Does monetary policy affect non-mining business investment in Australia? evidence from BLADE

Gulnara Nolan*, Jonathan Hambur* and Philip Vermeulen**

Research Discussion Paper
2023–[##]

June 2023

*Economic Research Department, Reserve Bank of Australia
**University of Canterbury, New Zealand

The authors would like to thank Gianni La Cava and Keaton Jenner for sharing their code on earlier analysis of aggregate investment.

Author: NolanG@rba.gov.au

Media Office: rbainfo@rba.gov.au

Abstract

We provide new evidence on the effect of monetary policy on investment in Australia using firm-level data. We find that contractionary monetary policy makes firms less likely to invest and lowers the amount they invest if they do so. The effects are similar for young and old firms, indicating that the decline in the number of young firms in Australia over time is unlikely to have weakened the effect of monetary policy. However, there is some evidence that the largest firms in each industry are less responsive. This suggests that survey evidence that some large firms have 'sticky hurdle rates' and don't respond to interest rates may not be representative. It also suggests that overseas findings that expansionary monetary policy lessens competition by supporting the largest firms likely do not apply to Australia. Finally, we find tentative evidence that sectors that are more dependent on external finance are more responsive to monetary policy, highlighting the important role of cash flow and financing constraints in the transmission of monetary policy.

JEL Classification Numbers:

Keywords:

Table of Contents

1. Introduction

Business investment is a key driver of economic growth both from a structural and cyclical point of view. From a structural perspective, as firms invest they grow the stock of capital and equipment that workers can use ('capital deepening'), enabling workers to produce more and therefore raising labour productivity and peoples' incomes. Many new technologies are also thought to be 'embodied' in equipment and investment, meaning that investment can push forward the technological frontier. From a cyclical perspective, investment is generally thought to be one of the more cyclical components of output, and therefore an important contributor to economic cycles (e.g. Kydland and Prescott 1982).

As such, it is concerning that non-mining investment was fairly weak over much of the 2010s, despite declines in interest rates and moderate economic growth (e.g. Heads of Treasuries 2017; Debelle 2017; Hambur and Jenner 2019; Van Der Merwe *et al* (2018)). While several explanations have been put forward, such as risk aversion and uncertainty, or pessimism about future outcomes ('animal spirits'), one potential explanation could be that monetary has become less effective at stimulating business investment. For example, survey evidence (generally for larger firms) suggests that the hurdle rates that businesses require investments to make can be 'sticky' and not responsive to monetary policy (Lane and Rosewall 2015; Edwards and Lane 2021; Sharpe and Suarez 2013).

Against this background it is important to understand how and whether monetary policy affects business investment. The key theoretical channels are fairly well documented. A reduction of the policy interest rate stimulates investment by: increasing aggregate demand; lowering the cost of investment (e.g. borrowing rates) – the 'user cost of capital'; and loosening credit and financing constraints by freeing-up cash flow for indebted firms or raising the value of collateral that firms can pledge to obtain loans (Bernanke and Gertler, 1995). However, in practice several factors make it difficult to quantify the effect of monetary policy on investment, and to understand the transmission channels.

A key factor that makes it hard to assess the effect of monetary policy on investment is endogeneity. Soft economic (current or expected) conditions are likely to lead to expansionary monetary policy, but also to weaker investment, biasing any estimated effect of interest rate change on investment down. Indeed a relationship is hard to find in aggregate time series data (e.g. Chirinko 1993; Caballero 1999; Hassett and Hubbard 2002; Cockerell and Pennings 2007). Another factor is that investment is very heterogenous. At any point in time, some businesses are investing a lot while others are not investing, reflecting business-specific conditions and past investment. This can make it hard to model aggregate investment.

To improve our understanding of the effects of monetary policy on investment we combine the exogenous monetary policy shock measures of Beckers (2020) with quarterly firm-level tax data on the near universe of firms from ABS Business Longitudinal Analysis Data Environment (BLADE). In doing so we follow earlier work by Cloyne *et al* (2018), Jeenas (2019), Ottonello and Winberry (2020) and Durante *et al* (2022) in estimating the dynamic effect on investment for a period of up to 12 quarters after a monetary policy shock using a local projections model.

By using firm-level data we can also explore monetary-policy transmission channels and whether monetary policy affects different types of firms differently. As well as providing additional insights

into how monetary policy works, this could give insights into the low levels of investment evident over the 2010s. For example, young firms might be more sensitive to monetary policy if they are more credit constrained and expansionary monetary policy alleviates these constraints. If this is the case, declining firm entry rates, and therefore smaller share of young firms in the economy, could potentially make monetary policy less effective. Alternatively, if very large 'leader' firms are more responsive due to their established relationships with financial institutions and ability to navigate economic fluctuations, expansionary monetary policy could entrench existing industry leaders and weaken competitive pressures and therefore investment (Kroen *et al* (2022) and Liu *et al* (2022). This could potentially help to explain the apparent decline in competition documented in Hambur (2023), which Andrews and Hambur (2023) link to slower investment particularly among more productive firms.

Our key findings are that contractionary monetary policy decreases both the likelihood that firms invest (extensive margin), and the extent of investment (intensive margin). We find that firms of different sizes and ages respond similarly to monetary policy shocks. However, there is tentative evidence to suggest that the largest firms in each industry ('leaders') tend to be less responsive. This has several implications for policymakers:

- It suggests that the decrease in the share of young firms in the economy, due to slower firm entry, is unlikely to have lowered the effectiveness of monetary policy (at least not directly)

- It suggests that survey evidence that some large leader firms have 'sticky hurdle rates' may not be representative of how the broader population of firms respond to monetary policy. Though it could also suggest that other channels of pass-through differ (e.g. credit constraints).

- It suggests that recent US evidence that expansionary monetary policy disproportionately supports leaders, and so reduces competition, does not apply to Australia.

Finally, we find tentative evidence that sectors that are more dependent on external finance are more responsive to monetary policy, highlighting the important role that cash flow and financing constraints play in the transmission of monetary policy.

As well as the Australia-specific results, our results contribute to the broader literature in several ways. First, we provide results for an advanced small open economy, where most of the literature has considered larger economies such as the US (Cloyne *et al* 2018, Jeenas 2019) and the Euro area (Durante *et al* 2022). This is relevant given Australian firms are potentially exposed to a greater range of international shocks and given the global cost of capital may play an important role in their financing decisions, rather than only the domestic costs.

In addition, our finding that monetary policy affects investment on both the intensive and extensive margin speaks to the ongoing discussion on how endogenous capital accumulation should be modelled in macroeconomic models. For example, many models, including Woodford (2005), model investment using convex adjustment costs, leading to smooth investment. This contrasts to the existing evidence (including in this paper) that investment tends to be lumpy. Sveen and Weinke (2007) model lumpy investment; however, they do so using an exogenous Bernouilli process that implies that monetary policy cannot effect the extensive margin of investment, in contrast to our

findings. Rather, our results support the use of fixed adjustment costs in investment, as proposed by Reiter, Sveen and Weinke (2013)

The rest of the paper is organized as follows. Section 2 describes the methodology and the firm level dataset. Sections 3 and 4 provide the empirical results. Section 5 concludes.

2. Methodology and data

Our analysis uses quarterly data on investment for the near universe of Australian firms for the period between 2002 and 2017 from the ABS BLADE database.[1] The particular data we use are reported in firms' quarterly Business Activity Statement (BAS), where firms report the amount of capital purchases they made in the quarter. We focus non-primary non-financial private sector. The primary sector (agriculture and mining) is excluded as we expect that commodity prices, rather than monetary policy, is the key driver of investment in that sector. The finance sector is removed due to conceptual difficulties in measuring investment and output in this sector from tax data. And the public sector (health, education, public administration) is removed as fiscal policy is likely to play a more important role in investment in this sector.

We consider both the intensive (how much firms invest) and extensive (whether they invest) margin of investment. We model the extensive margin as an indicator $ID_{i,t}$, that takes on the value 1 if firm i invests in time t and 0 otherwise. We model the intensive margin as the log of investment $Inv_{i,t}$.

Table 1 provides a summary of the data. The sample around 34 million observations. Over the sample around 28 per cent of firms invest in each quarter. The share is lower amongst small firms (25 per cent,) and much higher amongst large firms (78 per cent) (Appendix Table A1). Even conditional on investing, the degree of investment is highly heterogenous, with a very large standard deviation.

Table 1: Summary statistics

Aggregate sample

Variable	Observations (m)	Mean	Std.Dev.
Share of firms investing % (Extensive margin)	33.9	28.3	N/A
Investment, conditional on investing ($,000)	9.6	171	10,800
Sales growth %	30.2	0.5	73.3

Our analysis closely follows Durante, Ferrando and Vermeulen (2022) who analysed the heterogeneous effects of monetary policy shocks on European firms' investment. We employ a local projections approach (Jorda 2005) of the following form to trace out the effect of monetary policy shocks ($shock_t$) over a number of horizons.

[1] After 2017 the data collection method changed. For data consistency we end the sample in 2017.

$$I_{i,t+h} = \beta_h shock_t + \alpha_h I_{i,t-1} + \sum_{j=0}^{1} \gamma_h X_{t-j} + v_{i,t+h}$$

where $I_{i,t}$ is our measure of investment ($ID_{i,t}$ or $Inv_{i,t}$). When focusing on the extensive margin, the model is effectively a linear probability model and can be interpreted as the effect on the share of firms investing, or the probability of investing. When the intensive margin is used, we are considering the percentage change in investment for those firms continuing to invest.

The vector X_{t-j} includes a set of control variables, including current and lagged firm-level revenue growth, national GDP and CPI growth, as well as industry and firm size and age controls and the lag of the monetary policy shock.[2] As the shock are exogenous, controls are not strictly needed, but the controls to help with the precision of our estimates, particularly the firm-level controls. We cluster the errors for each period, allowing cross-sectional correlation across firms. This is important given the variable of interest is constant across all firms for a given period (Cameron and Miller 2015). We do not allow for serial correlation as this is addressed by the lagged variables.

2.1 Monetary policy shocks

Our measure of monetary policy shocks is the measure constructed in Beckers (2020). This is a Romer and Romer (2004) style shock which measures the shock as a deviation from a Taylor Rule, augmented with measures of financial conditions and financial market participants expectations.

In particular, Beckers (2020) estimates and augmented Taylor rule that includes forecast for economic conditions, as well as a number of indicators of financial conditions (e.g. bond spreads, option-implied volatility). The shocks are then constructed as the deviation of the actual policy rates from that implied by the rule. WE use the measure whether he also orthogonalises the shock with respect to market expectations for the policy rate, though our results are near identical using the measure without this step.

We choose this as our preferred measures as it has been shown to overturn the so-called price-puzzle in Australia data: that contractionary monetary policy is often estimated to lead to higher prices. Other measures, including measures constructed from high-frequency changes in bond yields, we also explored, see below.

We allow the shock to enter the model directly, similar to Durante, Ferrando and Vermeulen (2022). As such, we are implicitly taking the measure to be a true estimate of the shock, rather than a noisy estimate. That said, the results are reasonably robust to using the shock as an instrument for cash rate changes, which allows for the possibility that they are a noisy measure, though the estimated effects are larger and there is slightly less evidence of significance on the intensive margin (see Appendix Figure B11).

[2] The results are robust to including more or fewer lags of the RHS variables, as well as excluding the contemporaneous controls, which removes the implicit assumption that monetary policy cannot affect current conditions (Ramey 2016).

3. Results

3.1 Aggregate results

Figure 1 shows the results for the full sample. A 100 bps contractionary monetary policy shock leads to a decline in investment both at the intensive and extensive margin. The decline in both margins is statistically significant (at the 95 per cent level), and peaks after around two-years. In terms of magnitude, the share of firms investing falls by around 5 percentage points, and the average investment for previously investing firms fall by around 10 per cent.

Interpreting the relative importance of the two channels is difficult, given their different nature. To try to provide some insight we take a simple, back of the envelope approach to quantification. In 2016, the average investment by a firm investing both in the current and previous period (those in intensive margin estimation) was around $273,000. Taking the peak 10 per cent increase in investment, this equates to $27,300 extra per continuing firm. And these firms account for around 17 per cent of the population, so average firm-level investment rises by $4,700. For the extensive margin, average investment for firms investing this period, but not in the previous period, is $52,000. Multiplying this by the peak 5 per cent increase in the probability of investing raises average firm level investment $2,600. So using this simple framework, the intensive margin is about twice as important as the extensive margin.[3]

The timing of the trough is consistent with macro models of the Australian economy such as the RBA's MARTIN model (Ballantyne *et al* 2019) and DSGE (Gibbs, Hambur and Nodari (2018)), but the response is somewhat larger.

One explanation could be the use of nominal investment in the microdata, if monetary policy lowers the price of investment good. However, when using the aggregate investment deflator we find little evidence that contractionary monetary policy shocks lower the price of investment goods (Appendix Figure B10). That said, there is a slight decline in the point estimates, suggesting the effects may be slightly overstated.

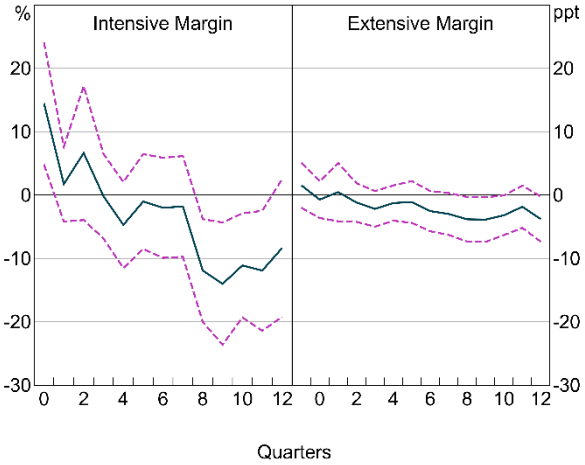
Another explanation could be the use of microdata. To consider this, we can estimate the equivalent local projection model using (log) aggregate real non-mining investment (gross fixed capital formation) from the national accounts. We estimate this over a longer sample given the longer sample available (from 1994 to match the shock availability). We again include controls for national GDP and CPI growth, as well as lags, but have no firm-level controls.

Using the aggregate data the magnitude and timing of the trough are consistent with aggregate results from the microdata, and are much larger than those from macro-models (Figure 2). This finding is consistent with Durante, Ferrando and Vermeulen (2022) and Holm, Paul and Tischbirek (2020) for the Euro Area and Norway, respectively. It indicates the results are not simply driven by our use of microdata. The finding is robust to changing the number of lags in the controls, removing current controls (to loosen the inherent assumption of no contemporaneous effect from the shock),

3 This is not surprising given continuing investors account for around 90 per cent of investment. Note that this approach does not take any account for the fact that firms with lower levels of investment may tend to have higher percentage increases, or differences between the marginal firm incentivised to invest by policy, and the average firm that moves from non-investing. As such, it should be seen as a very simple indication, not a precise quantification.

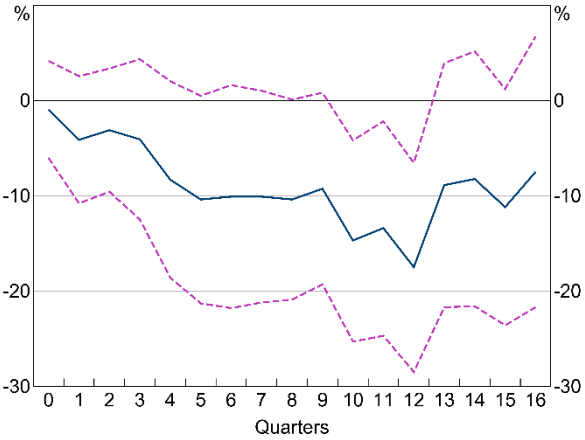
and accounting for breaks or trends in the level of investment. The results are also similar if we incorporate the Beckers (2020) shocks into a structural VAR with the components of GDP ordering the shock first, consistent with Plagborg-Moller & Wolf (2021) (Appendix Figure B1).

Figure 1: Investment Response to 100 Basis Point Monetary Policy Shock
Full sample



* Dash line represents 95 per cent confidence interval
Sources: ABS (BLADE); RBA.

Figure 2: Investment Response to 100 Basis Point Monetary Policy Shock
National accounts, non-mining investment



* Dash line represents 95 per cent confidence interval
Sources: ABS; RBA.

As a final robustness, we also consider a shock measure derived from high-frequency changes in yields around the time of the RBA's monetary policy announcements in our microdata regressions. In particular, we use the level shock from Hambur and Haque (2023), which focuses on high-frequency changes in the policy rate.[4] Doing so yields a similar profile, but a much smaller response and less evidence of a significant effect. In part this likely reflects differences in the implicit persistence of these shocks, which can make it hard to compare across shock measures. The shorter-

4 This measure is only available for a slightly shorter sample, starting in 2004.

available sample may also play a role, particularly given the relatively short sample available to begin with.

More generally, part of the difference between our results and existing macroeconomic models likely reflects differences in the implied persistence of the shock. For example, the decline in the cash rate following the shock in Beckers (2020) is much more persistent than that implied by the Taylor rules in MARTIN of the DSGE model. As such, we may not be comparing like for like.

Still. taken together the results suggest that contractionary monetary policy leads to lower investment, though the exact magnitude can vary depending on the approach and shock.

3.2 Results by firm size and age

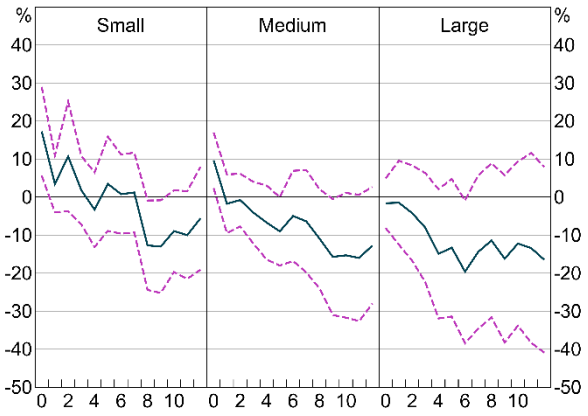
We next explore whether our microdata results differ by firm size or age. This is important for two reasons. First, it can help us to think about the transmission channels of monetary policy. Small and young firms may tend to be more financial constrained, with less free cash flows. As such, if these firms are more responsive to monetary policy it may suggest that monetary policy affects investment by influencing financing constrains and cash flow.[5] Second, over the past decade there has been a sharp decline in firm entry and exit, meaning that there are fewer young firms in the economy. If young firms are more responsive to monetary policy, this change in firm demographics could weaken the effects of monetary policy and potentially help to explain the subdued levels of non-mining investment evident in the 2010s.

Focusing first on size, Figures 3 and 4 show the results from splitting the sample into small (<20 staff), medium (20-199 staff) and large firms (200+ staff). Overall, the results do not show any substantial differences across firm sizes. There is some evidence that the extensive margin plays a slightly more important role for small firms, consistent with these firms investing less regularly than larger firms, but aside from this the differences appear small.[6]

[5] That said, many young firms may not have established banking relationship, or be heavily constrained, and so this could make them less responsive to monetary policy through the cash flow channel or as monetary policy may not loosen their credit constraints Casiraghi, McGregor and Palazzo (2021).

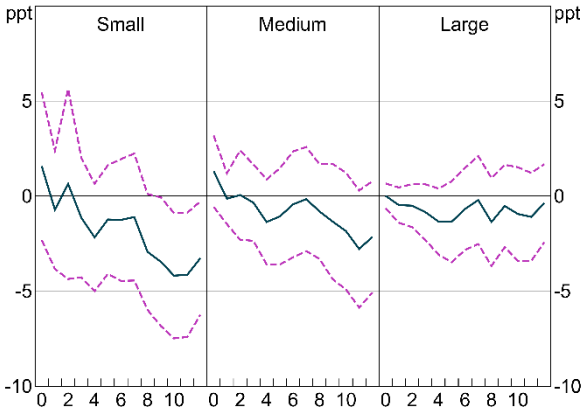
6 See Appendix Figures B5-B8 for charts of the significance of these differences.

Figure 3: Investment Response to 100 Basis Point Monetary Policy Shock
By size, intensive margin



* Dash line represents 95 per cent confidence interval
Sources: ABS (BLADE); RBA.

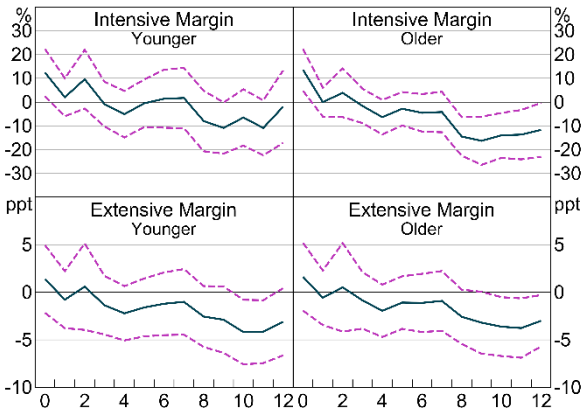
Figure 4: Investment Response to 100 Basis Point Monetary Policy Shock
By size, extensive margin



* Dash line represents 95 per cent confidence interval
Sources: ABS (BLADE); RBA.

Considering age, the results are again similar across young (0-5 years), and old (5+ years) firms (Figure 5). This suggests that the decrease in the share of young firms in the economy witnessed over the past decade is unlikely to have caused investment to become less responsive to monetary policy.

Figure 5: Investment Response to 100 Basis Point Monetary Policy Shock
By age



* Dash line represents 95 per cent confidence interval
Sources: ABS (BLADE); RBA.

3.3 Results by leader versus non-leader

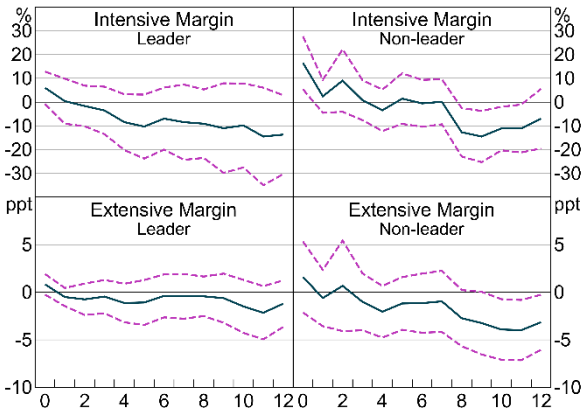
Another way to think about firm size is to define industry "leaders", the largest 5 per cent of firms in a 4-digit ANZSIC industry, and "non-leaders". This allows us to abstract from inherent differences in firm sizes across industries and to focus on the largest firms in each industry.

We use this split to think about to key aspects of monetary policy pass-through. The first is whether survey evidence suggesting that firms' investment is does not respond to interest rate changes, for example due to having sticky hurdle rates (Lane and Rosewall (2015); Edwards and Lane (2021)), is likely to be representative of the broader population of firms. Many of these surveys are focused on industry leaders. To the extent that they behave differently to the rest of the population it might suggest that the finding that firms do not respond to interest rates in part reflects a sample selection issue in surveys. Though it could also reflect differences in some of the other channels across firm types.

The second aspect is whether monetary policy could influence the degree of competition in the economy. In particular, recent work in the US has found that expansionary monetary policy disproportionately support growth for leader firms, thus undermining competitive pressures in the economy (Kroen *et al* (2022)) and (Liu *et al* (2022)). We can test whether this is also the case in Australia.

Overall, leaders' investment appears is anything less responsive to monetary policy than that of non-leaders, through the difference is not significant (Figure 6). This suggests that some caution should be taken in extrapolating findings regarding the investment behaviour of larger, more sophisticated firms covered in surveys and liaison to a broader range of firms.

Figure 6: Investment Response to 100 Basis Point Monetary Policy Shock
By industry "leader"



* Dash line represents 95 per cent confidence interval
Sources: ABS (BLADE); RBA.

The finding also provides some evidence that expansionary monetary policy does not weaken competitive pressures in Australia, in contrast to the US findings. There are a number of explanations for why our findings differ to the US findings. One is that we use a larger, more representative dataset, that includes more smaller firms. In contrast, the US work includes only listed firms. This could be important as non-listed firms could be more credit constrained, and so be more responsive to monetary policy.

To consider this, we perform the same exercise, but focusing on listed firm data from Morningstar, using the annual dataset outlined in Nguyen (2022). We apply the cleaning implemented in Kroen *et al* (2021). For this analysis we consider both a flow measure of investment (as above), and the capital stock (as in Kroen *et al* 2021). Unfortunately, the short sample available (from 2001) makes it difficult to draw conclusions around significance.[7] However, focusing on the point estimates there is some tentative evidence that leaders' investment is more responsive to shocks when focusing on larger, listed companies (Appendix Figure B2).[8] Taken at face value this could suggest the Kroen *et al* (2021) may not hold when considered in a larger more representative sample, though this would be better tested using comparable US data.

Other potential explanations for the different findings could include the different structure of borrowing in Australia, or the fact that Australia is a small open economy, and so larger firms with access to international capital markets may be relatively more exposed to overseas credit conditions.

4. Results by financial dependency

One of the key channels through which monetary policy is thought to affect investment is by influencing financial constraints. This can be through influencing the value of collateral that firms

7 We have a very small number of clusters, which can lead to incorrect inference with standard errors. Various approaches have been examined to adjust for small numbers of clusters, but given this regression is not our main focus we do not adopt these.

8 Results are shown including industry by year fixed effects and no firm-growth controls to be consistent with Kroen *et al* (2021). However, the results are very similar if the specification is changed to be similar to our BLADE regressions.

have available to pledge for loans – the so-called financial accelerator channel (Bernanke and Gertler (1995)) – or more generally by influencing firms cashflow and liquidity constraints, or credit supply.

To better understand the financing constraint channel, we explore whether firms that may be more subject to financial constraints, frictions, or more generally more reliant on borrowing, respond differently to other firms following a monetary policy shock. There is a large literature examining the effects of financing frictions and credit availability on firm investment and growth (e.g. Rajan and Zingales 1998). This literature measures financial frictions and credit supply in numerous ways, and there is no one agreed upon 'best' measure of frictions or financial dependence.

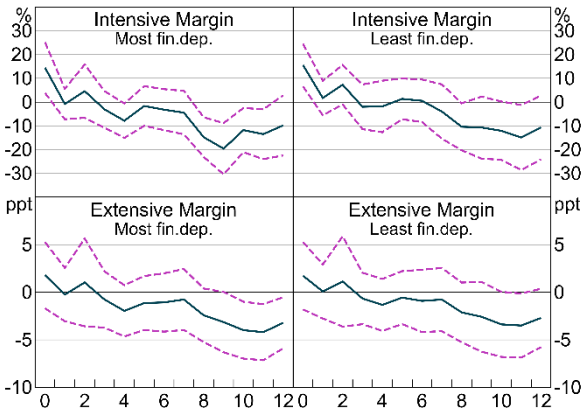
Our preferred approach is to use industry-level measure of external finance dependence. Specifically we use the measures of industry-level finance dependence from (Demmou *et al* 2019), who update Rajan and Zingales (1998) approach. We split firms based on whether they were in one of the most dependent sectors (top quartile) or least dependent (bottom quartile). Demmou *et al* (2019) produce these measures on an ISIC Revision 4 basis, and we map them to ANZSIC 4-digit industries.

This measure is constructed using information of the funding requirements of US firms. Using US-based metrics has some advantages and some disadvantages. The obvious disadvantage is that industries may finance themselves differently in Australia and the US. Still, there are several advantages: using an external dataset limits potential endogeneity concerns; the US data are based on a much longer sample than we have available; the US-based metrics are well-documented and have been used in numerous different studies, making them a robust and comparable set of indicators.

Another approach would be to construct firm-based metrics of financial dependence or constraints. However, this has several shortcomings. First, firms may appear highly geared, or have negative cash flow, as they are in a growth phase and this could complicate the interpretation. Second, it might be that we are actually capturing firms that are distressed and unable to invest whether or not financial conditions worsen (e.g. La Cava 2005). Due to these potential challenges in interpretation, focus on the industry-level metrics.

As expected, in sectors that are more dependent on external finance firms' investment appears slightly more responsive to monetary policy shocks. While the estimates aren't significantly different from each other, the responses for the most dependent sector are somewhat larger and are significant (at the 95 per cent level), whereas the least dependent sector shows no significant change in investment following a monetary policy shock.

Figure 7: Investment Response to 100 Basis Point Monetary Policy Shock
By financial dependency



* Dash line represents 95 per cent confidence interval
Sources: ABS (BLADE); RBA.

Overall, we do find some tentative evidence that firms in sectors that are more reliant on external finance have larger investment responses following a monetary policy shock. This is consistent with monetary policy influencing firms' investment in part by influencing financial constraints. That said, the evidence is not strong, likely in part due to the complex and multi-faceted nature of measures financing constraints.

5. Conclusion

Investment is a crucial driver of economic growth, both in cyclical and structural terms. As such, it is important to understand the extent that monetary policy affects business investment, as well as the channels through this occurs, as it helps to inform policy, and think about how the effects of monetary policy could change over time. This is particularly relevant in the context of the surprisingly low levels of non-mining investment evident in Australia over the past decade.

Using exogenous monetary policy shocks and firm-level data we find evidence that monetary policy has a large effect on investment, both on the intensive and extensive margins We find that contractionary monetary policy decreases both the likelihood that firms invest (extensive margin), and the extent of investment (intensive margin). The effects appear similar across firm sizes and ages, suggesting that the aging of the firm population that has occurred due to declining firm entry rates should not have weakened the effect of monetary policy on investment.

That said, we do find some evidence that the largest firms in each industry ('leaders') tend to be less responsive to monetary policy. This is in contrast to US findings, and suggests the expansionary monetary policy over the past decade is unlikely to have contributed to the weakening in competitive pressures documented in other work (e.g. Hambur 2023). It also suggests that extrapolate survey evidence on the investment behaviour of larger firms to all firms.

Finally, consistent with much of the literature, we find tentative evidence that financial frictions, such as collateral and cash flow constraints, may play an important role in the transmission of monetary policy, given the effect appears larger in sectors that are more exposed to external debt finance.

This suggests that monetary policy may be particularly effective in times where these constraints are more binding, such as banking crises or downturns more generally.

Appendix A: Sample

Table A1: Summary statistics

Extensive margin; by size[(a)]

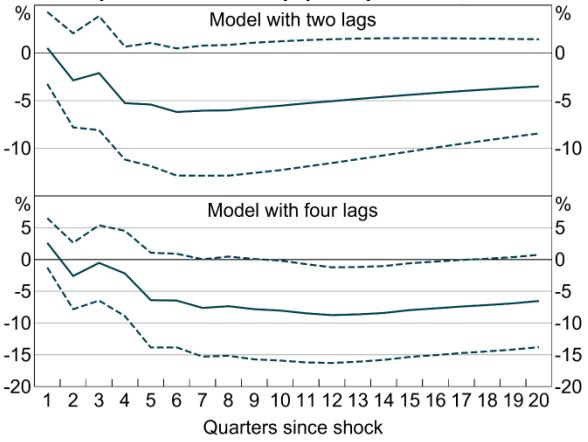
	Large	Medium	Small
Share of firms investing	78%	50%	25%
Total	287,801	3,961,966	29,650,565

Note: (a) Size is defined as small (<20 staff), medium (20-199 staff) and large (200+ staff)

Appendix B: Aggregate data results

Figure B1: Aggregate Non-mining Investment Response

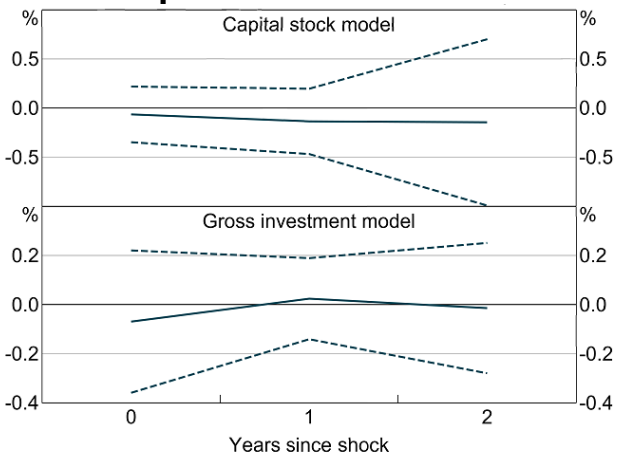
100 basis point monetary policy shock, VAR model



* Small VAR with (log) real trade-weighted index, (log) consumption, (log) non-miing business investment, (log) dwelling investment and cash rate

Source: Authors' calculations.

Figure B2: Investment Response to 100 Basis Point Monetary Policy Shock

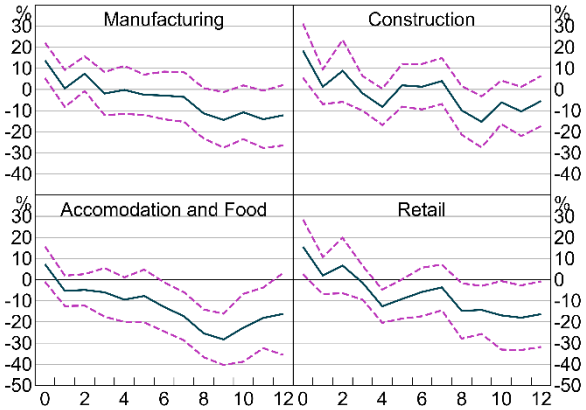


* Model with no growth controls, but with industry*year fixed effects. Dotted lines show 95 per cent confidence itnernval calcuated based of a t-n degree of freedom t-distirbution, where t is number of years and n number of coefficients

Sources: Authors' calculations; Morningstar.

Figure B3: Investment Response to 100 Basis Point Monetary Policy Shock

By industry, intensive margin



* Dash line represents 95 per cent confidence interval

Sources: ABS (BLADE); RBA.

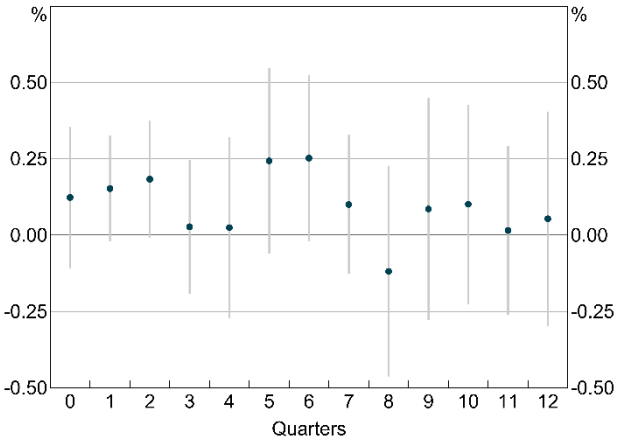
Figure B4: Investment Response to 100 Basis Point Monetary Policy Shock

By industry, extensive margin

* Dash line represents 95 per cent confidence interval

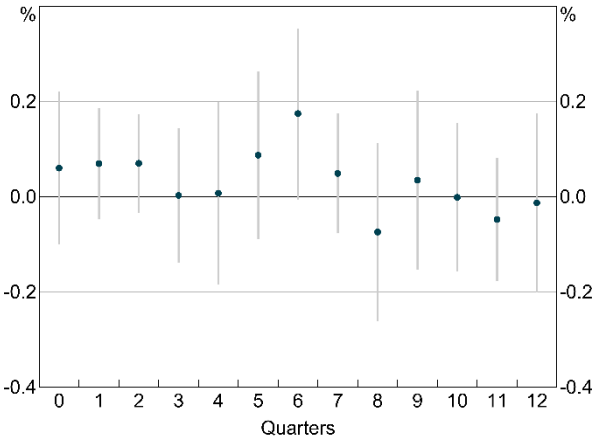
Sources: ABS (BLADE); RBA.

Figure B5: Investment Response to 100 Basis Point Monetary Policy Shock
Intensive margin, difference of small firm relative to large



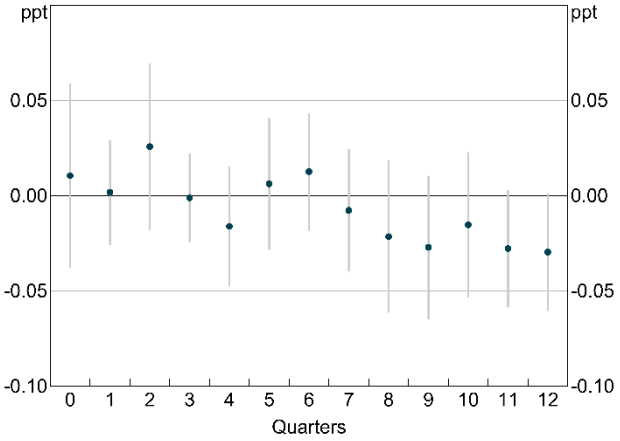
* The dots represent the point estimates of the differences in impulse reponses. Bars indicate 95 per cent confidence interval
Source: ABS (BLADE).

Figure B6: Investment Response to 100 Basis Point Monetary Policy Shock
Intensive margin, difference of medium firm relative to large



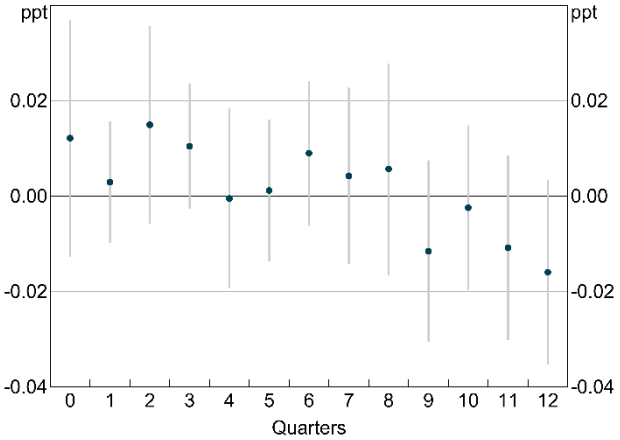
* The dots represent the point estimates of the differences in impulse reponses. Bars indicate 95 per cent confidence interval
Source: ABS (BLADE).

Figure B7: Investment Response to 100 Basis Point Monetary Policy Shock
Extensive margin, difference of small firm relative to large



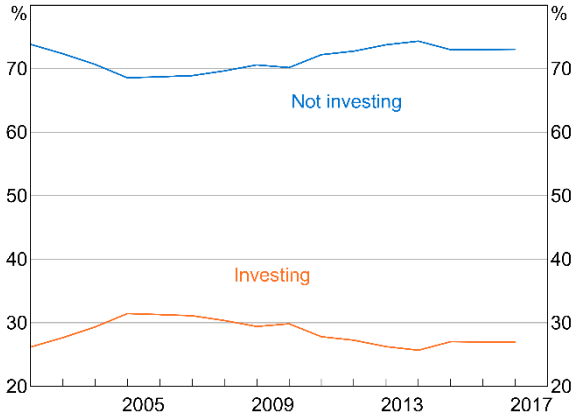
* The dots represent the point estimates of the differences in impulse reponses. Bars indicate 95 per cent confidence interval
Source: ABS (BLADE).

Figure B8: Investment Response to 100 Basis Point Monetary Policy Shock
Extensive margin, difference of medium firm relative to large



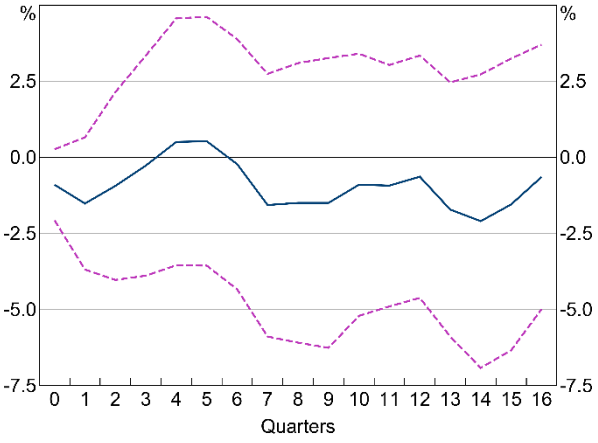
* The dots represent the point estimates of the differences in impulse reponses. Bars indicate 95 per cent confidence interval
Source: ABS (BLADE).

Figure B9: Share of firm by investment
Full sample



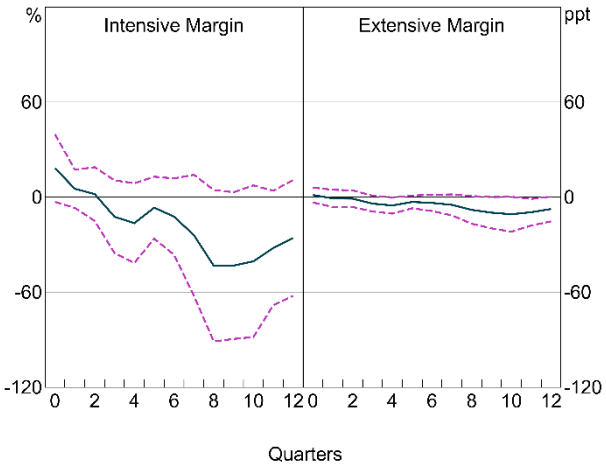
Sources: ABS (BLADE); RBA.

Figure B10: Deflator Response to 100 Basis Point Monetary Policy Shock
National accounts, non-mining investment price deflator



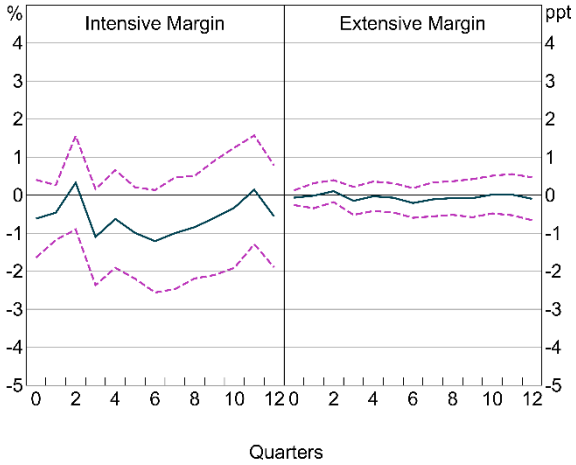
* Dash line represents 95 per cent confidence interval
Sources: ABS; RBA.

Figure B11: Investment Response to 100 Basis Point Monetary Policy Shock
IV approach, full sample



* Dash line represents 95 per cent confidence interval
** Monetary policy shock is instrumented via cash rate
Sources: ABS (BLADE); RBA.

Figure B12: Investment Response to 100 Basis Point Monetary Policy Shock
With Hambur (2023) shock, full sample



* Dash line represents 95 per cent confidence interval
** Monetary policy shock is defined as in Hambur (2023)
Sources: ABS (BLADE); RBA.

References

Andrews D and J Hambur (2023), 'Doing Less, with Less: Capital Misallocation, Investment and the Productivity Slowdown in Australia', RBA Research Discussion Paper No 2023-03.

Ballantyne A, Cusbert T, Evans R, Guttmann R, Hambur J, Hamilton A, Kendall E, McCririck R, Nodari G and D Rees (2019), 'MARTIN Has Its Place: A Macroeconometric Model of the Australian Economy', RBA Research Discussion Paper No 2019-07.

Beckers B (2020), 'Credit Spreads, Monetary Policy and the Price Puzzle', RBA Research Discussion Paper No 2020-01.

Bernanke BS and M Gertler (1995), 'Inside the black box: the credit channel of monetary policy transmission', *Journal of Economic Perspectives,* 9(4), pp 27–48.

Caballero RJ (1999), 'Aggregate Investment', in JB Taylor and M Woodford (eds), *Handbook of Macroeconomics: Volume 1B, Handbooks in Economics 15,* Elsevier Science, Amsterdam, pp 813–862.

Cameron AC and DL Miller (2013), 'A Practitioner's Guide to Cluster-Robust Inference', Unpublished manuscript, University of California – Davis, October.

Casiraghi M, McGregor T and B Palazzo (2021), 'Young Firms and Monetary Policy Transmission', *IMF Working Papers* 2021/063, International Monetary Fund.

Chirinko RS (1993), 'Business Fixed Investment Spending: Modeling Strategies, Empirical Results, and Policy Implications', *Journal of Economic Literature,* 31(4), pp 1875–1911.

Cloyne J, Ferreira C, Froemel M and P Surico (2018), 'Monetary Policy, Corporate Finance and Investment', mimeo, University of California at Davis, Bank of Spain and London Business School.

Cockerell L and S Pennings (2007), 'Private Business Investment in Australia', RBA Research Discussion Paper No 2007-09.

Debelle G (2017), 'Business Investment in Australia', Address to the UBS Australasia Conference 2017, Sydney, 13 November.

Demmou L, I Stefanescu and A Arquie (2019), 'Productivity Growth and Finance: The Role of Intangible Assets - A Sector Level Analysis', OECD Economics Department Working Papers No 1547.

Durante E, Ferrando A and P Vermeulen (2022), 'Monetary policy, investment and firm heterogeneity', *European Economic Review*, Elsevier, vol. 148(C).

Edwards H and K Lane (2021), 'Why Are Investment Hurdle Rates so Sticky?', RBA *Bulletin*, December.

Gibbs CG, Hambur J and G Nodari (2018), 'DSGE Reno: Adding a Housing Block to a Small Open Economy Model', RBA Research Discussion Paper No 2018-04.

Hambur J (2023), 'Did Labour Market Concentration Lower Wages Growth Pre-COVID?', RBA Research Discussion Paper No 2023-02.

Hambur J and K Jenner (2019), 'Can Structural Change Account for the Low Level of Non-Mining Investment?', RBA *Bulletin*, June.

Hassett KA and RG Hubbard (2002), 'Tax Policy and Business Investment', in AJ Auerbach and M Feldstein (eds), *Handbook of Public Economics: Volume 3, Handbooks in Economics 4,* Elsevier Science, Amsterdam, pp 1293–1343.

Heads of Treasuries (2017), 'Intergovernmental Review of Business Investment', September.

Holm MB, Paul P and A Tischbirek (2021), 'The Transmission of Monetary Policy under the Microscope', *Journal of Political Economy,* University of Chicago Press, vol. 129(10), pp 2861-2904.

Jeenas P (2019), 'Firm balance sheet liquidity, monetary policy shocks, and investment dynamics', *Job Market Paper.*

Jordà Ò (2005), 'Estimation and Inference of Impulse Responses by Local Projections', *The American Economic Review,* 95(1), pp 161–182.

Kroen T, Liu E, Mian AR and Sufi A (2021), 'Falling Rates and Rising Superstars', *NBER Working Papers 29368*, National Bureau of Economic Research, Inc.

Kydland FE and EC Prescott (1982), 'Time to build and aggregate fluctuations', *Econometrica, Econometric Society*, vol. 50(6), pp 1345-1370, November.

La Cava G (2005), 'Financial Constraints, the User Cost of Capital and Corporate Investment in Australia', RBA Research Discussion Paper No 2005-12.

Lane K and T Rosewall (2015), 'Firms' Invesment Decisions and Interest Rates ', RBA *Bulletin*, June, pp 1–8.

Liu E, Sufi A and Mian A (2019), 'Low Interest Rates, Market Power, and Productivity Growth', 2019 Meeting Papers 83, *Society for Economic Dynamics*.

Ngyuen K (2022), 'The Real Effects of Debt Covenants: Evidence from Australia', RBA Research Discussion Paper No 2022-05.

Nolan G and M Nolan (2020), 'Taxation, User Cost of Capital and Investment Behaviour of New Zealand Firms', *CEU Working Paper,* Ministry of Business, Innovation and Employment, New Zealand.

Ottonello P and T Winberry (2020), 'Financial Heterogeneity and the Investment Channel of Monetary Policy', *Econometrica: Econometric Society,* vol. 88(6), pp 2473-2502, November.

Plagborg-Møller M and CK Wolf (2021), 'Local Projections and VARs Estimate the Same Impulse Responses', *Econometrica,* Econometric Society, vol. 89(2), pp 955-980, March.

Ramey VA (2016), 'Macroeconomic Shocks and Their Propagation', in JB Taylor and H Uhlig (eds), *Handbook of Macroeconomics: Volume 2A,* Handbooks in Economics, Elsevier, Amsterdam, pp 71–162.

Rajan RG and L Zingales (1998), 'Financial Dependence and Growth', The American Economic Review, 88(3), pp 559–586.

Reiter M, Sveen T and L Weinke (2013), 'Lumpy investment and the monetary transmission mechanism'*, Journal of Monetary Economics,* Elsevier, vol. 60(7), pp 821-834.

Romer CD and DH Romer (2004), 'A New Measure of Monetary Shocks: Derivation and Implications', *The American Economic Review,* 94(4), pp 1055–1084.

Sharpe S and G Suarez (2013), 'Do CFOs Think Investment is Sensitive to Interest Rates?', Federal Reserve Board of Governors *FEDS Notes*, 26 September.

Sveen T and L Weinke (2007), 'Lumpy investment, sticky prices, and the monetary transmission mechanism', Journal of Monetary Economics, Elsevier, vol. 54(Supplemen), pp 23-36, September.

van der Merwe M, L Cockerell, M Chambers and J Jääskelä (2018), 'Private Non-Mining Investment in Australia', RBA *Bulletin*, June.

Woodford M (2005), 'Firm-Specific Capital and the New-Keynesian Phillips Curve', *NBER Working Papers 11149*, National Bureau of Economic Research, Inc.