columns 2–4 show the correlation between GFCF and Italy, France and Germany respectively. Finally, Column 5 shows the correlation with the firm's investments related to the rest of Eurozone.

Appendix E. Details on estimated coefficients

Table E.1. Baseline model: the effect of the monetary shock on investment activity.

	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate
	h = 0	h = 1	h = 2	h = 3	h = 4
ΔMP	−0.0094**	−0.0165***	−0.0185***	−0.0160**	−0.0000443
	(−2.98)	(−3.75)	(−3.70)	(−2.61)	(−0.01)
CF	0.0161***	0.0236***	0.0304***	0.0300***	0.0306***
	(8.58)	(6.91)	(7.38)	(6.73)	(6.09)
Asset	−0.241***	−0.484***	−0.711***	−0.876***	−0.918***
	(−42.10)	(−50.72)	(−58.66)	(−62.13)	(−56.30)
Sales growth	0.0399***	0.0452***	0.0994***	0.115***	0.171***
	(5.11)	(3.44)	(6.31)	(6.91)	(8.84)
Age	−0.0742	−0.0836	−0.255	−0.045	−0.184
	(−1.05)	(−1.27)	(−1.61)	(−1.78)	(−1.16)
GPG_growth_t-1	−0.0042*	0.118***	0.171***	0.146***	0.0890***
	(−2.14)	(14.59)	(17.56)	(13.13)	(6.02)
GPG_growth_t-2	0.0477***	0.0422***	0.0257***	−0.00829	−0.0156
	(12.38)	(6.81)	(3.67)	(−1.05)	(−1.79)
Inflation_t-1	−0.0353***	−0.0420***	−0.00746	0.000678	−0.0490*
	(−4.78)	(−3.84)	(−0.58)	(0.05)	(−2.34)
Inflation_t-2	−0.0568***	−0.02	−0.0613***	−0.152***	−0.188***
	(−7.96)	(−1.72)	(−4.07)	(−8.08)	(−8.98)
ΔMP *X* Cash	0.0018	0.00132	0.00383*	−0.0018	0.00048
	(0.01)	(0.8)	(1.97)	(−0.81)	(0.2)
ΔMP *X* Asset	−0.0019	−0.00380**	−0.00444**	−0.00132	−0.00108
	(−1.91)	(−2.79)	(−2.82)	(−0.73)	(−0.57)
ΔMP *X* Sales	0.0383***	0.0825***	0.0581***	0.0936***	0.109***
	(5.51)	(7.69)	(4.59)	(6.68)	(6.68)
ΔMP *X* Age	−0.0000881*	0.0000166	−0.000101	−0.0000614	−0.0000487
	(−2.00)	(0.26)	(−1.40)	(−0.70)	(−0.55)
GPG_growt_t-1 *X* Cash	−0.000202	0.00507***	0.00666***	0.00743***	0.00667***
	(−0.63)	(4.71)	(5.06)	(5.02)	(3.5)
GPG_growth_t-1 *X* Asset	0.0000415	−0.0159***	−0.0213***	−0.0189***	−0.0116***
	(0.13)	(−12.39)	(−13.63)	(−10.69)	(−5.06)
GPG_growth_t-1 *X* Sales	−0.00359	0.0115*	0.0143*	0.0185*	−0.0156
	(−1.92)	(2)	(2.06)	(2.31)	(−1.60)
GPG_growth_t-1 *X* Age	−0.0000270*	−0.000304***	−0.000179***	−0.0000511	−0.0000598
	(−2.19)	(−7.04)	(−3.33)	(−0.88)	(−0.72)
GPG_growth_t-2 *X* Cash	0.00235***	0.00089	0.00128	−0.000975	−0.00332**
	(4.2)	(1)	(1.3)	(−0.89)	(−2.66)
GPG_growth_t-2 *X* Asset	−0.00614***	−0.00420***	−0.00277*	0.00227	0.00339*
	(−9.51)	(−4.06)	(−2.40)	(1.77)	(2.35)
GPG_growth_t-2 *X* Sales	0.00996**	0.0110*	0.000692	−0.0220**	0.00223
	−3.28	−2.14	−0.12	(−3.26)	(0.29)
GPG_growth_t-2 *X* Age	−0.0000761***	0.0000446	0.0000584	0.0000356	−0.00000703
	(−3.68)	(1.38)	(1.61)	(0.92)	(−0.17)
Inflation_t-1 *X* Cash	−0.00188	−0.00109	−0.00241	0.000197	0.000801
	(−1.71)	(−0.68)	(−1.25)	(0.09)	(0.26)
Inflation_t-1 *X* Asset	0.00461***	0.00293	−0.000213	−0.0026	0.00422
	(3.69)	(1.6)	(−0.10)	(−1.04)	−1.2
Inflation_t-1 *X* Sales	0.0128*	0.0280**	0.0460***	0.0783***	0.0156
	(1.97)	(2.92)	(4.04)	(5.56)	(0.79)
Inflation_t-1 *X* Age	0.0000795*	−0.000151**	−0.000147*	−0.000027	0.0000499
	(2.03)	(−2.60)	(−2.05)	(−0.36)	(0.44)
Inflationt-2 *X* Cash	−0.00306**	−0.00344*	−0.00448*	−0.0100***	−0.0104***
	(−2.99)	(−2.20)	(−2.17)	(−4.23)	(−4.00)
Inflation_t-2 *X* Asset	0.00633***	0.00319	0.00943***	0.0230***	0.0247***
	(5.43)	(1.72)	(3.89)	(7.85)	(7.68)
Inflation_t-2 *X* Sales	0.0044	0.0133	−0.0318**	−0.0532***	−0.0313*
	−0.73	−1.52	(−2.72)	(−4.20)	(−2.13)
Inflation_t-2 *X* Age	−0.0001**	−0.0001**	−0.00002	0.00008	−0.00007
	(−2.78)	(−2.66)	(−0.31)	(0.89)	(−0.61)
Constant	4.745*	7.555***	14.87**	10.16***	14.52**
	(2.13)	(3.73)	(3.12)	(13.49)	(3.19)
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes
N	560,701	466,426	388,351	318,817	254,791

The independent variable is the log difference between tangible asset at the time $t+h$ with tangible asset at time t, where $h=0,\ldots,4$. The main interest variable is the monetary shock given by the OIS 3-month change rate around the monthly monetary announcement (ΔMP). Each column provides the estimation for each time period of projection. Firms control variables are: logarithm of total asset (Asset), logarithmic difference of sales (Sales_-growth), cash flow (CF) and Age as the year that firm is incorporated. All firm control variables are one-year lagged. The macroeconomic controls are the gross domestic product growth rate (GDP_growth) and the inflation rate (Inflation). We also include the interaction between firms control and macroeconomic control variables. Moreover, the interactions between firm controls variables and ΔMP are included. We use country/year macroeconomic data. For the macroeconomic variable, we use lagged variables at time t-1 and t-2. Firm fixed effects and year fixed effects are included in the estimation. T-statistics in parentheses. Standard errors are clustered by firm level.

Table E.2. Interaction between financial expenses and the monetary shock.

	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate
	h = 0	h = 1	h = 2	h = 3	h = 4
ΔMP X $\left(FE_{j,t-1} - E_j\left[FE_{j,t}\right]\right)$	−0.00191	0.00418	−0.00769	0.0105	0.0612***
	(−0.28)	(0.44)	(−0.51)	(0.68)	(3.65)
$\left(FE_{j,t-1} - E_j\left[FE_{j,t}\right]\right)$	−0.0481***	−0.0662***	−0.0544***	−0.0452***	−0.0579***
	(−7.51)	(−6.70)	(−4.70)	(−3.60)	(−4.24)
ΔMP	−0.00667*	−0.0142***	−0.0164***	−0.0128*	0.00123
	(−2.18)	(−3.60)	(−3.63)	(−2.44)	(0.24)
CF	1.397***	2.615***	3.471***	3.891***	3.882***
	(102.82)	(119.85)	(133.79)	(133.3)	(118.46)
Asset	−0.177***	−0.389***	−0.600***	−0.768***	−0.844***
	(−34.62)	(−50.68)	(−64.50)	(−71.36)	(−66.55)
Sales growth	0.00727	−0.0191	−0.00761	−0.0298*	0.0188
	(0.95)	(−1.56)	(−0.53)	(−1.98)	(1.11)
Age	0.00948	0.0355	0.0308	0.00306	0.0115
	(1.32)	(0.88)	(0.37)	(1.78)	(0.90)
GPG_growth_t-1	0.00121	0.102***	0.152***	0.129***	0.0708***
	(0.62)	(13.08)	(16.96)	(12.85)	(5.56)
GPG_growth_t-2	0.0446***	0.0455***	0.0328***	0.00093	0.0131
	(11.36)	(7.79)	(5.14)	(0.13)	(−1.68)
Inflation_t-1	−0.0260***	−0.0386***	0.00593	0.00801	0.0256
	(−3.60)	(−3.83)	(−0.50)	(0.59)	(−1.36)
Inflation_t-2	−0.0434***	0.00543	−0.0363**	−0.118***	−0.181***
	(−6.25)	(−0.50)	(−2.65)	(−6.93)	(−9.36)
GPG_growth_t-1 X $\left(FE_{j,t-1} - E_j\left[FE_{j,t}\right]\right)$	0.00108	−0.0278**	−0.0305**	−0.0315*	−0.0093
	80.71)	(−2.82)	(−2.64)	(−2.42)	(−0.65)
GPG_growth_t-2 X $\left(FE_{j,t-1} - E_j\left[FE_{j,t}\right]\right)$	−0.00234	0.0200*	0.0281**	0.0389**	0.0256*
	(−0.66)	−1.99	−2.63	−3.26	−1.97
Inflation_t-1 X $\left(FE_{j,t-1} - E_j\left[FE_{j,t}\right]\right)$	0.000407	−0.0459*	−0.0643**	−0.0861**	−0.0224
	−0.03	(−2.07)	(−2.65)	(−3.03)	(−0.67)
Inflation_t-2 X $\left(FE_{j,t-1} - E_j\left[FE_{j,t}\right]\right)$	−0.00212	0.00457	0.00513	0.0283	0.00328
	(−0.21)	−0.29	−0.28	−1.43	−0.14
ΔMP X Cash	−0.00346**	(0.00199)	0.00192	−0.00867***	−0.00512*
	(−2.95)	(−1.28)	(1.09)	(−4.15)	(−2.30)
ΔMP X Asset	0.00101	−0.00116	−0.00249	0.00446**	0.00370*
	(1.04)	(−0.91)	(−1.77)	(2.64)	(2.07)
ΔMP X Sales	0.0265***	0.0623***	0.0377***	0.0726***	0.0866***
	(3.91)	(6.37)	(3.38)	(5.95)	(6.1)
ΔMP X Age	−0.0000282	6.34E-05	−0.0000777	−0.0000895	−0.000122
	(−0.63)	(1.04)	(−1.20)	(−1.12)	(−1.57)
GPG_growt_t-1 X Cash	0.000315	0.00370***	0.00431***	0.00393***	0.00266
	(−0.98)	(4.25)	(4.22)	(3.39)	(1.81)
GPG_growth_t-1 X Asset	(0.000331)	−0.0134***	−0.0177***	−0.0143***	−0.00680***
	(−0.98)	(−11.99)	(−13.55)	(−9.77)	(−3.69)
GPG_growth_t-1 X Sales	0.00346	0.0077	0.00756	0.0122	0.0161
	(−1.87)	(1.41)	(1.2)	(1.72)	(−1.90)
GPG_growth_t-1 X Age	0.0000168	−0.000274***	−0.000199***	−0.000112*	0.00008
	(−1.39)	(−6.51)	(−3.84)	(−2.07)	(−1.05)
GPG_growth_t-2 X Cash	0.00255***	0.000372	0.000902	3.53E-05	0.00209
	(4.48)	(0.43)	(0.97)	(0.03)	(−1.83)
GPG_growth_t-2 X Asset	−0.00620***	−0.00419***	−0.00326**	0.000495	0.00224
	(−9.37)	(−4.21)	(−2.99)	(0.41)	(1.71)
GPG_growth_t-2 X Sales	0.00775**	0.00589	0.00339	−0.0189**	0.000689
	(2.58)	(1.22)	(−0.62)	(−3.16)	(0.1)
GPG_growth_t-2 X Age	−0.0000854***	2.42E-05	2.65E-05	0.0000172	0.0000584
	(−3.99)	(0.79)	(0.78)	(−0.49)	(−1.54)
Inflation_t-1 X Cash	−0.00169	−0.00146	−0.00158	−0.00596***	−0.00748***
	(−1.51)	(−0.17)	(−1.08)	(0.25)	(0.34)
Inflation_t-1 X Asset	0.00347**	0.00169	−0.00109	−0.00355	0.00176

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	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate
	h = 0	h = 1	h = 2	h = 3	h = 4
	(2.76)	(1)	(−0.53)	(−1.51)	(0.55)
Inflation_t-1 X Sales	0.00863	0.0220*	0.0398***	0.0724***	0.0329
	(1.37)	(2.46)	(3.84)	(5.75)	(1.93)
Inflation_t-1 X Age	0.000132***	−0.0000822	−0.0000724	0.0000316	0.000113
	(3.52)	(0.5)	(2.31)	(7.23)	(7.98)
Inflationt-2 X Cash	−0.00168	−0.00222	−0.000998	−0.00693***	−0.00760***
	(−1.77)	(−1.68)	(−0.60)	(−3.70)	(−3.57)
Inflation_t-2 X Asset	0.00385***	0.000814	0.00473*	0.0179***	0.0224***
	(3.52)	(0.5)	(2.31)	(7.23)	(7.98)
Inflation_t-2 X Sales	0.00262	0.0127	−0.0211*	−0.0320**	−0.0257
	(0.44)	(1.53)	(−1.97)	(−2.76)	(−1.94)
Inflation_t-2 X Age	−0.000126***	−0.000226***	−0.000157*	−0.000115	−0.000174
	(−3.31)	(−3.69)	(−1.98)	(−1.28)	(−1.63)
Constant	0.664	1.377	3.072	5.459	6.384***
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes
N	514,970	429,183	357,782	293,996	234,856

The independent variable is the log difference between tangible asset at the time $t+h$ with tangible asset at time t, where $h = 0,...,4$. The main interest variable is the interaction between financial expenses over EBITDA and the monetary shock given by the OIS 3-month change rate around the monthly monetary announcement (ΔMP). Each column provides the estimation for each time period of projection. Firms control variables are: logarithm of total asset (Asset), logarithmic difference of sales (Sales_growth), cash flow (CF) and Age as the year that firm is incorporated. All firm control variables are one-year lagged. The macroeconomic controls are the gross domestic product growth rate (GDP_growth) and the inflation rate (Inflation). We also include the interaction between firms control and macroeconomic control variables. Moreover, the interactions between firm controls variables and ΔMP are included. We use country/year macroeconomic data. For the macroeconomic variable, we use lagged variables at time t-1 and t-2. Firm fixed effects and year fixed effects are included in the estimation. T-statistics in parentheses. Standard errors are clustered by firm level.

Table E.3. Interaction between leverage and the monetary shock.

	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate
	h = 0	h = 1	h = 2	h = 3	h = 4
$\Delta MP(Lev_{j,t-1} - E_j[Lev_{j,t}])$	−0.0322** (−3.22)	−0.0570*** (−4.02)	−0.155*** (−6.82)	−0.0453 (−1.92)	0.0978*** (3.83)
$(Lev_{j,t-1} - E_j[Lev_{j,t}])$	−0.207***	−0.349***	−0.405***	−0.369***	−0.247***
	(−25.54)	(−25.22)	(−23.19)	(−18.43)	(−11.25)
ΔMP	−0.0105**	−0.0185***	−0.0202***	−0.0197**	−0.00222
	(−3.27)	(−4.14)	(−3.94)	(−3.09)	(−0.37)
CF	0.0155***	0.0239***	0.0303***	0.0291***	0.0301***
	(8.19)	(6.93)	(7.28)	(6.44)	(5.91)
Asset	−0.229***	−0.468***	−0.697***	−0.864***	−0.907***
	(−39.29)	(−48.73)	(−57.47)	(−61.04)	(−56.20)
Sales growth	0.0396***	0.0432**	0.0986***	0.111***	0.169***
	(5.06)	(3.29)	(6.26)	(6.65)	(8.68)
Age	−0.0744	−0.0699	−0.256	−0.0411	−0.187
	(−1.05)	(−1.17)	(−1.60)	(−1.65)	(−1.18)
GPG_growth_t-1	−0.00435*	0.117***	0.175***	0.156***	0.0990***
	(−2.20)	(14.34)	(17.8)	(13.68)	(6.72)
GPG_growth_t-2	0.0483***	0.0457***	0.0267***	−0.00835	−0.016
	(12.72)	(7.34)	(3.78)	(−1.05)	(−1.83)
Inflation_t-1	−0.0352***	−0.0458***	−0.00773	0.00759	−0.0433*
	(−4.79)	(−4.19)	(−0.59)	(0.51)	(−2.06)
Inflation_t-2	−0.0552***	−0.0163	−0.0543***	−0.144***	−0.183***
	(−7.75)	(−1.41)	(−3.55)	(−7.48)	(−8.62)
GPG_growth_t-1 X $(FE_{j,t-1} - E_j[FE_{j,t}])$	−0.00807**	−0.0258*	−0.0338*	−0.0430**	−0.0201
	(−3.11)	(−2.34)	(−2.58)	(−2.72)	(−1.09)
GPG_growth_t-2 X $(FE_{j,t-1} - E_j[FE_{j,t}])$	−0.00859	−0.0147	−0.0166	0.00105	−0.00923
	(−1.47)	(−1.40)	(−1.35)	(0.08)	(−0.66)
Inflation_t-1 X $(FE_{j,t-1} - E_j[FE_{j,t}])$	−0.0452***	−0.0507*	−0.0339	−0.0752**	−0.00352
	(−3.32)	(−2.38)	(−1.33)	(−2.67)	(−0.10)

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	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate
	h = 0	h = 1	h = 2	h = 3	h = 4
Inflation_t-2 X $\left(FE_{j,t-1} - E_j\left[FE_{j,t}\right]\right)$	0.0922***	0.127***	0.113***	0.0665**	−0.0586*
	(7.55)	(7.06)	(5.17)	(2.66)	(−2.12)
ΔMP X Cash	−0.000544	−0.000291	0.00241	−0.00194	0.000468
	(−0.44)	(−0.18)	−1.23	(−0.86)	(0.2)
ΔMP X Asset	−0.0016	−0.00269*	−0.00367*	−0.00151	−0.00105
	(−1.57)	(−1.97)	(−2.32)	(−0.82)	(−0.54)
ΔMP X Sales	0.0368***	0.0843***	0.0608***	0.0988***	0.111***
	(5.21)	(7.77)	(4.74)	(6.92)	(6.65)
ΔMP X Age	−0.0000988*	−0.0000203	−0.000121	−0.0000954	−0.0000875
	(−2.25)	(−0.32)	(−1.67)	(−1.07)	(−1.00)
GPG_growt_t-1 X Cash	−0.000211	0.00453***	0.00650***	0.00718***	0.00648***
	(−0.66)	(4.26)	(4.95)	(4.75)	(3.33)
GPG_growth_t-1 X Asset	0.0000677	−0.0155***	−0.0217***	−0.0195***	−0.0123***
	(0.2)	(−12.24)	(−13.93)	(−10.79)	(−5.29)
GPG_growth_t-1 X Sales	−0.00395*	0.0122*	0.0148*	0.0231**	−0.0117
	(−2.10)	(2.13)	(2.11)	(2.86)	(−1.19)
GPG_growth_t-1 X Age	−0.0000280*	−0.0003***	−0.00017**	−0.00006	−0.00006
	(−2.26)	(−6.58)	(−3.17)	(−1.08)	(−0.69)
GPG_growth_t-2 X Cash	0.00209***	0.000805	0.00136	−0.000785	−0.00326*
	(3.71)	(0.89)	(1.37)	(−0.70)	(−2.52)
GPG_growth_t-2 X Asset	−0.00610***	−0.0045***	−0.00285*	0.00212	0.00333*
	(−9.44)	(−4.33)	(−2.44)	(1.62)	(2.25)
GPG_growth_t-2 X Sales	0.00937**	0.0107*	−0.000596	−0.0276***	−0.00234
	(3.08)	(2.06)	(−0.10)	(−4.04)	(−0.30)
GPG_growth_t-2 X Age	−0.00006***	0.0000514	0.000053	0.0000338	−0.0000282
	(−3.40)	(1.6)	(1.46)	(0.87)	(−0.65)
Inflation_t-1 X Cash	−0.00178	−0.0018	−0.00349	−0.000661	0.000673
	(−1.60)	(−1.12)	(−1.79)	(−0.29)	(0.21)
Inflation_t-1 X Asset	0.00472***	0.00396*	0.000509	−0.00248	0.00396
	(3.78)	(2.18)	(0.23)	(−0.96)	(1.1)
Inflation_t-1 X Sales	0.0129*	0.0286**	0.0465***	0.0907***	0.0272
	(1.99)	(2.95)	(4)	(6.3)	(1.35)
Inflation_t-1 X Age	0.0000674	−0.00017**	−0.000156*	−0.0000509	0.0000622
	(1.75)	(−3.05)	(−2.14)	(−0.66)	(0.54)
Inflationt-2 X Cash	−0.00337**	−0.00399*	−0.00418*	−0.0092***	−0.0104***
	(−3.26)	(−2.55)	(−2.01)	(−3.80)	(−3.86)
Inflation_t-2 X Asset	0.00634***	0.00308	0.00858***	0.0218***	0.0245***
	(5.4)	(1.66)	(3.51)	(7.28)	(7.37)
Inflation_t-2 X Sales	0.00272	0.0135	−0.0319**	−0.0585***	−0.0398**
	(0.45)	(1.54)	(−2.71)	(−4.55)	(−2.68)
Inflation_t-2 X Age	−0.000120**	−0.000163**	−0.000034	0.0000741	−0.0000939
	(−3.11)	(−2.61)	(−0.41)	(0.75)	(−0.80)
Constant	4.648*	6.982***	14.80**	9.934***	14.54**
	(2.07)	(3.79)	(3.06)	(13.35)	(3.18)
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes
N	**539,305**	**448,452**	**373,170**	**306,107**	**244,406**

The independent variable is the log difference between tangible asset at the time $t + h$ with tangible asset at time t, where $h = 0,\ldots,4$. The main interest variable is the interaction between leverage and the monetary shock given by the OIS 3-month change rate around the monthly monetary announcement (ΔMP). Each column provides the estimation for each time period of projection. Firms control variables are: logarithm of total asset (Asset), logarithmic difference of sales (Sales_growth), cash flow (CF) and Age as the year that firm is incorporated. All firm control variables are one-year lagged. The macroeconomic controls are the gross domestic product growth rate (GDP_growth) and the inflation rate (Inflation). We also include the interaction between firms control and macroeconomic control variables. Moreover, the interactions between firm controls variables and ΔMP are included. We use country/year macroeconomic data. For the macroeconomic variable, we use lagged variables at time t-1 and t-2. Firm fixed effects and year fixed effects are included in the estimation. T-statistics in parentheses. Standard errors are clustered by firm level.

Table E.4. Short-term leverage and the monetary shock: the response of investments.

	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate
	h = 0	h = 1	h = 2	h = 3	h = 4
ΔMP X $\left(ST\_Lev_{j,t-1} - E_j\left[ST\_Lev_{j,t}\right]\right)$	−0.00908	−0.0337	0.00362	0.0487	0.164***
	(−0.39)	(−1.25)	(0.13)	(1.65)	(4.86)
$\left(ST\_Lev_{j,t-1} - E_j\left[ST\_Lev_{j,t}\right]\right)$	−0.168***	−0.256***	−0.300***	−0.289***	−0.224***
	(−11.88)	(−12.60)	(−12.40)	(−10.84)	(−7.85)
ΔMP	−0.00499	−0.0141***	−0.0178***	−0.0135*	0.000746
	(−1.61)	(−3.45)	(−3.97)	(−2.51)	−0.15
CF	1.638***	2.818***	3.530***	3.966***	3.977***
	(100.34)	(122.62)	(138.15)	(135.49)	(121.11)
Asset	−0.226***	−0.437***	−0.597***	−0.764***	−0.832***
	(−31.76)	(−49.54)	(−62.06)	(−72.02)	(−67.99)
Sales growth	0.00851	−0.00678	−0.00784	−0.0281	0.00942
	(0.88)	(−0.55)	(−0.57)	(−1.95)	(0.57)
Age	0.0128***	0.0288***	0.0326***	0.0378***	0.0223***
	(13.64)	(22.22)	(22.11)	(18.49)	(6.25)
GPG_growth_t-1	0.0603***	0.105***	0.148***	0.131***	0.0899***
	(10.79)	(13.91)	(17.11)	(13.47)	(7.17)
GPG_growth_t-2	0.0171***	0.0334***	0.0329***	0.000483	−0.0176*
	(3.97)	(5.85)	(5.32)	(0.07)	(−2.29)
Inflation_t-1	0.00263	−0.0348***	−0.0151	−0.00198	−0.00859
	(0.32)	(−3.44)	(−1.33)	(−0.15)	(−0.46)
Inflation_t-2	−0.0174*	−0.0239*	−0.0374**	−0.111***	−0.164***
	(−2.00)	(−2.01)	(−2.79)	(−6.76)	(−8.91)
GPG_growth_t-1 X $\left(ST\_Lev_{j,t-1} - E_j\left[ST\_Lev_{j,t}\right]\right)$	−0.00479	0.0262	0.0568**	0.0983***	0.146***
	(−0.36)	(1.52)	(2.93)	(4.23)	(4.9)
GPG_growth_t-2 X $\left(ST\_Lev_{j,t-1} - E_j\left[ST\_Lev_{j,t}\right]\right)$	0.0288*	−0.00307	0.00902	−0.0144	−0.0421*
	−2.21	(−0.21)	(0.54)	(−0.76)	(−1.96)
Inflation_t-1 X $\left(ST\_Lev_{j,t-1} - E_j\left[ST\_Lev_{j,t}\right]\right)$	−0.0572*	−0.0488	−0.0464	−0.00438	0.068
	(−2.16)	(−1.63)	(−1.38)	(−0.11)	(1.22)
Inflation_t-2 X $\left(ST\_Lev_{j,t-1} - E_j\left[ST\_Lev_{j,t}\right]\right)$	0.0782***	0.102***	0.111***	0.059	0.0327
	(3.54)	(3.63)	(3.51)	(1.63)	(0.79)
ΔMP X Cash	−0.00287	−0.00184	0.00152	−0.00356	−0.00334
	(−1.94)	(−1.13)	(0.93)	(−1.84)	(−1.61)
ΔMP X Asset	0.00165	0.000413	−0.00243	0.000573	0.00212
	(1.35)	(0.31)	(−1.83)	(0.36)	(1.26)
ΔMP X Sales	0.00317	0.0308**	0.0367***	0.0612***	0.0771***
	(0.37)	(2.98)	(3.33)	(5.07)	(5.52)
ΔMP X Age	−0.0000201	0.0000295	−0.0000581	0.00000637	−0.0000365
	(−0.39)	−0.47	(−0.92)	(0.08)	(−0.48)
GPG_growt_t-1 X Cash	0.00205**	0.00445***	0.00461***	0.00375***	0.00375**
	(3.24)	(5.32)	(4.93)	(3.51)	(2.71)
GPG_growth_t-1 X Asset	−0.00741***	−0.0138***	−0.0175***	−0.0144***	−0.00940***
	(−9.23)	(−12.76)	(−14.37)	(−10.46)	(−5.28)
GPG_growth_t-1 X Sales	0.00352	0.00871	0.00928	0.0141*	−0.0145
	(0.82)	(1.56)	(1.48)	(2.02)	(−1.70)
GPG_growth_t-1 X Age	−0.0000286	−0.000229***	−0.000176***	−0.000104*	−0.0000953
	(−0.92)	(−5.38)	(−3.48)	(−2.00)	(−1.27)
GPG_growth_t-2 X Cash	0.000947	0.000431	0.000865	0.000188	−0.00262*
	(1.48)	(0.52)	(0.98)	(0.19)	(−2.36)
GPG_growth_t-2 X Asset	−0.00204**	−0.00297**	−0.00321**	0.00043	0.00302*
	(−2.77)	(−3.09)	(−3.11)	(0.38)	(2.34)
GPG_growth_t-2 X Sales	0.000221	0.0036	−0.000609	−0.0177**	0.00309
	(0.06)	(0.74)	(−0.11)	(−3.00)	(0.46)
GPG_growth_t-2 X Age	−0.0000712**	0.0000562	0.0000481	0.0000181	−0.000021
	(−3.27)	(1.92)	(1.46)	(0.52)	(−0.55)
Inflation_t-1 X Cash	−0.000872	−0.00072	−0.000968	−0.000333	0.00242
	(−0.74)	(−0.49)	(−0.58)	(−0.17)	(0.89)
Inflation_t-1 X Asset	−0.000515	0.0011	−0.000976	−0.00201	−0.000835
	(−0.38)	(0.65)	(−0.51)	(−0.91)	(−0.27)
Inflation_t-1 X Sales	0.0280***	0.0365***	0.0361***	0.0716***	0.0288
	(3.82)	(4.02)	(3.55)	(5.79)	(1.68)

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	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate
	h = 0	h = 1	h = 2	h = 3	h = 4
Inflation_t-1 X Age	0.0000245	−0.000165**	−0.0000797	0.00000683	0.0000724
	(0.6)	(−3.14)	(−1.25)	(0.1)	(0.71)
Inflationt-2 X Cash	−0.00169	−0.00146	−0.00158	−0.00596***	−0.00748***
	(−1.59)	(−1.07)	(−1.04)	(−3.54)	(−3.80)
Inflation_t-2 X Asset	0.00330**	0.00343*	0.00513**	0.0163***	0.0204***
	(2.58)	(2)	(2.64)	(7.11)	(7.78)
Inflation_t-2 X Sales	−0.0166*	−0.0138	−0.0179	−0.0317**	−0.0175
	(−2.25)	(−1.50)	(−1.72)	(−2.85)	(−1.37)
Inflation_t-2 X Age	−0.0000689	−0.0000939	−0.000115	−0.0000465	−0.000149
	(−1.43)	(−1.44)	(−1.53)	(−0.55)	(−1.47)
Constant	0.864***	1.864***	2.923***	4.152***	5.311***
	(13.03)	(21.85)	(31.03)	(37.71)	(36.9)
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes
N	440,253	409,174	382,503	313,597	250,335

The independent variable is the log difference between tangible asset at the time $t+h$ with tangible asset at time t, where $h = 0,\ldots,4$. The main interest variable is the interaction between short-term leverage and the monetary shock given by the OIS 3-month change rate around the monthly monetary announcement (ΔMP). Each column provides the estimation for each time period of projection. Firms control variables are: logarithm of total asset (Asset), logarithmic difference of sales (Sales_growth), cash flow (CF) and Age as the year that firm is incorporated. All firm control variables are one-year lagged. The macroeconomic controls are the gross domestic product growth rate (GDP_growth) and the inflation rate (Inflation). We also include the interaction between firms control and macroeconomic control variables. Moreover, the interactions between firm controls variables and ΔMP are included. We use country/year macroeconomic data. For the macroeconomic variable, we use lagged variables at time t-1 and t-2. Firm fixed effects and year fixed effects are included in the estimation. T-statistics in parentheses. Standard errors are clustered by firm level.

Table E.5. Long-term leverage and the monetary shock: the response of investments.

	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate
	h = 0	h = 1	h = 2	h = 3	h = 4
ΔMP X $\left(LT\_Lev_{j,t-1} - E_j\left[LT\_Lev_{j,t}\right]\right)$	−0.167***	−0.241***	−0.332***	−0.402***	−0.240***
	(−9.79)	(−11.91)	(−15.10)	(−18.01)	(−10.09)
$\left(LT\_Lev_{j,t-1} - E_j\left[LT\_Lev_{j,t}\right]\right)$	0.0696***	0.0671***	0.0565**	0.00275	0.00552
	(6.55)	(4.52)	(3.27)	(0.15)	(0.26)
ΔMP	−0.00673*	−0.0131**	−0.0171***	−0.0126*	0.00204
	(−2.19)	(−3.20)	(−3.84)	(−2.39)	(0.4)
CF	1.631***	2.803***	3.510***	3.945***	3.944***
	−98.08	−119.99	−135.06	−131.77	−116.82
Asset	−0.232***	−0.445***	−0.606***	−0.775***	−0.843***
	(−31.58)	(−50.12)	(−62.07)	(−71.31)	(−66.79)
Sales growth	0.0135	0.0021	0.000245	−0.0248	0.013
	(1.4)	(0.17)	(0.02)	(−1.74)	(0.79)
Age	0.0135***	0.0295***	0.0340***	0.0394***	0.0223***
	(14.4)	(22.81)	(23.21)	(19.43)	(6.37)
GPG_growth_t-1	0.0628***	0.109***	0.152***	0.137***	0.0950***
	(11.17)	(14.47)	(17.56)	(13.98)	(7.5)
GPG_growth_t-2	0.0166***	0.0339***	0.0344***	0.000857	−0.0144
	(3.91)	(5.97)	(5.57)	(0.13)	(−1.87)
Inflation_t-1	0.00313	−0.0340***	−0.0117	0.00529	−0.0163
	(0.39)	(−3.42)	(−1.04)	(0.41)	(−0.86)
Inflation_t-2	−0.0134	−0.0191	−0.0331*	−0.109***	−0.158***
	(−1.54)	(−1.62)	(−2.49)	(−6.67)	(−8.54)
GPG_growth_t-1 *X* $\left(LT\_Lev_{j,t-1} - E_j\left[LT\_Lev_{j,t}\right]\right)$	−0.0514***	−0.0582***	−0.0410**	−0.0406**	−0.0325
	(−5.61)	(−4.65)	(−3.00)	(−2.71)	(−1.89)
GPG_growth_t-2 X $\left(LT\_Lev_{j,t-1} - E_j\left[LT\_Lev_{j,t}\right]\right)$	−0.00261	−0.0178	−0.0397***	−0.0108	0.0081
	(−0.31)	(−1.69)	(−3.33)	(−0.89)	(0.66)
Inflation_t-1 X $\left(LT\_Lev_{j,t-1} - E_j\left[LT\_Lev_{j,t}\right]\right)$	−0.0113	0.0570*	0.123***	0.113***	0.117***
	(−0.63)	(2.57)	(5.1)	(4.47)	(3.66)
Inflation_t-2 X $\left(LT\_Lev_{j,t-1} - E_j\left[LT\_Lev_{j,t}\right]\right)$	0.123***	0.236***	0.263***	0.262***	0.126***
	(7.51)	(11.45)	(11.77)	(10.91)	(4.94)

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	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate	Inv. Rate
	h = 0	h = 1	h = 2	h = 3	h = 4
ΔMP X Cash	−0.00231	−0.00155	0.00178	−0.0034	−0.00263
	(−1.59)	(−0.97)	(1.1)	(−1.77)	(−1.28)
ΔMP X Asset	0.00124	0.000355	−0.00275*	0.000298	0.00164
	(1.03)	(0.27)	(−2.07)	(0.19)	(0.98)
ΔMP X Sales	0.00341	0.0331**	0.0376***	0.0669***	0.0788***
	(0.4)	(3.23)	(3.44)	(5.57)	(5.66)
ΔMP X Age	−0.0000263	0.0000284	−0.0000493	0.00000883	−0.0000627
	(−0.51)	(0.45)	(−0.78)	(0.11)	(−0.83)
GPG_growt_t-1 X Cash	0.00232***	0.00545***	0.00594***	0.00535***	0.00555***
	(3.76)	(6.75)	(6.47)	(5.06)	(4.06)
GPG_growth_t-1 X Asset	−0.00785***	−0.0149***	−0.0190***	−0.0161***	−0.0109***
	(−9.91)	(−14.16)	(−15.71)	(−11.65)	(−6.14)
GPG_growth_t-1 X Sales	0.00157	0.00478	0.00604	0.0141*	−0.0133
	(0.37)	(0.87)	(0.97)	(2.05)	(−1.58)
GPG_growth_t-1 X Age	−0.0000253	−0.000227***	−0.000167***	−0.000108*	−0.000123
	(−0.82)	(−5.34)	(−3.29)	(−2.10)	(−1.66)
GPG_growth_t-2 X Cash	0.00111	0.000471	0.000991	−0.0000134	−0.00280**
	(1.77)	(0.58)	(1.15)	(−0.01)	(−2.58)
GPG_growth_t-2 X Asset	−0.00215**	−0.00301**	−0.00333**	0.00063	0.00279*
	(−2.96)	(−3.16)	(−3.26)	(0.56)	(2.18)
GPG_growth_t-2 X Sales	0.000695	0.00435	−0.00105	−0.0208***	0.00056
	(0.19)	(0.91)	(−0.20)	(−3.58)	(0.08)
GPG_growth_t-2 X Age	−0.0000633**	0.000055	0.0000434	0.00000785	−0.0000161
	(−2.92)	(1.89)	(1.33)	(0.23)	(−0.43)
Inflation_t-1 X Cash	−0.000444	−0.000321	−0.000553	0.000995	0.00322
	(−0.39)	(−0.22)	(−0.34)	(0.52)	(1.21)
Inflation_t-1 X Asset	−0.000879	0.000701	−0.00161	−0.00364	−0.000442
	(−0.66)	(0.42)	(−0.84)	(−1.64)	(−0.14)
Inflation_t-1 X Sales	0.0279***	0.0365***	0.0381***	0.0813***	0.0350*
	(3.85)	(4.04)	(3.77)	(6.7)	(2.03)
Inflation_t-1 X Age	0.0000183	−0.000176***	−0.0000978	0.000000836	0.0000226
	(0.46)	(−3.37)	(−1.54)	(0.01)	(0.22)
Inflationt-2 X Cash	−0.0011	−0.000539	−0.000386	−0.00531**	−0.00650***
	(−1.05)	(−0.41)	(−0.26)	(−3.21)	(−3.34)
Inflation_t-2 X Asset	0.00249*	0.00236	0.00381*	0.0157***	0.0189***
	(1.98)	(1.41)	(2.01)	(6.92)	(7.22)
Inflation_t-2 X Sales	−0.0190**	−0.0176	−0.0217*	−0.0365***	−0.0213
	(−2.60)	(−1.94)	(−2.11)	(−3.32)	(−1.65)
Inflation_t-2 X Age	−0.0000595	−0.0000935	−0.0000919	−0.000045	−0.000138
	(−1.23)	(−1.44)	(−1.24)	(−0.53)	(−1.36)
Constant	0.915***	1.949***	2.998***	4.245***	5.457***
	(13.51)	(22.89)	(31.75)	(38.43)	(37.95)
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry-year FE	Yes	Yes	Yes	Yes	Yes
N	436,076	405,863	379,812	311,962	249,269

The independent variable is the log difference between tangible asset at the time $t+h$ with tangible asset at time t, where $h = 0,\ldots,4$. The main interest variable is the interaction between long-term leverage and the monetary shock given by the OIS 3-month change rate around the monthly monetary announcement (ΔMP). Each column provides the estimation for each time period of projection. Firms control variables are: logarithm of total asset (Asset), logarithmic difference of sales (Sales_growth), cash flow (CF) and Age as the year that firm is incorporated. All firm control variables are one-year lagged. The macroeconomic controls are the gross domestic product growth rate (GDP_growth) and the inflation rate (Inflation). We also include the interaction between firms control and macroeconomic control variables. Moreover, the interactions between firm controls variables and ΔMP are included. We use country/year macroeconomic data. For the macroeconomic variable, we use lagged variables at time t-1 and t-2. Firm fixed effects and year fixed effects are included in the estimation. T-statistics in parentheses. Standard errors are clustered by firm level.

Table E.6. Interaction coefficients of leverage, long-term and short-term leverage with monetary policy under different country-risk factors.

(a) Leverage x ΔMP shock coefficients	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$
	Country risk factors				
Stressed	−0.0481***	−0.0793***	−0.206***	−0.116***	0.127***
	(−3.48)	(−4.17)	(−6.48)	(−3.53)	(3.45)
Non-Stressed	−0.0280*	−0.0466*	−0.132***	−0.00083	0.0249
	(−1.97)	(−2.20)	(−4.04)	(−0.02)	(0.74)
-Loan to Deposit					
33rd pc.	−0.0353	0.0333	−0.00433	−0.0156	0.0256
	(−1.85)	−1.41	(−0.08)	(−0.24)	(0.35)
33rd-66th pc.	−0.0269	−0.0317	−0.0102	0.0664*	0.232***
	(−1.17)	(−1.25)	(−0.38)	(2.39)	(7.31)
66th pc.	−0.103***	−0.271***	−0.290***	−0.122**	0.035
	(−3.40)	(−6.98)	(−6.55)	(−2.61)	(0.74)
-Cost of Borrowing					
33rd pc.	−0.0272*	−0.0474*	−0.125***	0.0536	0.0523
	(−1.96)	(−2.12)	(−3.72)	(1.54)	(1.56)
33rd-66th pc.	−0.0194	−0.0519*	−0.119**	−0.062	0.209***
	(−1.14)	(−2.25)	(−3.02)	(−1.51)	(4.55)
66th pc.	−0.103***	−0.271***	−0.290***	−0.122**	0.035
	(−3.40)	(−6.98)	(−6.55)	(−2.61)	(0.74)

(b) Short-Term Leverage x ΔMP shock coefficients	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$
	Country risk factors				
Stressed	−0.0494*	−0.0545*	−0.0502	0.00321	0.148**
	(−2.56)	(−2.12)	(−1.11)	−0.07	−2.84
Non-Stressed	0.0189	0.0331	0.032	0.068	−0.00985
	(0.89)	(1.07)	(0.67)	(1.38)	(−0.18)
-Loan to Deposit					
33rd pc.	−0.0448	0.0168	0.0144	0.0633	−5.8E-05
	(−1.68)	−0.51	−0.18	−0.59	(−0.00)
33rd-66th pc.	0.0192	0.00855	0.0433	0.0577	0.130**
	−0.57	−0.24	−1.17	−1.42	−2.74
66th pc.	0.0039	−0.113	−0.106	0.00436	0.0504
	−0.09	(−1.79)	(−1.36)	−0.06	−0.59
-Cost of Borrowing					
33rd pc.	0.0329	0.05	0.0882	0.111*	−0.0138
	(1.74)	(1.71)	(1.91)	(2.27)	(−0.27)
33rd-66th pc.	−0.0459	−0.0582	−0.0466	0.0197	0.215***
	(−1.90)	(−1.85)	(−0.84)	−0.35	−3.43
66th pc.	0.0039	−0.113	−0.106	0.00436	0.0504
	(0.09)	(−1.79)	(−1.36)	(0.06)	(0.59)

(c) Long-term leverage x ΔMP shock coefficients	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$
	Country risk factors				
Stressed	−0.0725***	−0.0952***	−0.447***	−0.429***	−0.205***
	(−4.52)	(−4.33)	(−10.79)	(−11.06)	(−4.77)
Non-Stressed	−0.0213	−0.0298	−0.168***	−0.194***	−0.140***
	(−1.81)	(−1.60)	(−5.25)	(−5.83)	(−3.84)
-Loan to Deposit					
33rd pc.	−0.195***	−0.236***	−0.320***	−0.261***	−0.180*
	(−9.74)	(−8.94)	(−5.39)	(−3.92)	(−2.51)
33rd-66th pc.	0.00114	0.0323	−0.0288	−0.025	0.146***
	−0.06	−1.25	(−0.93)	(−0.78)	−3.87
66th pc.	−0.0336	−0.228***	−0.426***	−0.456***	−0.297***
	(−1.06)	(−5.12)	(−8.09)	(−8.13)	(−5.53)
-Cost of Borrowing					
33rd pc.	−0.0261	−0.0339	−0.196***	−0.195***	−0.154***
	(−1.90)	(−1.50)	(−5.28)	(−5.10)	(−3.74)
	−0.0261	−0.0339	−0.196***	−0.195***	−0.154***
33rd-66th pc.	−0.00125	−0.00129	−0.230***	−0.190***	0.0195
	(−0.07)	(−0.05)	(−5.05)	(−4.36)	(0.39)
66th pc.	−0.0336	−0.228***	−0.426***	−0.456***	−0.297***
	(−1.06)	(−5.12)	(−8.09)	(−8.13)	(−5.53)

The independent variable is the log difference between tangible asset at the time $t + h$ with tangible asset at time t, where $h = 0,...,4$. In panel (a) the interaction term between the monetary shock and firms' leverage, whereas the interaction between monetary shock and short-term and long-term leverage are shown in panels (b) and (c), respectively. The table provides the interaction coefficient between the monetary policy shock and the demeaned leverage ratio. Each column provides the estimation for each time period of projection. In the first specification, *stressed* countries include Portugal, Italy, Ireland, Greece and Spain. The *non-stressed* countries include the remained EMU countries. In "*Loan to Deposit*", we split our sample in three terciles based on the loan-to-deposit distribution in 2021. In the "*Cost of Borrowing*" section, the sample is clustered by the three terciles of cost of borrowing distribution in 2021. Both "*Loan to Deposit*" and "*Cost of Borrowing*" are yearly country-based data. In each macro class, we split our sample according to the employment rate distribution: we divide firms in three terciles. The employment rate is provided for each country. We consider the employment rate at year 2021. Firms control variables are: logarithm of total asset (Asset), logarithmic difference of sales (Sales_growth), cash flow (CF) and Age as the year that firm is incorporated. All firm control variables are one-year lagged. The macroeconomic controls are the gross domestic product growth rate (GDP_growth) and the inflation rate (Inflation). We also include the interaction between firms control and macroeconomic control variables. Moreover, the interactions between firm controls variables and ΔMP are included. We use country/year macroeconomic data. For the macroeconomic variable, we use lagged variables at time t-1 and t-2. Firm fixed effects and year fixed effects are included in the estimation. T-statistics in parentheses. Standard errors are clustered by firm level.

Table E.7. Interaction coefficients of leverage, long-term and short-term leverage with monetary policy under different market structure specifications.

Market structure factors																	
	(a) Leverage x ΔMP shock coefficients						(b) Short-Term Leverage x ΔMP shock coefficients						(c) Long-term leverage x ΔMP shock coefficients				
SMEs' Size factor	*h = 0*	*h = 1*	*h = 2*	*h = 3*	*h = 4*	*SMEs' Size factor*	*h = 0*	*h = 1*	*h = 2*	*h = 3*	*h = 4*	*SMEs' Size factor*	*h = 0*	*h = 1*	*h = 2*	*h = 3*	*h = 4*
- Micro SMEs						*- Micro SMEs*						*- Micro SMEs*					
33rd pc.	−0.0119	−0.0301	−0.102**	0.0568	0.0444	33rd pc.	0.0337	0.048	0.0974*	0.106*	0.00474	33rd pc.	−0.00204	−0.00137	−0.110***	−0.131***	−0.0845*
	(−0.89)	(−1.39)	(−3.05)	(1.61)	(1.3)		(1.74)	(1.6)	(2.06)	(2.08)	(0.09)		(−0.17)	(−0.07)	(−3.37)	(−3.81)	(−2.20)
33rd-66th pc.	−0.0589*	−0.101**	−0.283***	−0.183***	−0.0893	33rd-66th pc.	0.0151	0.038	−0.0845	−0.0456	−0.0732	33rd-66th pc.	−0.0961***	−0.159***	−0.493***	−0.516***	−0.425***
	(−2.51)	(−3.27)	(−5.94)	(−3.66)	(−1.64)		(0.43)	(0.77)	(−1.03)	(−0.55)	(−0.79)		(−4.43)	(−4.91)	(−8.44)	(−8.69)	(−7.04)
66th pc.	−0.0483**	−0.0697**	−0.156***	−0.0849*	0.206***	66th pc.	−0.0437*	−0.0635*	−0.0576	0.0186	0.191**	66th pc.	−0.106***	−0.0915***	−0.474***	−0.447***	−0.145**
	(−2.90)	(−3.06)	(−4.06)	(−2.17)	−4.74		(−1.96)	(−2.17)	(−1.11)	(0.35)	(3.26)		(−5.27)	(−3.42)	(−9.08)	(−9.45)	(−2.75)
- Medium SMEs						*- Medium SMEs*						*- Medium SMEs*					
33rd pc.	−0.0450**	−0.0785***	−0.186***	−0.0910**	0.149***	33rd pc.	−0.0492*	−0.0556*	−0.0366	0.0079	0.167**	33rd pc.	−0.0765***	−0.104***	−0.467***	−0.444***	−0.203***
	(−3.12)	(−3.98)	(−5.71)	(−2.70)	−3.92		(−2.43)	(−2.08)	(−0.77)	(0.16)	(3.06)		(−4.51)	(−4.48)	(−10.74)	(−10.87)	(−4.51)
33rd-66th pc.	−0.0445*	−0.0486	−0.164***	−0.0165	0.048	33rd-66th pc.	0.018	0.0322	0.0178	0.0641	−0.065	33rd-66th pc.	−0.0425**	−0.0368	−0.280***	−0.269***	−0.210***
	(−2.53)	(−1.92)	(−4.19)	(−0.42)	(1.27)		(0.77)	(0.98)	(0.34)	(1.21)	(−1.14)		(−2.63)	(−1.45)	(−6.47)	(−6.27)	(−4.70)
66th pc.	0.00018	−0.029	−0.0639	0.0067	−0.00055	66th pc.	−0.0069	0.038	0.032	0.0862	0.18	66th pc.	0.000872	−0.0156	−0.0473	−0.132**	−0.0539
	−0.01	(−0.87)	(−1.21)	−0.11	(−0.01)		(−0.20)	−0.61	−0.35	−0.91	−1.65		−0.05	(−0.60)	(−1.04)	(−2.72)	(−0.96)
Countries Intangible-intensive						*Countries Intangible-intensive*						*Countries Intangible-intensive*					
33rd pc.	−0.0393	−0.0484	−0.134**	−0.107*	−0.0695	33rd pc.	−0.0371	−0.0182	−0.105	−0.0122	−0.0134	33rd pc.	−0.0261	−0.0498*	−0.158***	−0.239***	−0.166**
	(−1.69)	(−1.46)	(−2.60)	(−1.96)	(−1.21)		(−0.90)	(−0.31)	(−1.16)	(−0.14)	(−0.13)		(−1.63)	(−1.99)	(−3.58)	(−5.15)	(−3.14)
33rd-66th pc.	−0.0397	−0.0926**	−0.269***	−0.130*	−0.0791	33rd-66th pc.	0.0123	0.0333	−0.0361	−0.0525	−0.0628	33rd-66th pc.	−0.0665**	−0.125***	−0.393***	−0.413***	−0.384***
	(−1.74)	(−2.93)	(−5.73)	(−2.44)	(−1.34)		(0.34)	(0.67	(−0.41)	(−0.56)	(−0.58)		(−2.74)	(−3.51)	(−6.24)	(−6.29)	(−5.68)
66th pc.	−0.0353**	−0.0572**	−0.137***	−0.0158	0.162***	66th pc.	−0.0145	−0.0137	0.0205	0.0671	0.155***	66th pc.	−0.0584***	−0.0588**	−0.339***	−0.305***	−0.141***
	(−2.82)	(−3.22)	(−4.74)	(−0.53)	−5.11		(−0.86)	(−0.60)	(0.53)	(1.65)	(3.49)		(−4.17)	(−2.97)	(−9.39)	(−8.89)	(−3.82)

The independent variable is the log difference between tangible asset at the time $t + h$ with tangible asset at time t, where $h = 0,\ldots,4$. In panel (a) the interaction term between the monetary shock and firms' leverage, whereas the interaction between monetary shock and short-term and long-term leverage are shown in panels (b) and (c), respectively. Each column provides the estimation for each time period of projection. Concerning the market structure factor, we use two main factors: intangible intensive countries and the SMEs size factor. By using the intangible-intensive factor, the sample is clustered according to the tercile of the countries' intangible ratio distribution (intangible assets over total assets). Concerning the SMEs size factor, we use the employment rate differentiated by micro and medium SMEs in the Eurozone. In each macro class, we split our sample according to the employment rate distribution: we divide firms in three terciles. The employment rate is provided for each country. We consider the employment rate at year 2021. Firms control variables are: logarithm of total asset (Asset), logarithmic difference of sales (Sales_growth), cash flow (CF) and Age as the year that firm is incorporated. All firm control variables are one-year lagged. The macroeconomic controls are the gross domestic product growth rate (GDP_growth) and the inflation rate (Inflation). We also include the interaction between firms control and macroeconomic control variables. Moreover, the interactions between firm controls variables and ΔMP are included. We use country/year macroeconomic data. For the macroeconomic variable, we use lagged variables at time t-1 and t-2. Firm fixed effects and year fixed effects are included in the estimation. T-statistics in parentheses. Standard errors are clustered by firm level.

Appendix F. Asymmetries and non-linearities of the monetary shock

Regarding a potential mirroring of the tightening shock with the loosening shock, we test this effect by following the established literature on the topic. The "direction" of the shock has been widely discussed by scholars (Pozo and Rojas, 2024; Ferrando and Grazzini, 2023). Inspired by these contributions, we estimate the following LP model:

$$\begin{aligned}\log k_{j,t+h} - \log k_{j,t-1} = {} & \alpha_j + \alpha_{t,s} + \beta_{j,h} \mathbb{1}_{\{MP_t>0\}} \Delta MP^m_{TIGHTj,t} + \beta_{j,h} \mathbb{1}_{\{MP_t<0\}} \Delta MP^m_{EASj,t} + \Gamma_{1,h} X_{j,t-1} \\ & + \Gamma_{2,h} Z_{c,t-1,t-2} + \Gamma_{3,h} X_{j,t-1} \Delta MP^m_{j,t} + \Gamma_{4,h} Z_{c,t-1,t-2} X_{j,t-1} + u_j \end{aligned} \tag{F.1}$$

We separately estimate the effects of restrictive and expansive monetary policies. Two dummy variables were created: *Loosen*, which takes the value of the monetary policy shock when it is negative, and zero otherwise; *Tightening*, which takes the value of the MP shock when it is positive, and zero otherwise. Thus, we replace the monetary policy shock in the main eq. (2) with *Tightening* and *Loosen*.

The findings shown in Fig. F.1. indicate that the effect is not symmetric: the response of investments to a one-standard-deviation increase in *Tightening* is negative, with a response dynamic similar to that estimated in the main results. Conversely, the investment response is positive but not significant when considering a decrease in interest rates. These findings align with the widely debated asymmetry of monetary shocks. This validates our choice of using the annual aggregate monetary shock (Durante et al., 2022).

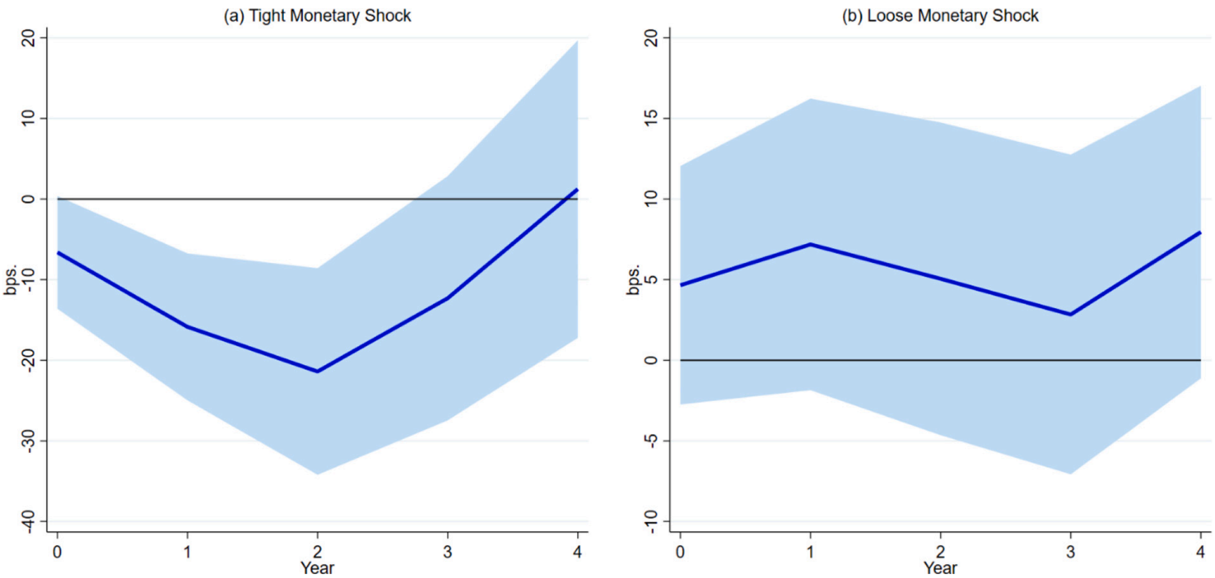

Fig. F.1. Investment response to a tightening and loosening monetary shock. Note: Dynamics of the monetary policy shock coefficients over time. Panel (a) provides the estimation when the monetary policy shock is tightening, whereas panel (b) shows the estimated coefficients when the monetary shock is loosening. The figures report the coefficient γ_h over years h. All variables are defined in Section 4. Shaded bands report 95 % confidence bands.

Finally, we explore possible non-linearities by also considering additional factors such as the magnitude of the shock (Ferrando and Grazzini, 2023). Ferrando and Grazzini (2023) estimate the non-linear local projections by examining the non-linearity in magnitude, including a dummy variable for the size of the shock. Specifically, the monetary shock variable is interacted with the variable I_m. I_m is alternatively a dummy equal to 1 if the shock $\Delta MP^m_{j,t}$ is larger than one standard deviation (corresponding to 7.94 basis points) and 0 otherwise. The baseline specification takes the following form:

$$\log k_{j,t+h} - \log k_{j,t-1} = \alpha_j + \alpha_{t,s} + \gamma_{j,h} I_m \Delta MP^m_{j,t} + \Gamma_{1,h} X_{j,t-1} + \Gamma_{2,h} Z_{c,t-1,t-2} + \Gamma_{3,h} X_{j,t-1} \Delta MP^m_{j,t} + \Gamma_{4,h} Z_{c,t-1,t-2} X_{j,t-1} + u_j \tag{F.2}$$

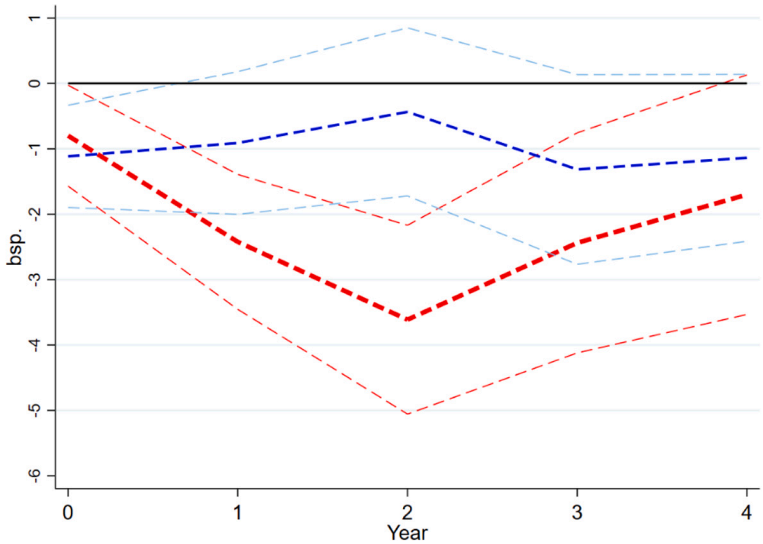

Fig. F.2. - Investment response to the monetary shock 1 std higher and lower. Note: Dynamics of the monetary policy shock coefficients over time. The figure reports the coefficient γ_h over years *h* The blue line shows the dynamic of monetary policy shock coefficient when the shock is lower than 1 std. The red line shows the dynamic of monetary policy shock coefficient when the shock is higher than 1 std. All variables are defined in Section 4. Shaded bands report 95 % confidence bands. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

The results shown in Fig. F.2 highlight a strong non-linearity in the relationship between monetary policy shocks and corporate investment. The magnitude of the shock appears to be associated with more pronounced adverse movements in firms' investment behavior. The larger the size of the shock, the more responsive the investments are, amplifying the negative effect of the monetary policy shock.

Appendix G. Transmission of monetary policy and debt exposure

Unlike the literature that studies the role of debt in the transmission of monetary policy shocks (Jeenas, 2018; Anderson and Cesa-Bianchi, 2020; Auer et al., 2019; Ottonello and Winberry, 2020; Deng and Fang, 2022), in this appendix we examine whether firms with higher (lower) leverage reduce their investments more than firms with less (more) leverage when a monetary shock occurs. We capture the higher (lower) indebtedness of firms by constructing two dummy variables, i.e., *High-Leverage* and *Low-Leverage*. In detail, *High-Leverage* dummy variables take value one if total leverage for firm *i* in year *t* is greater than the 75th percentile of the firms' average level and zero otherwise. Likewise, the *Low-Leverage* dummy variable takes value one if total leverage is lower than the 25th percentile of the firms' average level and zero otherwise.

To estimate the investment response associated with the tightening monetary condition when firms held high leverage level we change the main independent variables of interest with the *High-Leverage* and *Low-Leverage*. Panel (a) of Fig. G.1 shows the interaction coefficient between the monetary policy shock and the different debt's size. Regarding the interaction between the monetary shock and the highest level of leverage, a one-standard-deviation tightening shock is associated with a significant decline in investment across all four years following the shock. For firms with indebtedness above the 75th percentile, the effects of the monetary shock on investments persist until the end of the fourth year, albeit with a decrease in the coefficient after the second period following the shock. The contractionary pattern reaches its peak at $h = 2$, with the investment response to the monetary shock increasing in magnitude by 11.91 basis points.

On the contrary, panel (b) shows that firms with lower exposure are not negatively affected by a tightening monetary condition. Firms with lower indebtedness (below the 25th percentile) exhibit relatively higher investment increases compared to more highly indebted firms. However, the interaction coefficient shows a significant positive effect only 3 years after the shock.

Our findings thus suggest that the size of debt is associated with differences in the investment response to monetary policy shocks. Firms with higher levels of indebtedness tend to show larger reductions in investment activity following a tightening shock compared to firms with lower debt. The highest levels of debt are linked to more severe debt overhang conditions, which may limit firms' capacity to undertake future profitable investments (Myers, 1977). Conversely, firms with lower debt exposure tend to exhibit more positive investment responses, likely reflecting less restrictive financial conditions on their investment decisions.

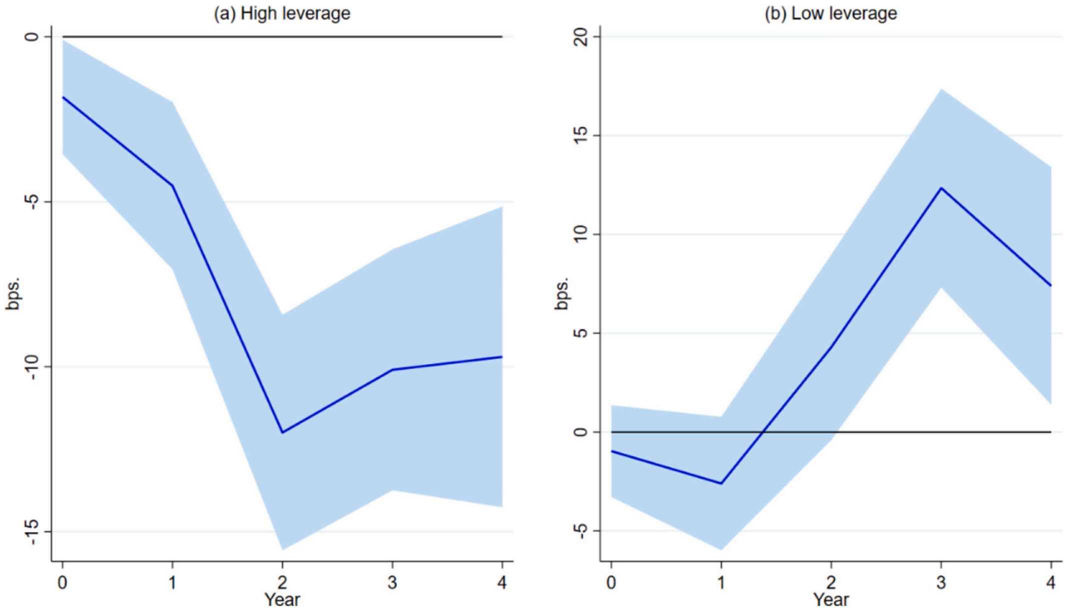

Fig. G.1. Dynamics of the differential response of investment to the interaction between the monetary policy shock and the level of debt exposure. Note: Panel (a) shows the dynamics of the interaction coefficient between high leverage dummy variable and the monetary policy shock over time. Panel (b) shows the dynamics of the interaction coefficient between low leverage dummy variable and the monetary policy shock over time. The figure reports the coefficient δ_h over years h. All variables are defined in Section 4. Shaded bands report 95 % confidence bands.

Appendix H. Transmission of monetary policy and debt exposure: the industry sector perspective

We now explore the investment response to monetary policy changes through the industry sector perspective. Several contributions investigate industry differences in the firm's investment response to monetary policy shocks (Ganley and Salmon, 1996; Barth and Ramey, 2001; Dedola and Lippi, 2005; Peersman and Smets, 2005). We extend our main model by investigating the role of the industry sector indebtedness for the investment channel of monetary policy. Compared to Durante et al. (2022), who find heterogeneity in investments related to the industry, we explore how the worsening financial exposition respect to industry's average shape the investment response to monetary shock. We assess how the difference between a company's financial position and the sector's average is associated with variations in the propagation of the monetary shock. Leverage and FE/EBITDA are demeaned by the industry sector's average.[22] The investment response dynamics is estimated performing eq. (2). Vector x includes the leverage ratio demeaned at NACE level, i.e., $\left(Lev_{j,t-1} - E_s\left[Lev_{j,t}\right]\right)$, and the financial expenses over EBITDA demeaned at NACE level, i.e., $\left(FE_{j,t-1} - E_s\left[FE_{j,t}\right]\right)$.

Panel (a) of Fig. H.1 plots the coefficients capturing the effect of the interaction between the monetary policy shock and the demeaned leverage on the firm's investment activity. The interaction between the monetary policy shock and leverage is associated with significant negative effects on investment, peaking at horizon $h = 3$. Additionally, the findings indicate that these effects persist at least until the fourth period. Quantitatively, a one-percentage-point higher leverage compared to the sector mean corresponds to an increase in the investment semi-elasticity to the monetary shock of 0.38 % at $h = 0$ and 7.32 % at $h = 3$.

Unlike the results reported in Section 4.2.2, the cost of financial debt is associated with a more pronounced change in investment activity following an interest rate increase, lasting at least until the fourth period. However, the overall reduction in investment remains limited. Specifically, panel (b) displays the dynamics of the interaction coefficient, showing that financial expenses correspond to a significant increase in the investment semi-elasticity to the monetary policy shock starting from the time of the shock. The peak is achieved in the second period with a decrease in investment by 0.25 bps. A one-percentage-point higher coverage than the cost borne by the industry sector is associated with a 1.90 % increase in the investment semi-elasticity to changes in monetary conditions.

Our results provide new insights into the role of the industry sector in the transmission mechanism of monetary policy. A one-percentage-point higher debt exposure than the industry average is associated with a stronger negative effect following a one standard deviation increase in the monetary shock. Elevated financing costs relative to industry standards correspond to a more pronounced change in investment dynamics compared to estimates accounting for heterogeneity within firms. These findings suggest that industries with greater heterogeneity in financial expenditure patterns may be more sensitive to the effects of monetary tightening than sectors with more uniform financial outlays. Therefore, the financial expenses could be a significant driver of tightening monetary policy among industry sectors. Nevertheless, the effects are lower and economically not significant.

[22] In order to capture the higher differentiation among sector, the industry sectors refer to 3-digit NACE code. This type of identification enables us to identify 752 different NACE sectors on 996 total codes. The analysis does not consider firms operating in financial and government sectors.

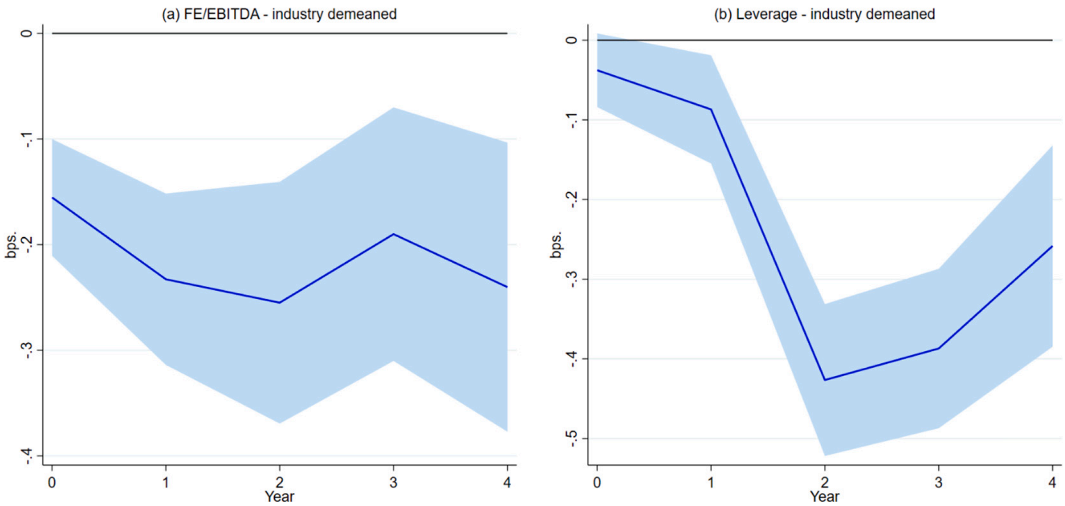

Fig. H.1. Dynamics of the differential response of investment to the interaction between the monetary policy shock and the financial position demeaned by NACE sector's average. Note: Panel (a) shows the dynamics of the interaction coefficient between financial expenses demeaned by NACE average and the monetary policy shock over time. Panel (b) shows the dynamics of the interaction coefficient between leverage demeaned by NACE sectors' average and the monetary policy shock over time. The figure reports the coefficient δ_h over years h. All variables are defined in Section 4. Shaded bands report 95 % confidence bands.

Data availability

The authors do not have permission to share data.

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