Monetary Policy and the Firm-level Labor Share: A Story about Capital*

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Abstract

We study the heterogeneous pass-through of monetary policy across firms with different labor shares. The goal is to obtain evidence on a labor-intensity transmission channel that should in fact be operating for other kinds of demand shocks as well. Our basic idea is that labor is special: unlike capital, it cannot be pledged against loans as collateral due to property rights, rendering firms with higher labor shares more financially constrained. Based on a sample of over two million European firms, we document substantial heterogeneity in terms of firms' response: when conditions tighten, fixed capital stock of labor intensive firms decreases relative to capital intensive production. Concomitant corporate dynamics include a decline in long-term debt and the profitability of labor dependent firms. These findings cannot be explained by other proxies for financial constraints such as age, size or financial leverage. Our results suggest that the impact of monetary policy is driven by borrowing constraints of high labor share firms and provide evidence for the role of external finance in this relation. Taken together, these findings point to new venues for modeling firms' borrowing constraints, and suggest that monetary policy is more potent in an economy characterized by a high labor share.

JEL classification: D22, E52, D31, E23, E32.

Keywords: Monetary policy, labor share, firm heterogeneity, financial constraints, factor input costs.

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1 Introduction

The labor share of value added is a major expense for firms. Labor is, however, also a non-diversifiable, rigid cost factor (Bouvard & De Motta, 2021; Donangelo et al., 2019; Favilukis et al., 2020). One key reason for this is that labor cannot be pledged as collateral for loans due to property rights. As such, labor costs play a crucial role in the transmission of monetary policy at the firm level. Given the substantial variation in labor intensity across firms, several important questions arise: Which firms are most responsive to demand shocks? How does the distribution of income between wages and capital affect monetary policy transmission, and through which channels? Considering that firms' labor obligations are not only large (Kehrig & Vincent, 2021; Kaymak & Schott, 2023; Grazzini & Rossi, 2023) but also tend to adjust slowly, how do firms' responses to higher interest rates vary depending on their labor intensity?

Our study answers these questions. We provide robust evidence on the response in fixed assets to monetary policy shocks and conditional on the labor share of value added at the highest resolution, the firm level. The labor share is not only a key indicator for the distribution of income (Autor et al., 2020; Piketty, 2015) but linked to the mark-up and, by implication, central to the pricing behavior of firms (Choi & Rios-Rull, 2021; Nekarda & Ramey, 2020; Galı & Gertler, 1999; Sbordone, 2002). Notwithstanding the labor share's centrality for monetary policy, however, empirical or theoretical literature on its role in the transmission of exogenous changes in policy rates is virtually nonexistent.

To study these nuances, we analyze a micro-panel from 1999-2018 covering over 2.1 million listed and unlisted European firms. Europe provides an ideal case study because, on the one hand, labor market frictions are heterogeneous across jurisdictions and, on the other hand, such frictions tend to be higher compared to the US (Wasmer, 2006). We propose the hypothesis that firm heterogeneity in factor input cost structure is a decisive factor to consider with respect to firms' response to interest policy given that labor cannot be pledged as collateral against loans due to property rights. At the same time, labor obligations are financial constraints that stretch into the future, comparable to financial leverage (Lian & Ma, 2021). We inform the macro-financial debate on the transmission of monetary policy and firm heterogeneity (Cloyne et al., 2023; Crouzet, 2021; Durante et al., 2022; Gertler & Gilchrist, 1994; Holm-Hadulla & Thürwächter, 2021; Krusell et al., 2023; Jeenas, 2019; Ottonello & Winberry, 2020; Popov & Steininger, 2023) and on 'labor leverage' (Bouvard & De Motta, 2021; Choi & Rios-Rull, 2021; Donangelo et al., 2019; Favilukis et al., 2020).

To quantify the relationship between a firm's labor share and its capital semi-elasticity, we group firms by labor-intensity and estimate a single semi-elasticity for each group over a 4-year horizon. We document the following: First, labor share-specific estimations show a significant, highly robust and pronounced negative reaction of investment of high labor share firms after monetary tightening and relative to capital intensive production. Specifically, a one standard deviation contractionary monetary policy shock (an interest rate increase) decreases total tangible asset stock of firms in the highest labor share bin by 0.6 percentage points more compared to medium labor share firms, and almost 1.1 percentage points more compared to capital intensive firms four years after the shock. Second, we document only a small, transitory effect on the semi-elasticity of employment as we split the universe of firms according to labor dependence. Third, we document that labor dependent firms respond at the expense of their cash flow and financial performance. Fourth, we find that the effect is driven by a decline in long-term debt and more pronounced for firms with inferior access to bank credit, which suggests that bank-lending is the relevant transmission channel at play at the micro level. These results are very robust to changing specifications and conditions as we control for a high-dimensional combination of fixed effects and perform a number of robustness exercises. Although our findings are also mirrored by firms with high capital-intensity of production which display a weaker response, the latter results deliver a slightly less clear picture.

We use exogenous monetary policy shocks developed by Jarociński & Karadi (2020) for identified changes in monetary tightness. These shocks may be interpreted as exogenous with respect to credit conditions insofar as they measure the market response during a short window of time after a monetary policy announcement; for this reason, they mute the endogeneity issues that typically arise when central bank policy is driven by the state of the economy, rather than the other way around. Additionally, they do not contain any central bank information on the state of the economy as they separate surprise effects from information effects.

In order to interpret these empirical findings, we rationalize firms' varying access to external finance based on cost structure. Motivated by a strand of literature that suggests that firms with high labor shares cannot easily adjust to demand shocks (Bouvard & De Motta, 2021; Donangelo et al., 2019), we assume that the resulting labor-intensity is a form of operating leverage which impairs firms' collateral, idiosyncratic risk as well as tangibility, and thus access to bank credit. Therefore, labor intensive production is more sensitive to changes in the monetary policy stance (Gorodnichenko & Weber, 2016), and firms with high labor share are more vulnerable to increasing costs of capital. In particular, a labor intensive firm will have little leeway to react to monetary policy on the asset side (Merz & Yashiv, 2007; Favilukis et al., 2020), and therefore

have a stronger incentive to reduce its investment as monetary conditions tighten. In this way, and because labor, unlike capital, cannot be pledged against loans as collateral, labor intensive firms face greater difficulty accessing external finance due to their cost structure.

Related literature. This study contributes to at least three strands of literature. First, our analysis relates to the literature that studies how the effect of monetary policy varies across firms by showing that firms with different balance sheet compositions have fundamentally different prospects in responding to monetary policy shocks. Other studies suggest that the firm level response depends on age (Cloyne et al., 2023; Durante et al., 2022; Krusell et al., 2023), liquidity (Jeenas, 2019), default risk (Ottonello & Winberry, 2020), bank dependence (Holm-Hadulla & Thürwächter, 2021; Crouzet, 2021) or size (Gertler & Gilchrist, 1994; Popov & Steininger, 2023). Our data allows to study different features of business model, cost structure, and general balance sheet composition. However, we consider some of these firm characteristics in the final part of our empirical analysis (see Section 3.2 or Section 3.2.2, for instance) and show that our results complement these studies. Additionally, we base our analysis on a data set that covers both listed and unlisted firms.

Second, we contribute to a growing strand of literature which argues that the labor share is a relevant metric to scrutinize when it comes to the effectiveness of monetary policy. In particular, Cantore et al. (2020) and Nekarda & Ramey (2020) analyze the cyclical behavior of markups and labor market variables conditional on demand shocks at the macro or industry-level. Our contribution relative to this extant literature is that, on the empirical side, we provide systematic, robust micro-level evidence. Importantly, this granular approach allows us to study the monetary transmission channels in detail.

Finally, there is an existing literature that studies the firm level response of prices (e.g.: Karadi et al. 2022; Galı & Gertler 1999; Sbordone 2002) and markups (such as Meier & Reinelt 2022) to monetary policy shocks. However, markups pose an accounting residual that is less smooth relative to the firm level labor compensation. The labor share's idiosyncratic smoothness and sensitivity to economic shocks is instead analogous to financial leverage as it leads to higher expected returns and amplified firm risk (Bouvard & De Motta, 2021; Donangelo et al., 2019), rendering it a distinct yet much less extensively studied characteristic compared to prices and markups. Similarly, the macroeconomic computation of profit shares requires estimations of capital risk premia, risk-free rates, relative prices of investment goods. Profit shares are thus a less direct empirical measure of the distributional impact of monetary policy.

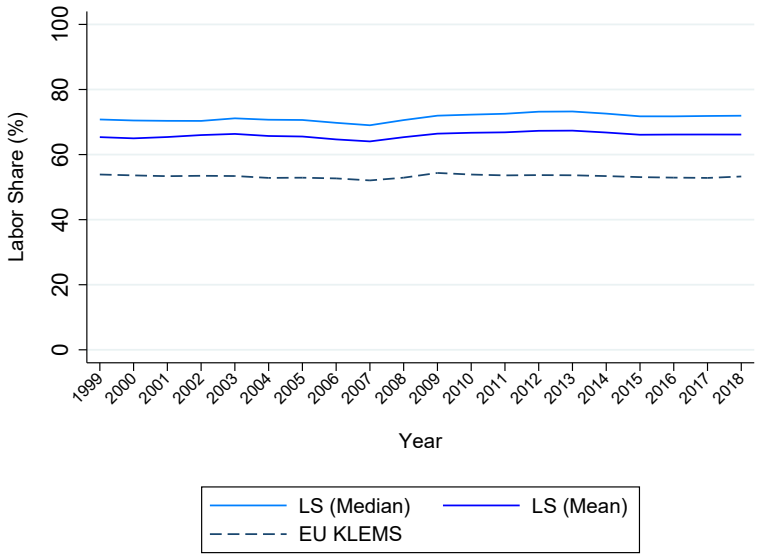
Outline. The remainder of the paper is structured as follows. The subsequent Section 2 explains our

data set and methodology. Section 3 contains the empirical results and robustness exercises. Section 4 discusses and interprets the findings, explains the theory of our working hypothesis and puts them into context with the existing literature. Section 5 concludes.

2 Data and empirical strategy

We base our analysis on an annual corporate-sector micro panel of EA companies from 1999 until 2018. While the sample excludes the public sector, freelancers, and financial companies, it is highly representative at the macro-level. Figure 1 demonstrates the representativeness of our data, benchmarked by the `EU KLEMS`[1] labor share for our sample. The solid line (sample mean) captures the dynamics as well as the level of well-established statistics (dashed line) very aptly. Figure 1 highlights that the aggregate labor share in our sample, in contrast to the US labor share, is relatively stable (Gutierrez & Piton, 2020) and thus not characterized by a decline described by Autor et al. (2020) during the period under observation.

Figure 1: Euro Area Labor Shares - BvD Orbis/EU KLEMS Comparison



Notes: The dark dashed line displays the mean labor share according to `EU KLEMS` for the eight countries included in our sample (defined as the ratio of labor compensation to gross value added; data are from the National Accounts dataset released in February 2023, downloaded from https://euklems-intanprod-llee.luiss.it/download/). The (dark) blue line is the `BvD Orbis` (mean) median firm level labor share for these eight countries in our sample. Structurally higher `BvD Orbis` labor shares are due to diverging accounting standards (Kalemli-Özcan et al., 2024).

[1] `EU KLEMS` stands for EU level analysis of capital (K), labor (L), energy (E), materials (M) and service (S) inputs.

2.1 Firm level data

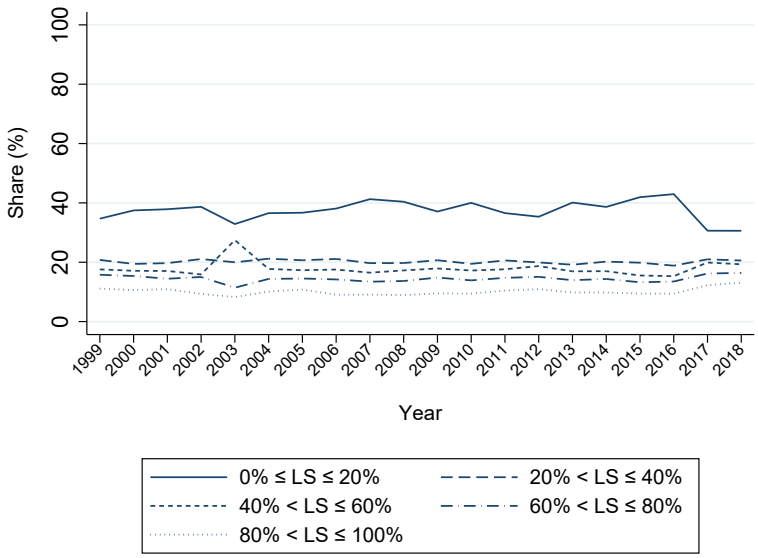
The data for our main sector-level analysis come from the `Bureau van Dijk's` (BvD) `Orbis` commercial database for European firms. This rich database comprises employment statistics, detailed balance sheet information and industrial sector affiliation for SMEs and large firms, reported with annual frequency. It covers all EA countries and is thus, despite some noteworthy shortcomings[2], the best publicly available dataset for comparing firm data across Europe over time (Kalemli-Özcan et al., 2024; Gopinath et al., 2017). Crucially, for our purpose, `BvD Orbis` provides firm reporting of total assets, equity, outstanding loans, sales, value added and cost of employees, the latter two of which are the basis to calculate firm level labor shares over the period from the introduction of the euro in 1999 until 2018. Figure 13 depicts spatial variations in the labor share at the NUTS-3 level, where we control for country-level fixed effects. Table 3 depicts industry variations in the labor share.

In addition, we collect information on firms' bank relationships, which has also been available in `BvD Orbis` since the 2010 vintage. Similar to balance sheet data, bank data comes from individual vintages of the database. We observe both firms with at least one house bank relationship (58% of firms) and firms with no bank relationship (42% of firms). For the analysis, we consider unconsolidated firm statements across the full range of corporate firms and industries. We follow Gopinath et al. (2017) to correct for basic reporting mistakes and omit firm-year observations that have missing data on their industry of activity. The main variables are winzorized at the 1% and 99% level to account for outliers. We keep only firms with at least 5 consecutive years of observations given our interest in the dynamic response to the monetary policy shock (Durante et al., 2022). After applying all data cleaning process, we are left with 2,171,524 firms and 15,086,800 firm-year observations for the sample period. Appendix B.1 describes our sample selection and data cleaning operations. Our baseline sample includes the eight EA members[3] (see also Figure 13).

We are interested in how firms' idiosyncratic labor share affects the firm-level pass-through of a monetary policy shock. Following Autor et al. (2020), we define the firm labor share as cost of employees divided by value added. We drop observations where the labor share exceeds one or is below zero and bin the universe of firms in five groups: Specifically, the first group consists of firms with a labor share $\leq p20$, the second group are firms with $p20 <$ labor share $\leq p40$, the medium group are firms with $p40 <$ labor share $\leq p60$, the fourth group are firms with $p60 <$ labor share $\leq p80$ and the fifth groups are firms with a labor share

[2]Such as increasing sample size over time and non-uniform national reporting requirements across countries.
[3]These are Austria, Belgium, Germany, Spain, Finland, France, Italy, and Portugal.

Figure 2: Share of outstanding debt by labor share group



Notes: The figure depicts the evolution of the average shares of total outstanding debt by labor share group from 1999-2018 (weighted by total assets). Computations are based on the full sample used in the estimations.

$> p80$. Figure 2 depicts the average debt shares by labor share groupings, showing that the total firm-level loan burden increases with capital-intensity. Summary statics and details are provided in Appendix 2.

2.2 Monetary policy shocks

Our employed monetary policy shocks for the EA as a whole are identified by and retrieved from Jarociński & Karadi (2020). These monthly shocks are relatively new, but at the same time quickly becoming the gold standard for identified EA monetary policy surprises because they can be interpreted as unanticipated changes in credit conditions. Rather than trying to control for confounding variables, these shocks address potential endogeneity of monetary policy by focusing on movements of prices in a narrow window around announcements.

Jarociński & Karadi (2020) provide evidence that it is not uncommon for the stock market to depreciate after markets are surprised with lower than expected policy rates (e.g., a surprisingly strong cut may sends the signal that the economy is in worse condition than previously expected by market participants). Specifically, as proxy for monetary policy shocks, the authors use the fed funds future surprise in the months when the stock price surprise had the opposite sign of the fed funds futures surprise. The shock proxy is zero otherwise. The authors call the approach Poor Man's sign restrictions and show that it yields similar results

to their sign restriction approach. The approach allows to disentangle information conveyed in the shocks about the European Central Bank's assessment of the economic outlook from its monetary policy decisions. Separating news about the state of the economy from changes in financing conditions are important for our paper because we specifically study the effect of changing credit conditions rather than the effect of changes in the state of the economy as a whole.

We sum up the monthly shocks to match the frequency of our annual firm level data (Holm et al., 2021). In our main specification, we take the sum of the last six months of the respective year. However, as a robustness exercise, we also consider i) the sum over the last three months and all twelve months of the respective year and ii) the alternative euro area monetary policy shocks proxies by Altavilla et al. (2019). See Section C in the Appendix for details.

2.3 Empirical Strategy

Our main econometric model focuses on the differential response in investment of different labor share firms to our exogenous measures of changes in monetary policy. We employ a local projection framework (Jordà, 2023) which allows us to estimate how a firm over horizon $h > 0$ responds to monetary policy shocks. An advantage of local projections is that each impulse response coefficient is estimated directly with a different regression which makes it less sensitive to misspecification. Since local projections are often subject to residual autocorrelation (Jordà, 2005; Lusompa, 2023), for $h > 1$, we add the residuals of the previous regression at $t + h - 1$, as additional regressor. Adjusting the model this way allows us to account for potential autocorrelation in the residuals. Therefore, our specification reads as follows:

if $h = 0$

$$\Delta_h y_{f,t-1} = \alpha_f^h + \gamma_t^h + \sum_{g=1}^{LS} \beta_g^h MP_t LS_t^g + \sum_{p=1}^{P} \theta_p^h \Delta y_{f,t-p} + \sum_{p=0}^{P} \mathbf{X}_{f,t-p} \mathbf{\Gamma}_p^h + \epsilon_{f,t+h}, \tag{1}$$

if $h > 0$

$$\Delta_h y_{f,t-1} = \alpha_f^h + \gamma_t^h + \sum_{g=1}^{LS} \beta_g^h MP_t LS_t^g + \sum_{p=1}^{P} \theta_p^h \Delta y_{f,t-p} + \sum_{p=0}^{P} \mathbf{X}_{f,t-p} \mathbf{\Gamma}_p^h + \epsilon_{f,t+h} + \epsilon_{f,t+h-1}, \tag{2}$$

where, on the left-hand side of Equation 1, $\Delta_h y_{f,t-1} = y_{f,t+h} - y_{f,t-1}$ denotes the long difference in fixed

assets. β_g^h captures the dynamic effects to monetary policy changes at horizon h of group g relative to the baseline group and is therefore our coefficient of interest. β_g^h captures the extent to which investment responds to changes in the monetary policy stance for firms with different labor-intensities of production relative to the baseline group. We use the following percentiles of the firm labor share as thresholds to sort our data into groups: p20, p40, p60, and p80 (pn denotes the n^{th} percentile). LS is the number of labor share groups. We interact our measure of monetary policy changes with an indicator variable for the respective labor share bin, LS_t^g, where the omitted category is firms with medium (40-60%) labor shares. The variable MP_t measures the change in the European Central Bank's monetary policy stance. To compute this change, we start from the monthly exogenous monetary policy shocks as per Jarociński & Karadi (2020), and aggregate them over different periods. In the main analysis, we aggregate these shocks over the past six months, but in robustness tests we also do so for three and twelve months, respectively. When interpreting the results from the regressions, higher values of the shock measure should be understood as monetary tightening. α_f controls for firm fixed effects which ensure that we are identifying within-firm variation in the labor share in response to exogenous changes in monetary policy. The term γ_t captures time fixed effects, which absorb any time-varying variation in business conditions as well as any time-varying shocks to demand or technology. We add lags of our dependent variable, $\Delta y_{i,t-p}$, to our model. $\mathbf{X}_{i,t-p}$ is a vector of additional controls which comprises country- and firm-specific controls. Country-specific controls include inflation, GDP growth, and the unemployment rate. We further want to control for the independent effect of firm-specific characteristics that may affect investment independently of labor-intensity of production in response to monetary policy. The literature has accounted for factors such as age (Cloyne et al., 2023; Durante et al., 2022), leverage (Ottonello & Winberry, 2020), liquidity (Jeenas, 2019), bank dependence (Holm-Hadulla & Thürwächter, 2021; Crouzet, 2021) and size (Gertler & Gilchrist, 1994; Popov & Steininger, 2023) to explain heterogeneous corporate sector responses to changes in monetary policy. The following empirical proxies are included: the $log(total\ assets)$ to control for firm size, firm age, $log(cash\ holdings)$ to control for liquidity, and the leverage ratio to control for bank dependence. Finally, we set the lag length $P = 2$ (see, e.g., Jordà et al., 2015; Durante et al., 2022). Finally, $\varepsilon_{f,t+h}$ is the idiosyncratic error term. In all applications, standard errors are clustered at the firm level.

3 Empirical results

3.1 Main finding

Figure A.1 presents the paper's headline findings, estimating the effect of monetary policy on firms' investment based on Equation 1. We find that the impact of monetary policy on investment is heterogeneous across bins of the functional income distribution. The point estimates on the bin interaction variables suggest that, relative to medium labor share firms, fixed capital stock decreases for labor intensive firms and increases for capital intensive firms following a monetary tightening. For instance, labor intensive groups' investment decreases by 0.5 percentage points on impact relative to the baseline, and relatively increases by almost 0.2 percentage points on impact for the least labor dependent firms. These effects are statistically significant at the 5% statistical level across the four-year horizon.

In contrast, the employment response follows a similar pattern but is more muted and largely statistically insignificant. Labor intensive firms exhibit a slight decline in employment in the first and third years after the shock, with no discernible effects thereafter. Low labor share – i.e. capital intensive – firms relatively reduce employment on impact but show an increase of 0.3 percentage points four years after the shock. Firms in the lower-medium and higher-medium labor share bins display no notable employment response over the four-year horizon relative to the baseline group.

These headline results are robust to the inclusion of country-industry, industry-time, and country-time fixed effects. By controlling for them, we make sure that our estimates are not biased by unobservable factors such as country-specific and industry-specific trends in technology or demand or firm idiosyncrasy as well as time-invariant heterogeneity in demand or technology across industries in the same country (see Table 3). However, due to the risk of overfitting, we proceed with the specification stated in Equ.2 and control for firm and year fixed effects. The Appendix Figure 21 contains the robustness exercise.

To summarize, our main findings strongly support the hypothesis that contractionary monetary policy is associated with a decrease in fixed asset stock of firms with labor intensive production as well as an increase in investment of firms with capital intensive production, compared to medium labor share firms. The opposite applies for monetary easing. Although investment responses vary based on the labor intensity of production, we do not observe similar patterns in firms' employment decisions. This suggests that monetary policy has a differential impact on investment, depending on the firm's functional income distribution, but it does not

strongly affect employment choices of labor dependent firms.

3.2 Firms' labor obligations as financial constraint

In this section, we complement the main results with evidence on firms' financial decisions in response to changes in monetary policy. What is the main mechanism whereby labor intensive production decreases investment relatively more than capital intensive production as funding conditions tighten? We emphasize the role of labor as firm 'leverage' and resulting restrictions in firm borrowing as potential mechanism.

To address the role of firm borrowing, we study how market credit interacts with the differential effect of monetary policy on investment. In a bank-based economy such as the euro area, monetary policy mostly transmits into real economic activity via the bank lending channel. Therefore, it is straightforward to hypothesize that access to credit may play a key role. We highlight that it is essential to consider both outstanding credit and cash flow, as novel research has indicated that balance sheet composition plays a crucial role for firms' borrowing constraints (Lian & Ma, 2021; Favilukis et al., 2020; Diamond & He, 2014). First, we look at the response of firm level cash flow and financial performance indicators and explore the operating principles whereby monetary transmits to firm investment differently, depending on the labor-intensity of production. Second, we explicitly study the role of the bank lending channel for our results by looking at differences in behavior between firms with good bank relationships vs. banks with no house bank relationship. Results are depicted in Appendix A.2.

3.2.1 Firm dynamics

We estimate a variant of Equation 1 where the dependent variable is the year-on-year change in firm level cash flow, total debt, long-term debt and ROA using the same firm level data from `Orbis`. Figures 5 and 6 show the response of cash flows and firms' ROA, respectively. The results strongly suggest that changes in the labor share are mirrored by changes in financial performance indicators and cash flow from firms' operations. In particular, high labor share firms see their cash flows and ROA reduced in response to monetary tightening and relative to medium labor share firms while capital intensive firms react by increasing their ROA and cash flow. These results indicate that cash-flow based lending is impaired for high labor share firms. As monetary policy tightens, those firms see their cash flows reduced by more relative to the baseline group. In turn, borrowing constraints rise and investment reduces. We complement this finding by splitting our

sample among high EBITDA and low EBITDA firms. Figure 10 shows the differential investment response for each split. We argue that for firms with high cash flows, cash-flow based lending is the major source of credit. The results underline our hypothesis as the labor share introduces heterogeneity within the sample of high EBIDTA firms. Firms with low EBITDA, however, do not experience much heterogeneity with respect to the labor in the response to monetary tightening. Interestingly, in support of our hypothesis, within the group of low EBIDTA firms, those firms with the highest labor share react significantly different to the baseline group and reduce investment in response to the shock.

Figure 7 displays the differential response of total debt. We do not find evidence for heterogeneity in the effect of changes in monetary policy on outstanding total loan volumes for low-labor share groups. However, high labor share firms significantly decrease their total outstanding loans in response to monetary tightening relative to the baseline group. Similarly, high labor share firms significantly reduce their long-term debt in the first year after the shock. At the same time, low labor share firms, i.e. capital intensive firms, follow a different pattern whereby they increase their long-term debt relative to to medium labor share firms (Figure 8).

The evidence thus suggests that, with monetary tightening, labor intensive firms lower their investment, ROA, and cash flow, and this is accompanied by a lower propensity to take on risky long-term debt. The opposite reaction of long-term debt to changes in monetary policy by labor-intensity groups supports the notion that debt responds to the cost of external market finance and that firms with rigid payroll obligations make other financial commitments (i.e., interest payments) less likely. The finding is consistent with existing theories that suggest that high labor share firms tend to opt for lower long-term debt (Campello, 2006; Favilukis et al., 2020). We explore the role of these balance sheet alterations after monetary policy changes in the context of bank lending in the next subsection.

3.2.2 Labor obligations and bank-lending

In order to provide supportive evidence of the labor share as financial constraint, we study the bank lending channel more explicitly by investigating the role of banking relationships. While it may be challenging to distinguish between the effects of demand for credit on the one hand and credit availability on the other hand, we present some evidence regarding the latter. To accomplish this, we split the sample into two groups: firms with good bank relationships and others with no house bank relationship. The idea is that

firms with established bank relationships will face the same demand for credit, on average, compared to otherwise similar firms with poor/non-existing established bank relationships. However, we reason that the likelihood of banks offering credit to firms may depend upon their information and personal relationship with the firm. Therefore, banks will be more likely to grant loans to firms they already know and have good relationships with, holding other factors constant (Boot & Thakor, 2000). Our prior is that this setup allows for a sizable and plausible measure of the differences in credit supply, especially because Europe is known to be a bank-based (rather than market-based) economy (Beck & Levine, 2002).

The results from this sample split exercise are depicted in Figure 9. We observe that for firms with established bank relationships, investment does not vary much with respect to the labor intensity of production. While low labor share firms experience a significant decrease in investment following monetary tightening and relative to the baseline group, the remaining groups do not show any differences in response. At the same time, there is significant heterogeneity in the investment response to monetary tightening for firms without a reported house bank relationship. These findings suggest that the fall in investment after contractionary monetary policy is more substantial for firms without easy access to banking services, and where we expect reduced availability of credit. We therefore feel strongly supported in our hypothesis that firms can mitigate the negative impact of high labor obligations following contractionary demand shocks if they have adequate access to finance.

3.3 Other channels of firm financial constraints

Collateral quality, age, size, idiosyncratic risk as well as liability structure are important for monetary transmission to the firm as they might constitute financial constraints. In particular, research shows that age, size and leverage are potent proxies for firms' financial constraints (Cloyne et al., 2023; Gertler & Gilchrist, 1994; Krusell et al., 2023; Jeenas, 2019; Ottonello & Winberry, 2020; Popov & Steininger, 2023). Those constraints matter to firms as they determine their access to external finance, credit conditions, and loan eligibility and thereby, strongly impact their response to monetary policy. First, we examine the correlation between firms' labor share and other indicators of financial constraints to ensure that our results are not influenced by other variables. Second, we assess whether financially constrained firms respond differently compared to those that operate with greater financial independence.

We want to test whether those characteristics are underlying factors that drive our results of firms' differ-

ential response to monetary policy. For this purpose, we compute the correlation coefficients of our measure of firms' labor share with age, size, and financial leverage. In Table 1, we show that the correlation of firms' labor share with other firm characteristics is low. The correlation coefficients between the labor share and leverage and size are 0.12 and 0.16, respectively. In particular, the coefficient between the labor share and age is remarkably low (0.03) (Krusell et al., 2023). We additionally provide information on the correlation between other firm characteristics. Correlation between size and age (0.27) as well as leverage and age (0.23) in our sample are sizeable while the labor share does not seem to be highly correlated with other metrics. We additionally provide scatter plots in Section C.3. The plots show additional evidence that our results are not driven by other firm characteristics. The likely reason is that labor shares are more idiosyncratic to the business model and thus unlikely to reflect other characteristics relevant to financial constraints. These statistics strengthen our confidence in the analysis as they suggest that the labor share is indeed a relevant metric to examine when it comes to understanding the financial constraints of companies expanding on the constraints already well known in the literature.

	Labor Share	Age	Size	Leverage Ratio
Labor Share	1.00			
Age	0.0345	1.00		
Size	-0.1575	0.2715	1.00	
Leverage Ratio	0.1220	-0.2312	-0.0969	1.00

Table 1: Correlation coefficients based on the full sample.

In the following, we assess how our results relate to other firm-level financial constraints to illustrate how firms that are already constrained respond relative to those operating more independently. This improves our understanding of the differential effect of monetary policy and underlying mechanisms of transmission. In Figure 11 in Section A.2, we split our data along dimensions age and size. Both age and size serve as proxies for financial constraints (Cloyne et al., 2023; Gertler & Gilchrist, 1994; Krusell et al., 2023; Popov & Steininger, 2023) and are well-established in the literature. We estimate Equation 1 for each sample spit.

We find that vulnerable firms – these are, on average, young or small firms – are not driving our headline investment results (see Figures 10, 11 and 12 in Section A.2). The differential response is strong, however, among more mature and large firms. Those firms experience more heterogeneity in their response according to their level of the labor share. More specifically, among old and large firms, we see that high labor-share firms reduce investment relative to medium labor-share firms while high-capital firms increase investment

in response to a monetary policy contraction. Our study, therefore, complements existing work in showing that high labor shares operate as a type of financial constraint that affects foremost firms that are already close to or at their optimal levels of capital (Wolf, 2021, 2023).

4 Discussion

Our estimates indicate that when facing negative demand shocks, capital intensive firms – those with a low labor share – fare better than labor intensive firms and and better avoid the contractionary impact of such tightening shocks. In the following, we discuss how labor's "specialness" imposes limitations on firms' borrowing. Spelling out this argument enables us to contemplate the impact of monetary policy-induced changes in external debt accessibility for non-financial businesses, and how this impact might differ based on labor obligations.

4.1 Labor's 'specialness': An asset-based constraint

Like much of the existing literature suggests, borrowing constraints indicate that a borrower's capacity to take on debt is restricted due to underlying impediments. We attribute our findings to variations in borrowing constraints, which stem from differences in asset tangibility and the cost structures of firms due to labor obligations. Specifically, labor is different from capital in the sense that it cannot be pledged as collateral against loans due to property rights. Similarly, it is a type of financial obligation that cannot be sold off or diversified quickly (unlike financial leverage, for instance), which implies that the present value of labor declines sharply in the face of higher interest rates (Favilukis et al., 2020; Merz & Yashiv, 2007). As a result, monetary tightening renders high labor share firms more vulnerable compared to high capital share firms, who may use their capital to re-finance their position to escape liquidity strains. In line with this argument, we find that high labor share firms decrease their long-term borrowing, cash flow and financial performance, and grow at a lower rate compared to their low labor share peers as demand dries up. Our analysis offers valuable insights into how a firm's response to changing costs of capital may be influenced by the idiosyncratic labor share: this type of financial constraint primarily affect non-financial firms with riskier cost structures in the shape of labor obligations via the bank-lending channel. The channel operates through alterations in the value of capital and corporate profits, and implies that a high labor share of production is especially valuable when interest rates decrease and demand is on the rise (Bouvard

& De Motta, 2021). Therefore, high labor obligations tend to amplify the overall influence of monetary policy shocks on the spending behavior of borrowers when organizational and technological choices generate path-dependencies. Although intentionally simplified, we provide a verbal discussion of the related 'labor leverage' in the following.

4.2 'Labor leverage': A cash-flow-based constraint

Another logical candidate to explain these findings is the fact that the labor-intensity of production is a primary factor affecting a company's undiversiviable risk, as high ex-ante labor obligations lead to an inflexible cost framework that is typically not readily adaptable to fluctuations in demand (Bouvard & De Motta, 2021) or supportive of taking on new commitments such as higher interest payment (Favilukis et al., 2020). Because of the smoothness of the labor share and the high input factor complementary in the European economy, non-financial firms with high labor-intensity of production can be expected to have higher idiosyncratic risk, a lower tangibility of assets, and more monetary policy-responsive pricing of equity and debt: The reason is that, analogous to financial leverage, high labor shares lead, on average, to lower cost of production because variable costs are lower and fixed costs (labor costs) are higher during good times when demand is strong. However, after a negative demand shock such as monetary policy tightening, the higher fixed costs of the wage bill render such firms more vulnerable (Bouvard & De Motta, 2021) and prone to liquidity strains. In this way, high labor share firms' balance sheet composition and cost structure are more vulnerable to negative demand shocks (Donangelo et al., 2019). Similarly, existing empirical research suggests that they tend to have a high labor-intensity induced form of operating leverage (Bouvard & De Motta, 2021; Donangelo et al., 2019; Favilukis et al., 2020; Merz & Yashiv, 2007). Empirically, it has been shown that, on average, high labor share firms take on less financial leverage (Favilukis et al., 2020). See Figure 2 but also Table B.3 and Section 3.3 for a rough account of the empirical financial leverage-labor share relationship. It follows that financial constraints increase with labor compensation as a share of value added.

❄

In the transmission of monetary policy, cash flow constraints are typically considered more influential in bank lending decisions than asset-based constraints, at least in the US (Lian & Ma, 2021). Additionally,

it is reasonable to expect that monetary policy primarily affects the European economy through credit markets given that Europe is a bank-based economy. It is hence not surprising that we find that, in a currency union where monetary policy predominantly impacts funding conditions through bank lending channels, firms reliant on labor with higher labor-related vulnerability as well as rigid financial commitments react more vigorously to alterations in monetary policy compared to capital intensive firms with otherwise similar default probabilities. In particular, both asset-based constraints as well as cash flow from operations seems to have a vast role in the transmission, and render firms with high labor obligations more financially constrained. Perhaps surprisingly, we find that the firms most strongly affected by monetary policy are firms that otherwise face *low* constraints: in particular, the labor share appears to be important when it comes to explaining differential behavior of mature, large, cash-rich firms.

Conceptualizing the linkage between real and financial variables may offer a way for understanding the role of monetary policy within a scenario of heterogeneous labor shares. High operating leverage, such as a labor leverage, can magnify the impact of monetary policy shocks on profits because firms cannot easily adjust to demand shocks. This conversation implies that macro-models could be expanded to encompass scenarios where financial constraints are influenced in varying degrees by labor dependence. Monetary policy-induced fluctuations could impact firm profits, the amount of available capital for businesses, the capacity of banks to offer loanable funds, considering regulatory requirements for loan risk treatment, or a combination of these mechanisms. Consequently, companies with substantial capital investments and less rigid costs would experience more significant advantages from higher interest rates, especially when the transmission of monetary policy to the real economy through bank balance sheets is more seamless.

5 Conclusion

The academic consensus is that labor market frictions are higher in Europe compared to the US (Wasmer, 2006). This fact provides an excellent setup to study the emergence of financial constraints of firms due to high labor shares of production and in the conduct of monetary policy. Understanding the transmission of demand shocks conditional on the labor-intensity of production is also an important question for inequality, firm level dynamics, wages, and productivity as these are all aspects that matter for economic welfare, the business cycle (Caggese et al., 2019; Grazzini & Rossi, 2023), and inflation (Sbordone, 2002). We are first to study this.

We present evidence on the cyclical behavior of labor intensive versus capital intensive firms in response to monetary policy in the euro area. Our goal is to take a step toward quantifying the effect of demand shocks on investment in the business cycle from the perspective of the firm, as well as the role of credit market imperfections in the light of factor input rigidity. For this purpose, we employ firm level data from `Orbis` for eight EA members during two decades after the introduction of the euro (1999–2018). We employ recent high-frequency identified monetary policy shocks by Jarociński & Karadi (2020) to circumvent concerns that monetary policy may respond endogenously to the business cycle.

Our main finding is that contractionary monetary policy is associated with decreased fixed capital stock by labor intensive firms relative to capital intensive ones. Importantly, not only do their capital stock shrink, but also cash holdings and financial performance decline relatively more for firms with high labor shares in the onset of tight monetary policy. We do not document an effect on firm-level employment. In a monetary union, such as the euro area, this implies that transmission is stronger to countries with a larger share of labor in production. Moreover, monetary policy may become less potent following declines in the labor share.

We hypothesize that this is a story about capital: the transmission of monetary policy is due to changes in access to bank credit due to cashflow- as well as asset-based borrowing constraints of high labor share firms. In support of this hypothesis, we show that the underlying effect is one whereby high labor share firms decrease their levels of long-term debt in response to higher policy rates relative to low labor share firms which increase their long-term debt.

The proposed mechanism is that labor intensive firms face greater difficulty accessing external finance due to their cost structure. A significant portion of their costs are fixed in the short term, making it harder to adjust labor in response to changing economic conditions. This creates operating leverage, whereby small changes in revenue result in disproportionately large swings in profits. labor intensive firms are also more exposed to idiosyncratic risks, such as wage fluctuations, strikes, or labor shortages, which make profitability more volatile. Additionally, these firms typically possess fewer tangible assets, like machinery or property, that can be used as collateral, leading to collateral impairment. The combination of lower collateral value, heightened idiosyncratic risk, and reduced tangibility makes labor intensive firms appear riskier to banks, limiting their access to loans and increasing their sensitivity to monetary policy changes. Overall, these results suggests that high interest rates are to the detriment of labor intensive firms which have relatively

lower present value of assets, more risky business models, and higher 'labor leverage' (Bouvard & De Motta, 2021; Donangelo et al., 2019).

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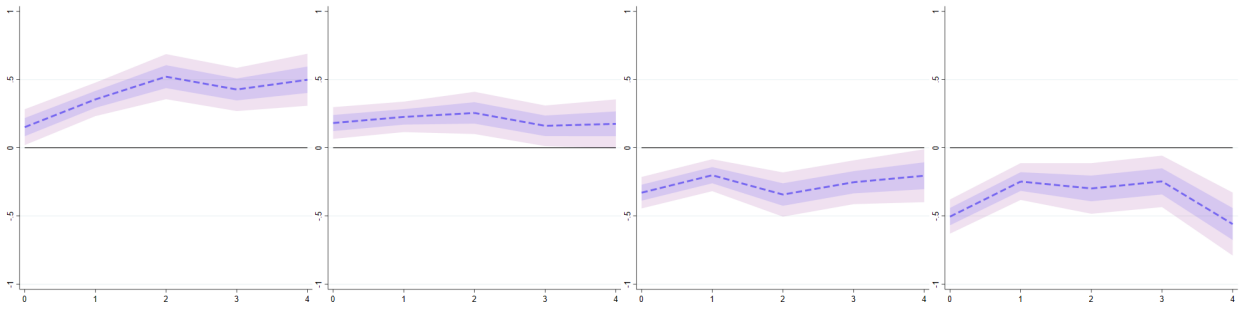
Appendix A Figures

A.1 Firms' labor share & monetary policy: Headline results

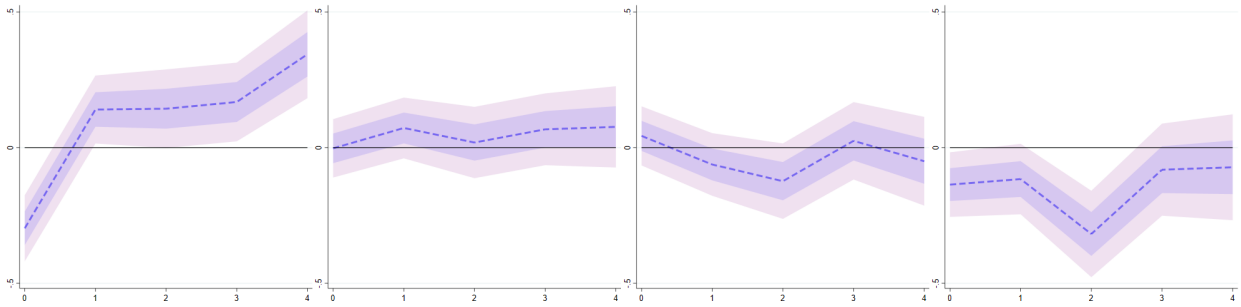
Figure 3: Differential investment response



(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level investment response to a one standard deviation monetary policy tightening shock according to the firm's labor share relative to the baseline (40% - 60%). It shows the cumulative log-change in fixed assets between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

Figure 4: Differential employment response

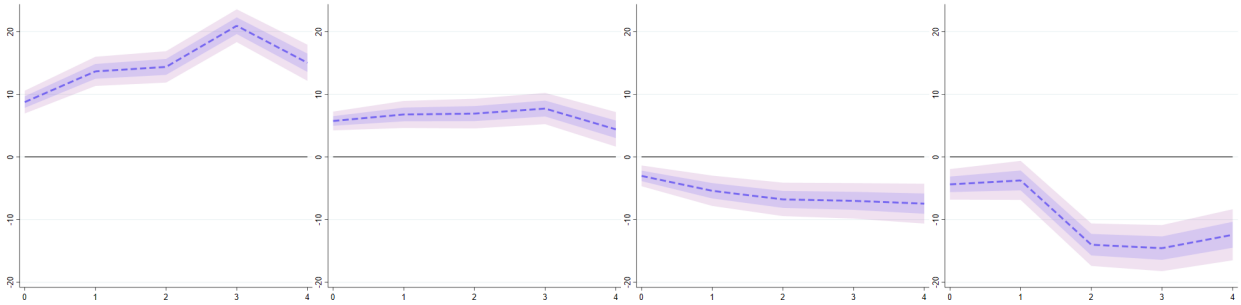


(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level employment response to a one standard deviation monetary policy tightening shock according to the firm's labor share relative to the baseline (40% - 60%). It shows the cumulative log-change in employment between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

A.2 Firms' labor share & monetary policy: complementary findings

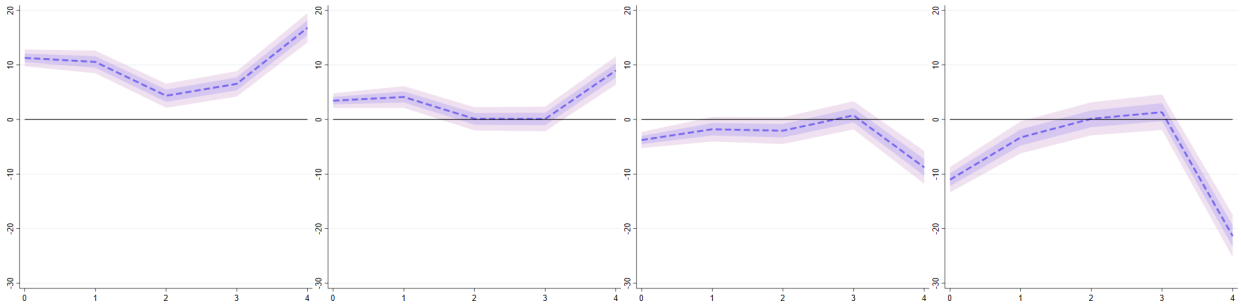
Figure 5: Differential cash flow response



(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level cash flow response to a one standard deviation monetary policy tightening shock according to the firm's labor share relative to the baseline (40% - 60%). It shows the cumulative log-change in cash flow between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

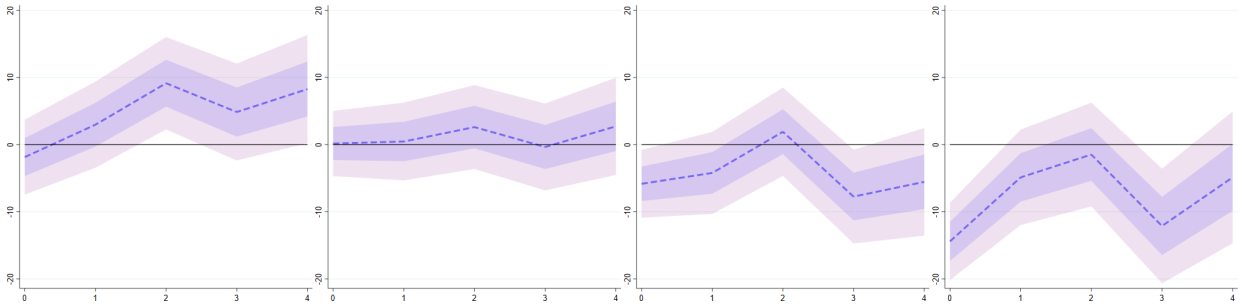
Figure 6: Differential ROA response



(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level ROA response to a one standard deviation monetary policy tightening shock according to the firm's labor share relative to the baseline (40% - 60%). It shows the cumulative log-change in cash flow between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

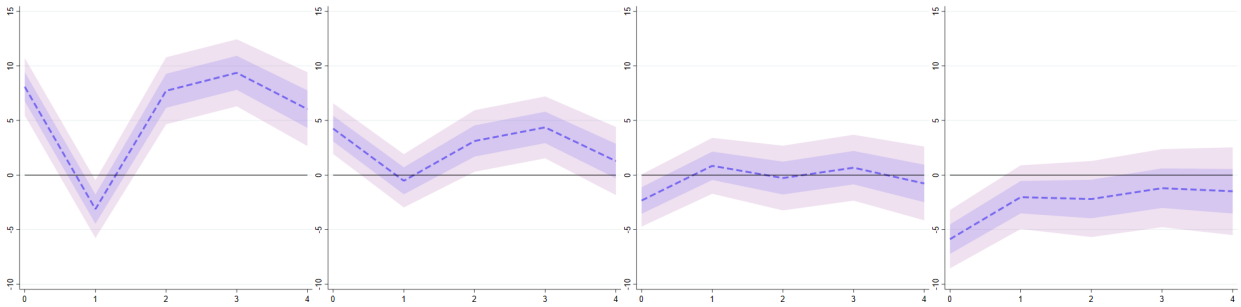
Figure 7: Differential total debt response



(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level loans response to a one standard deviation monetary policy tightening shock according to the firm's labor share relative to the baseline (40% - 60%). It shows the cumulative log-change in loans between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

Figure 8: Differential long-term debt response

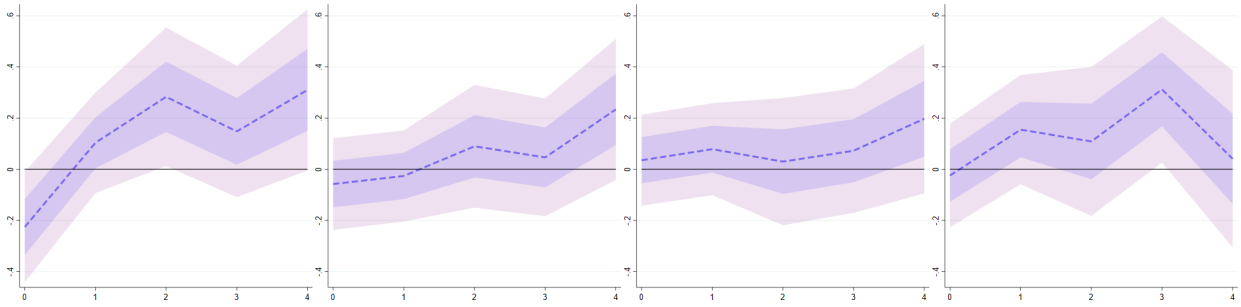


(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level non-current liabilities response to a one standard deviation monetary policy tightening shock according to the firm's labor share relative to the baseline (40% - 60%). It shows the cumulative log-change in non-current liabilities between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

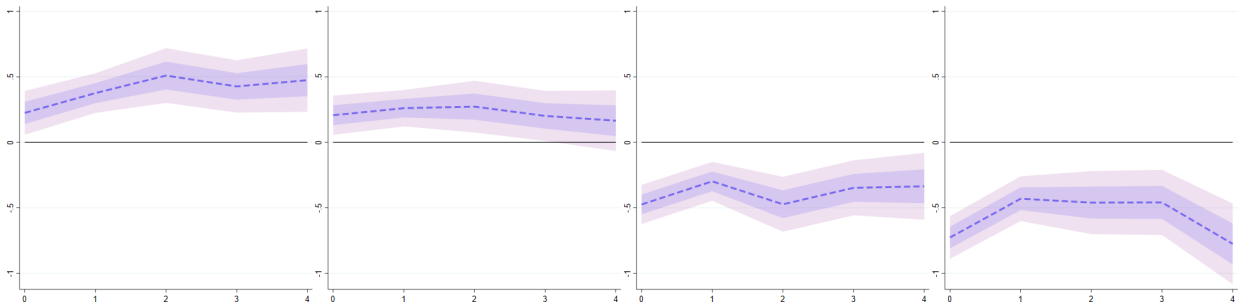
Figure 9: Monetary policy and firms' labor share – Bank lending channel

Differential investment response – **relationship banking**



(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Differential investment response – **no relationship bank**

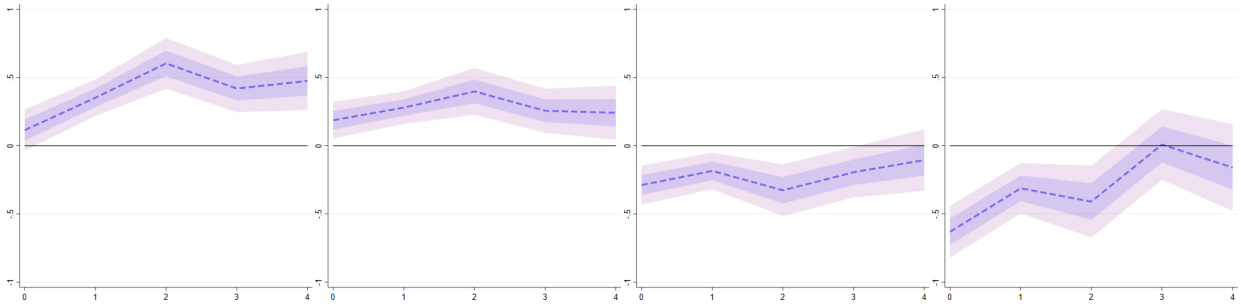


(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level investment response to a one standard deviation monetary policy tightening shock according to the firm's labor share relative to the baseline (40% - 60%) for firms. The sample is split into (a) firms reporting a 'house bank' relationship and (b) firms with no house bank in the bottom panel. It shows the cumulative log-change in fixed assets between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

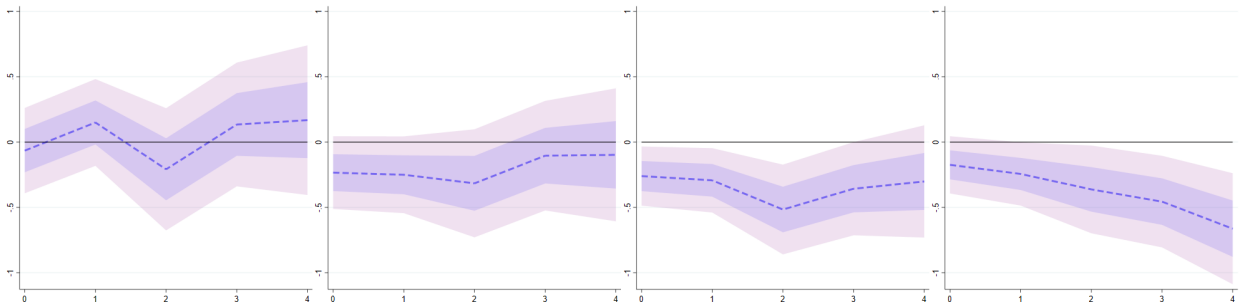
Figure 10: Monetary policy and firms' labor share – sample split by EBITDA

Differential investment response – **high EBITDA**



(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

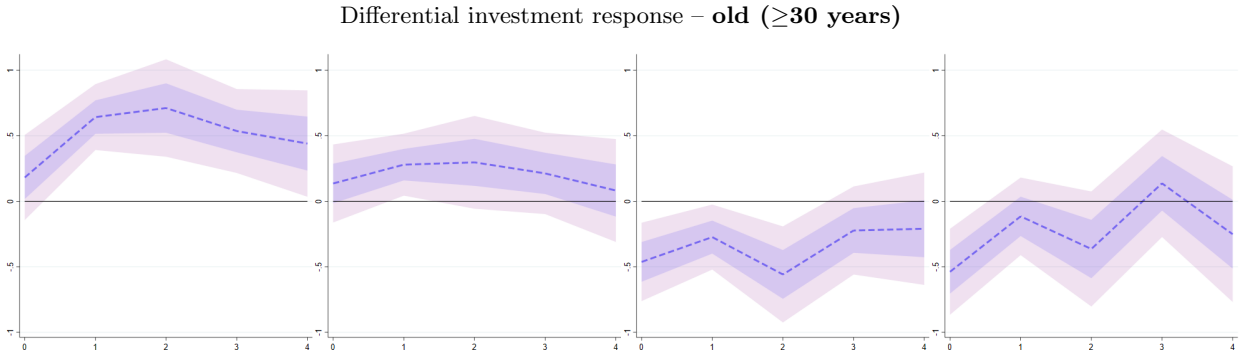
Differential investment response – **low EBITDA**



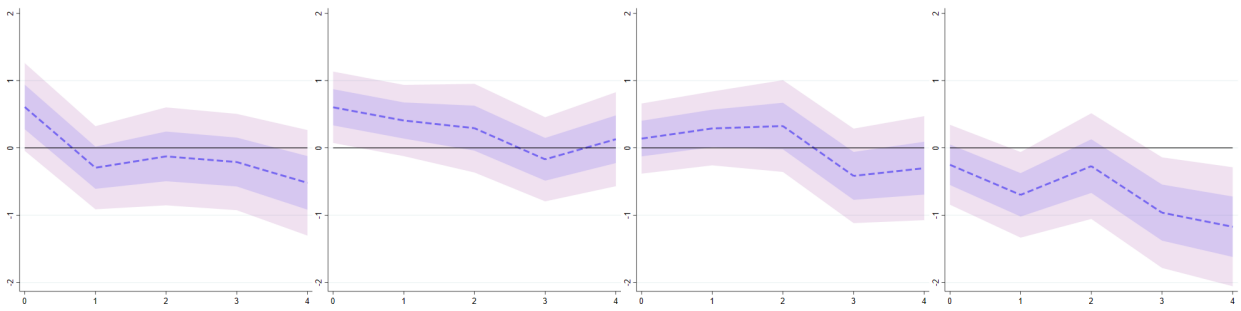
(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level investment response to a one standard deviation monetary policy tightening shock according to the firm's labor share relative to the baseline (40% - 60%) for firms. The sample is split into (a) firms reporting an above median EBITDA (b) firms with below median EBITDA in the bottom panel. It shows the cumulative log-change in fixed assets between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

Figure 11: Monetary policy and firms' labor share – sample split by age



(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

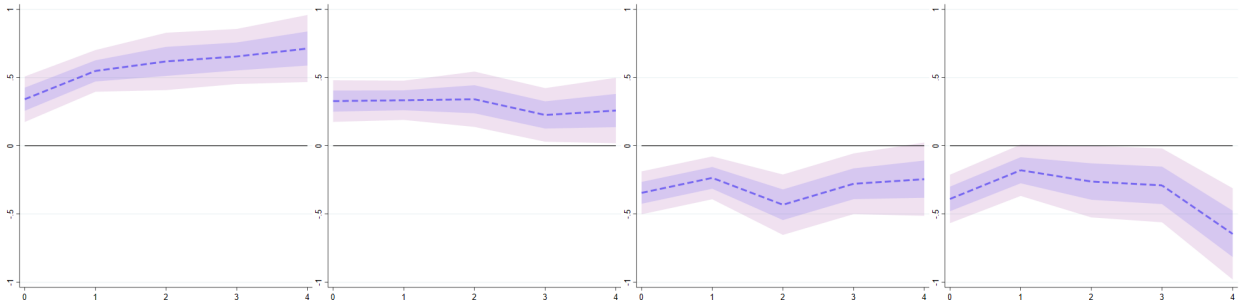


(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level investment response to a one standard deviation monetary policy tightening shock according to the firm's labor share relative to the baseline (40% - 60%) for firms. The sample is split into (a) old firms ($\geq$ 30 years) and (b) young firms ($\leq$ 5 years) in the bottom panel. It shows the cumulative log-change in fixed assets between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

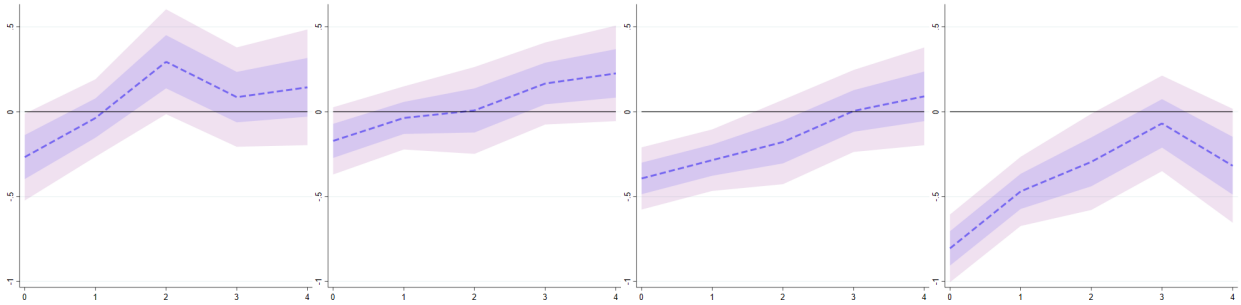
Figure 12: Monetary policy and firms' labor share – sample split by size

Differential investment response – **large firms**



(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Differential investment response – **small firms**



(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level investment response to a one standard deviation monetary policy tightening shock according to the firm's labor share relative to the baseline (40% - 60%) for firms. The sample is split into (a) small firms ($<$ 50 employees) and (b) large firms ($\geq$ 50 employees) in the bottom panel. It shows the cumulative log-change in fixed assets between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

Appendix B Data

B.1 Sample Selection

For data cleaning purposes, we follow the procedures as outlined in Kalemli-Özcan et al. (2024) and Durante et al. (2022):

- We keep only corporate industry firms. By doing so, we drop financial institutions like banks and insurance companies, foundations, funds, private equity and venture capital firms, as well as public authorities, states and governments.
- We keep only unconsolidated company data, i.e. when their consolidation code is U1 or U2.
- We drop observations that have missing information on identifiers and closing dates.
- We identify and drop duplicate entries. If firms report multiple times per year, only their reported data as at 31st of December is kept.
- We drop firms that report negative total assets, negative employment, employment larger than than 2 million employees, negative sales, or negative fixed fixed assets.
- Firm-year observations are omitted if total assets equals zero, firm age is negative, and fixed assets is missing, negative, or zero. Moreover, observations are discarded when fixed fixed assets is missing or negative, and infixed fixed assets is negative. Observations with simultaneously missing data on total assets, operating revenue, sales and employment are also dropped.

We proceed further with the data cleaning process according to Gopinath et al. (2017). The following steps correct for basic reporting mistakes:

- We drop firm-year observations that have missing data on their industry of activity.
- We drop observations if they contain missing values, zero, or negative values on material costs or total assets.
- Next, we construct the following ratios and estimate their distribution by country. We exclude from our analysis extreme values by trimming observations below the 0.1st percentile or above the 99.9th percentile.

- Sum of fixed fixed assets, infixed fixed assets, and other fixed assets as ratio of total fixed assets.
- Sum of fixed assets, and current assets as a ratio of total assets.
- Sum of long term debt and other non-current liabilities as a ratio of total non-current liabilities.
- Sum of loans, creditors, and other current liabilities as a ratio of total current liabilities.
- Sum of non current liabilities, current liabilities, and shareholder funds as a ratio of the variable that reports the sum of shareholder funds and total liabilities.

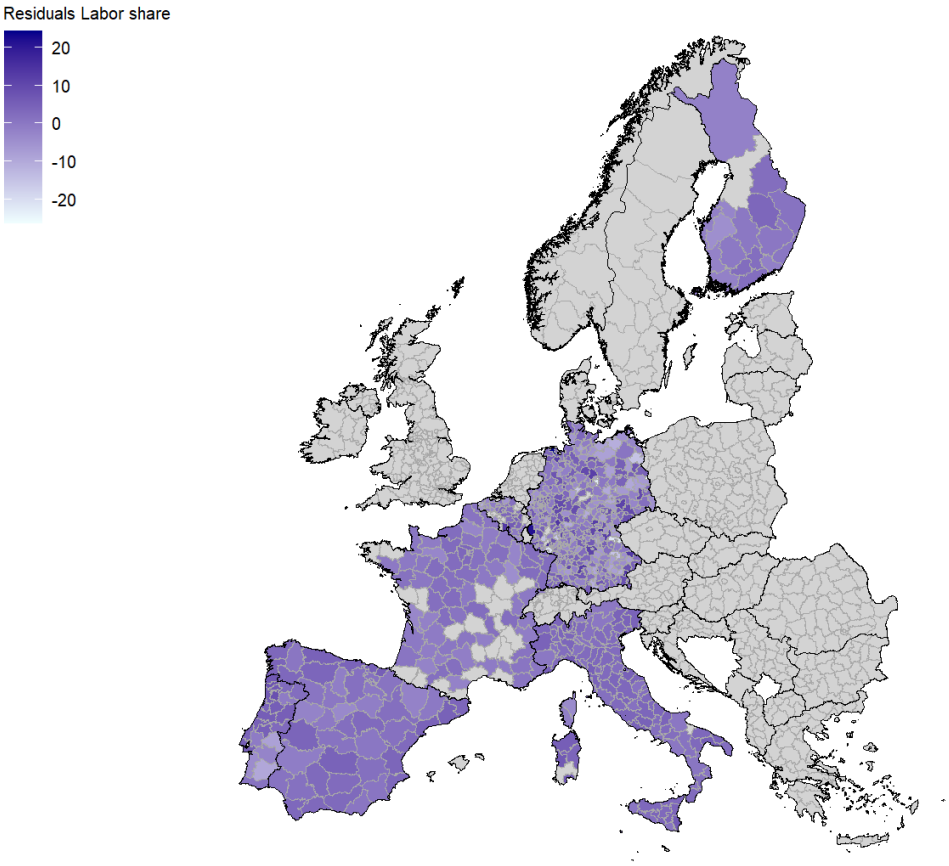
Additionally, we winsorize the following variables at the 1st and 99th percentile: added value, operating revenue, material costs, total assets, shareholders' funds, fixed assets, fixed fixed assets, other fixed assets, total liabilities (defined as total assets minus shareholders' funds), and labor share (defined as costs of employees divided by added value, multiplied by 10). We replace negative values of cash and cash equivalents with missing values. We generate cash-to-total assets ratios (CCE/total assets) and replace them with missing values if they are larger than 1. We generate working capital-to-total assets (WC/total assets) ratios and replace them with missing values if they are smaller than -1 and larger than 1. We generate leverage ratios by dividing total liabilities by total assets. We generate profitability ratios by dividing EBITDA by operating revenue. We only keep firms in our dataset that report for at least 5 consecutive years. We create a variable for the labor share by dividing costs of employees by added value and then multiplying by 100. Before that, we replace zeros and missing values in added value and costs of employees with 0.1. We drop observations if labor share is negative. Lastly, we define returns on assets (ROA) as EBITDA divided by total assets and calculate the gross profit margin by taking the difference between operating revenue turnover and costs of goods sold divided by operating revenue turnover.

	N	Mean	Median	Std	Min	p5	p95	Max
Total assets	15086800	4185154.1	796552.00	10905905	12634	80901	19879100	67734817
Fixed assets	15086800	1603183.2	194143.00	5032786.2	297	7031	7276903	33876000
Cash	14677488	783289.75	44720.00	81815588	0	834	1441694	2.900e+11
Non current liabilities	15056894	1351020	105437.00	9933559.7	30	3586	3467000	3.461e+08
Long-term debt	15070109	755022.17	27394.00	5980714.2	0	0	1939584	2.187e+08
Current liabilities	15056654	2480348.4	338728.50	13103038	504	20822	8052151	4.052e+08
Loans	15066484	396152.4	1620.00	2312446.4	0	0	1461000	69062000
Working capital	14973947	1573373.7	122925.00	2.938e+08	-1.060e+11	-95236	4563628	1.120e+12
Operating revenue turnover	14946522	4364449.4	881000.00	11158262	0	85000	21359113	68117435
Sales	14828005	9457421.6	857826.00	5.138e+08	0	76300	20688085	1.670e+12
Costs of goods sold	1498710	3372603.7	208536.50	22550908	-97450	772	9397657	7.536e+08
Costs of employees	15086800	1427958.7	183448.00	1.462e+08	0	12596	3577000	5.540e+11
Cashflow	15049490	823339	45682.00	94120306	-3.478e+09	981	1345761	3.400e+11
Added value	15086800	1261464.2	283288.00	3283731.9	-122217	31100	5764116.5	21765000
Ebitda	15057975	845146.73	65577.00	77014875	-1.660e+10	2652	1689000	2.650e+11
Number of employees	11716348	37.32	7.00	612.98	0	1	107	791678
Firm age	14928688	15.39	12.00	13	0	2	40	150
Labor share	15086800	66.06	71.47	23.37	0	16.52	94.77	100
Cash/TA	14662615	.13	0.06	.16	0	0	.48	1
Working capital/TA	14927045	.24	0.21	.27	-1	-.12	.74	1

Table 2: Summary statistics firm-level data

B.2 Spatial distribution of labor shares

Figure 13: Labor Shares across Euro Area Regions



Notes: The image displays the residual of a simple regression of sample averages of aggregated labor shares on country-level fixed effects of NUTS-3 regions for our sample in 2016. Dark blue colors mark regions with (very) high labor shares, light blue colors mark regions with (very) low labor shares controlling for country-level fixed effects. Teal-colored areas are either missing NUTS-3 data or not part of our sample.

B.3 Labor share by industry

Table 3: Labor Share by two-digit NACE Code

Labor share	NACE code	Industry
0.30	06	Extraction of crude petroleum and natural gas
0.33	35	Electricity, gas, steam and air conditioning supply
0.41	68	Real estate activities
0.47	64	Financial service activities, except insurance and pension funding
0.49	77	Rental and leasing activities
0.51	19	Manufacture of coke and refined petroleum products
0.51	07	Mining of metal ores
0.52	12	Manufacture of tobacco products
0.52	11	Manufacture of beverages
0.53	01	Crop and animal production, hunting and related service activities
0.53	09	Mining support service activities
0.53	92	Gambling and betting activities
0.54	36	Water collection, treatment and supply
0.56	59	Motion picture, video and television programme production, sound recording and music publishing activities
0.56	08	Other mining and quarrying
0.57	50	Water transport
0.59	21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
0.59	60	Programming and broadcasting activities
0.59	38	Waste collection, treatment and disposal activities; materials recovery
0.60	55	Accommodation
0.60	93	Sports activities and amusement and recreation activities
0.60	70	Activities of head offices; management consultancy activities
0.60	61	Telecommunications
0.60	41	Construction of buildings
0.61	05	Mining of coal and lignite
0.62	02	Forestry and logging
0.62	20	Manufacture of chemicals and chemical products
0.62	46	Wholesale trade, except of motor vehicles and motorcycles
0.63	51	Air transport
0.63	99	Activities of extraterritorial organisations and bodies
0.64	74	Other professional, scientific and technical activities
0.64	66	Activities auxiliary to financial services and insurance activities
0.64	03	Fishing and aquaculture
0.65	37	Sewerage
0.65	90	Creative, arts and entertainment activities
0.65	82	Office administrative, office support and other business support activities
0.65	72	Scientific research and development
0.66	24	Manufacture of basic metals
0.66	17	Manufacture of paper and paper products
0.66	73	Advertising and market research
0.66	23	Manufacture of other non-metallic mineral products
0.66	22	Manufacture of rubber and plastic products
0.67	86	Human health activities
0.67	10	Manufacture of food products
0.67	52	Warehousing and support activities for transportation
0.67	14	Manufacture of wearing apparel
0.68	26	Manufacture of computer, electronic and optical products
0.68	30	Manufacture of other transport equipment
0.68	15	Manufacture of leather and related products
0.68	47	Retail trade, except of motor vehicles and motorcycles
0.68	58	Publishing activities
0.68	13	Manufacture of textiles
0.68	71	Architectural and engineering activities; technical testing and analysis
0.68	27	Manufacture of electrical equipment
0.68	32	Other manufacturing
0.69	39	Remediation activities and other waste management services
0.69	79	Travel agency, tour operator and other reservation service and related activities
0.69	94	Activities of membership organisations
0.69	16	Manufacture of wood and of products of wood and cork, except furniture; articles of straw and plaiting materials
0.69	84	Public administration and defence; compulsory social security
0.69	28	Manufacture of machinery and equipment n.e.c.
0.70	42	Civil engineering
0.70	29	Manufacture of motor vehicles, trailers and semi-trailers
0.71	49	Land transport and transport via pipelines
0.71	63	Information service activities
0.71	65	Insurance, reinsurance and pension funding, except compulsory social security
0.71	45	Wholesale and retail trade and repair of motor vehicles and motorcycles
0.71	91	Libraries, archives, museums and other cultural activities
0.71	18	Printing and reproduction of recorded media
0.71	25	Manufacture of fabricated metal products, except machinery and equipment
0.71	62	Computer programming, consultancy and related activities
0.73	75	Veterinary activities
0.73	31	Manufacture of furniture
0.73	96	Other personal service activities
0.73	33	Repair and installation of machinery and equipment
0.74	95	Repair of computers and personal and household goods
0.74	56	Food and beverage service activities
0.74	69	Legal and accounting activities
0.75	85	Education
0.75	43	Specialised construction activities
0.76	53	Postal and courier activities
0.77	97	Activities of households as employers of domestic personnel
0.79	87	Residential care activities
0.80	81	Services to buildings and landscape activities
0.81	98	Undifferentiated goods- and services-producing activities of private households for own use
0.83	80	Security and investigation activities
0.85	88	Social work activities without accommodation
0.86	78	Employment activities

Notes: The table displays the sample average labor share by "Statistical Classification of Economic Activities in the European Community" (NACE) Revision 2 for SIC 2-digit industries in percent. It is ordered from low to high labor share industries.

Appendix C Robustness

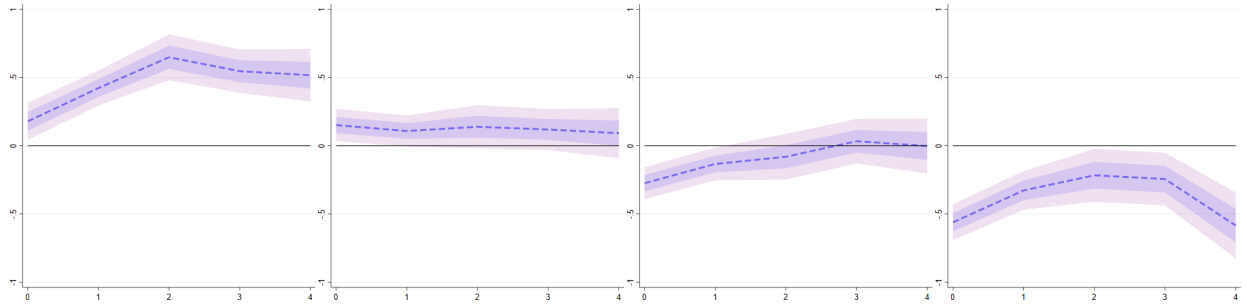
In order to make sure our results are not impaired by certain empirical choices, we now report a range of robustness checks where we employ i) alternative MP shock proxies, ii) alternative estimation specifications, iii) different MP shock frequencies, as well as iv) an alternative measure of the labor share.

C.1 Robustness check I: alternative MP shock proxies

We perform robustness checks using the EA MP shocks identified by and retrieved from Altavilla et al. (2019). Altavilla et al. (2019) report the response of minute-by-minute observations of EA overnight indexed swap (OIS) contracts after ECB Governing Council announcements. While their identifying scheme does not a priori exclude supply side information shocks to which the central bank would respond, they provide a EA MP Event-Study Database (the EA-MPD is freely available online) on forward rate changes in future short-term rates along the entire yield curve after a public communication of changes in the ECB's MP stance. These shocks address the endogeneity of MP by focusing on high frequency asset price movements in a brief window around announcements.

We consider the surprise effect of MP by looking at the forward rate change associated with a horizon of three months (Andrade & Ferroni, 2021; Krusell et al., 2023) within the monetary event window, including both the press release and the press conference. We sum up the daily surprises to obtain a monthly surprise series. To capture the monetary shock and to test for robustness of our results, we only use surprise (months) when the interest rates and stock prices move in the opposite direction. Last, we match the frequency of our annual firm-level data by summing up the monthly surprises to retrieve a yearly series (Holm et al., 2021). Impulse response functions are shown in Figure 14 and support our main findings.

Figure 14: Differential investment response: MP shocks by Altavilla et al. (2019)



(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

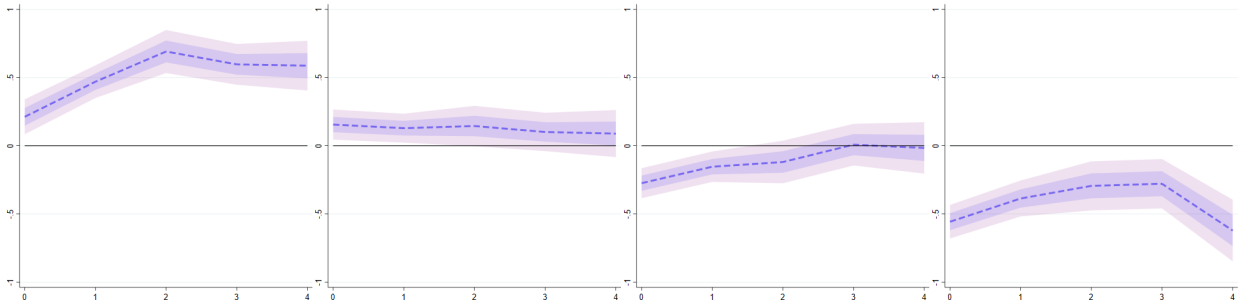
Notes: Firm-level investment response to a one standard deviation monetary policy tightening shock according to the firm's labor share relative to the baseline (40% - 60%). It shows the cumulative log-change in fixed assets between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

C.2 Robustness check II: Frequency of monetary policy shocks

In Figures 15 and 16, we employ other time horizons and identification approaches to compute the relevant MP shocks. Recall that in the main specification, we aggregate the monthly shocks from Jarociński & Karadi (2020) over the 6 months before the relevant time period. We now repeat this procedure over 3 months and over 12 months. We find that the choice of aggregation period matters economically, but not qualitatively. In both cases, high labor share firms relatively decrease their tangible investment in response to monetary tightening. In contrast, we find that capital intensive firms respond forcefully and significantly positive when the shocks are aggregated over longer horizons.

These results suggest that the length of the period over which MP affects responses by firms or the identification approach of the MP shocks are not driving the significance of the findings. They also continue to support the main conclusion of our analysis – that monetary tightening (easing) is associated with a decrease (increase) in tangible asset stock of high labor dependent firms vis-a-vis capital dependent firms.

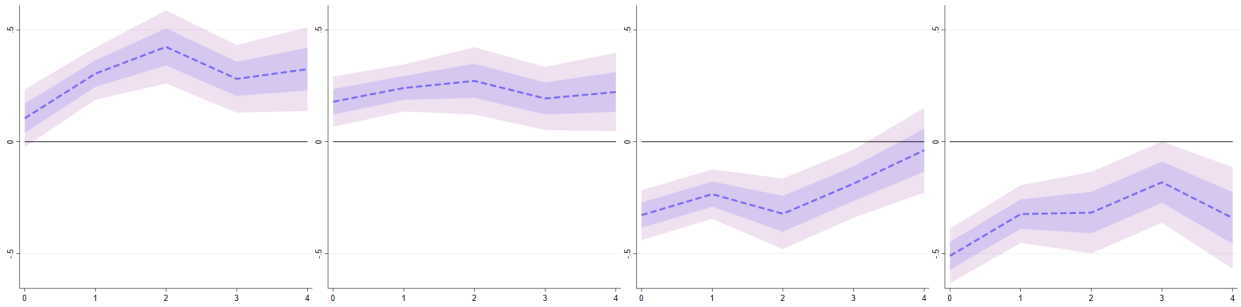
Figure 15: Differential investment response: 1 year aggregation



(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level investment response to a one standard deviation monetary policy tightening shock according to the firm's labor share relative to the baseline (40% - 60%). It shows the cumulative log-change in fixed assets between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

Figure 16: Differential investment response: 3 month aggregation



(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level investment response to a one standard deviation monetary policy tightening shock according to the firm's labor share relative to the baseline (40% - 60%). It shows the cumulative log-change in fixed assets between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

C.3 Robustness check III: other proxies for financial constraints

See discussion in Section 3.3 as well as the figures below.

Figure 17: Scatterplot: labor share - firm age

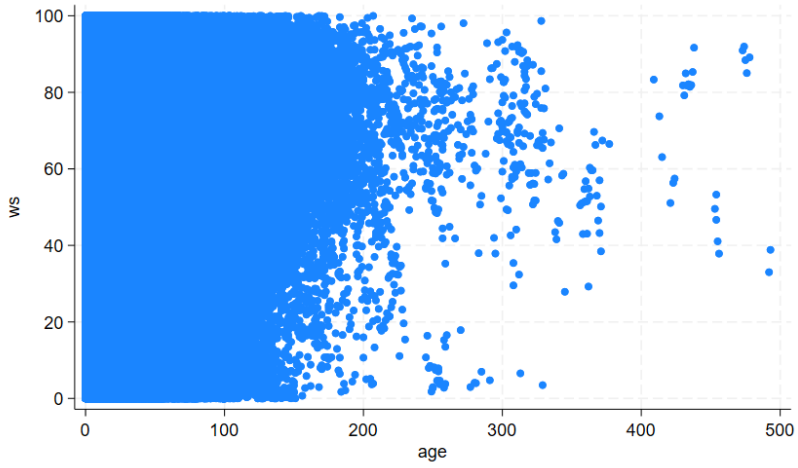


Figure 18: Scatterplot: labor share - firm size

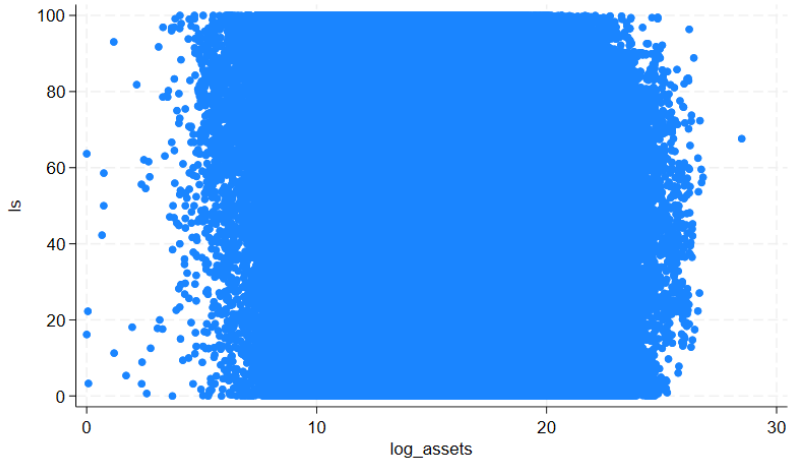
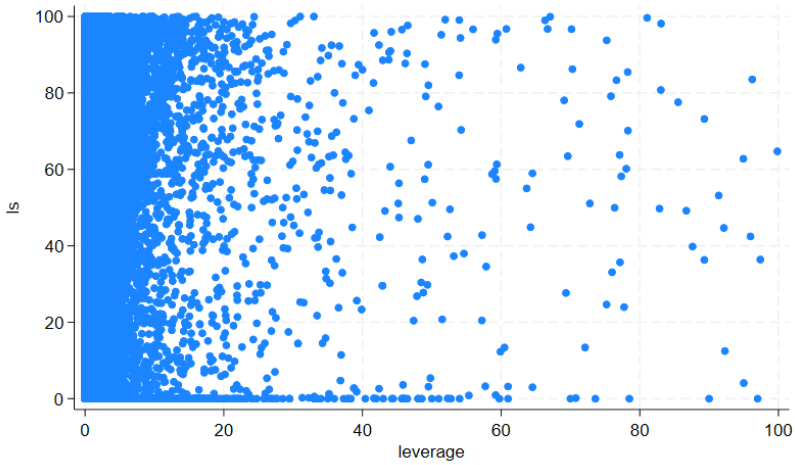


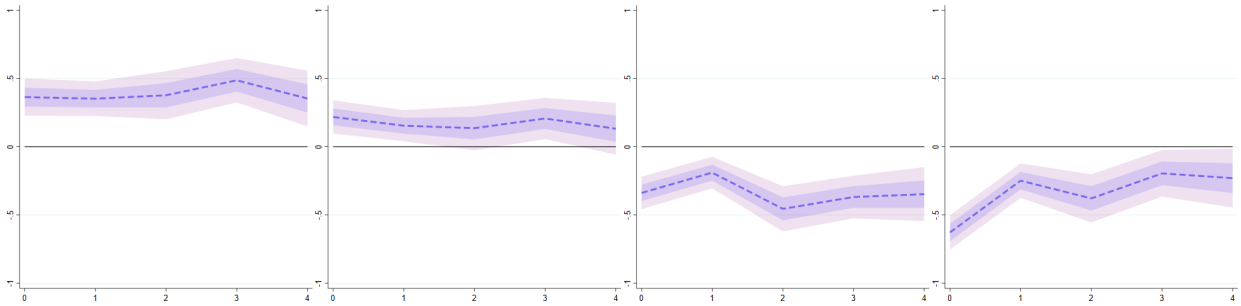
Figure 19: Scatterplot: labor share - financial leverage



C.4 Robustness check IV: labor share of sales

In our main analysis, we follow Autor et al. (2020) and define the labor share as the cost of employees divided by value added. We test for robustness of our results to our definition of the labor share by employing using an alternative definition: cost of employees divided by sales Autor et al. (2020). Figure 20 shows that our results are robust to this alternative labor share definition.

Figure 20: Differential investment response



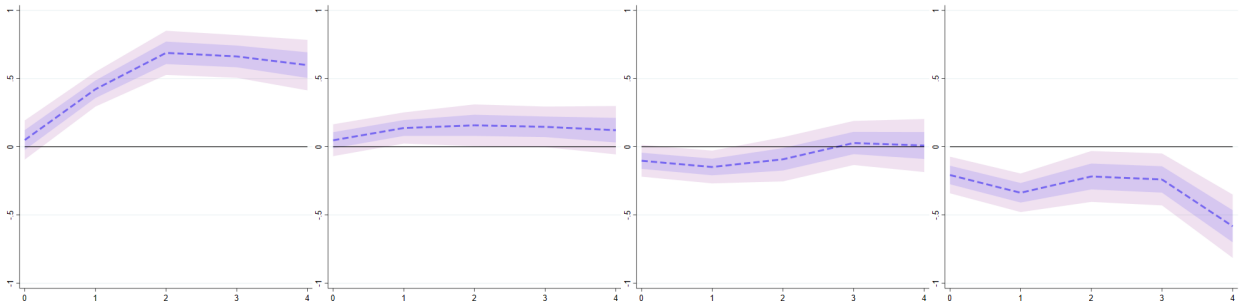
(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level investment response to a one standard deviation monetary policy tightening shock according to the firm's labor share (cost of employees divided by sales) relative to the baseline (40% - 60%). It shows the cumulative log-change in fixed assets between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.

C.5 Robustness check V: fixed effects

We perform the following robustness exercise in order to make sure that the headline results are robust to the inclusion of high-dimensional fixed effects. To this end, the figure below contains IRFs using country-industry, industry-time, and country-time dummies as well as firm fixed effects. The exercise demonstrates that the results are qualitatively robust. We proceed without this specification, however, due to the risk of overfitting.

Figure 21: Differential investment response



(a) bottom 20% (b) 20%-40% (c) 60%-80% (d) top 20%

Notes: Firm-level investment response to a one standard deviation monetary policy tightening shock according to the firm's labor share (cost of employees divided by sales) relative to the baseline (40% - 60%). It shows the cumulative log-change in fixed assets between period $t-1$ and $t+h$ with the monetary policy shock dated at t. Time is in years. Shaded (dark) purple areas represent 95 (68) percent confidence bands. The confidence bands are based on clustered standard errors by firm. We control for potential residual autocorrelation.