

WHICH FIRMS DRIVE BUSINESS INVESTMENT? EVIDENCE FROM MICRODATA¹

Until now, our insight into the distribution of business investment in the Australian economy according to firm size has been limited. The nature of the distribution matters because it may have substantial implications for our understanding of the drivers of aggregate investment. To the extent economic, financial or fiscal (tax) conditions facing firms vary according to their size, changes in these conditions may be of greater consequence if they affect firms that account for a large share of investment. Using firm-level data from BLADE, I find that:

- **Large firms account for a very large share of investment.** The largest 1 per cent of firms (by output) account for around 50 per cent of non-mining business investment.
- Consequently, **large firms are the major driver of the growth patterns and volatility in aggregate investment.** Aggregate investment is a notoriously volatile component of GDP, and these results further our understanding of why; the skewness in the distribution means any ‘lumpiness’ in investment at large firms carries through to the aggregate.
- **The concentrated nature of investment broadly reflects the concentration in output.** The skewness in the investment distribution appears to be associated with the distribution of sales or output; the top 1 per cent of Australian firms account for around 70 per cent of gross output.
- **Small to medium-sized firms (SMEs) have tended to spend a larger share of their revenue (gross output) on capital investment compared to larger firms.**
- **These distributions do not appear to have changed significantly over the last two decades.**

Why we care about the distribution of investment by firm size

The distribution of investment according to firm size has the potential to be highly important in understanding the patterns in aggregate investment. Differences in firm size are often associated with differences in internal and external operating environments faced by firms – including economic, financial or fiscal (tax) conditions – and these differences may affect investment behaviour. For example:

- Smaller firms often have more difficulty accessing finance, and face higher borrowing costs, often due to perceived riskiness, and there is evidence suggesting this has can constrain investment (Hambur & LaCava [2018](#)). In addition, small firms often need to provide real-estate as security (Connolly & Bank [2018](#)), which may act as a channel through which housing prices could affect aggregate investment (in addition to any indirect effect of housing prices on broader demand, and thus investment).
- Smaller firms also typically have lower liquidity buffers compared with larger, listed firms (Araujo & La Cava (internal note; 2020), which may affect investment behaviour.
- The COVID-19 pandemic is likely to have affected smaller firms more severely (Lewis & Liu [2020](#)), which may have forced them to cut back on investment by relatively more.
- On the other hand, smaller firms are often granted concessional tax treatment in some areas, while larger firms are excluded. Most recently, and directly relevant for investment, the government has put in place tax incentives for investment, but excluded [large](#) and [very large](#) firms from eligibility at different stages (very large firms remain ineligible). Similarly the GFC investment tax incentives varied in generosity according to firm size (Rodgers & Hambur [2018](#)).

However, limited knowledge of the distribution of investment by firm size in Australia has made it difficult to gauge the extent to which these differences may affect aggregate investment outcomes. To our knowledge there has been little to no research done looking specifically at the distribution of investment by firm size in the Australian context, and relevant international contributions are limited.

In this note I draw upon unit record business tax data to construct and analyse the distribution of investment and output in the Australian economy. This work is intended to generate answers to current questions, but also presents new questions and avenues for future work on the distribution of Australian investment and economic activity.

¹ Many thanks to Gianni La Cava, as well as Business and Trade team members and managers for their helpful comments and input.

Data and approach

Constructing distributions of investment by firm size requires cross-sectional data of sufficient size and quality to be representative of the overall distribution. The increasing availability of confidentialised unit record files (CURF) from administrative sources over recent years, in Australia and overseas, has made distributional and other exciting firm-level analysis much more achievable. In the Australian case, the ABS's Business Longitudinal Analysis Data Environment (BLADE) combines annual business tax data (from business activity statements (BAS)) with information from ABS surveys and other administrative data over time, covering almost the entire population of Australian companies and unincorporated businesses.²

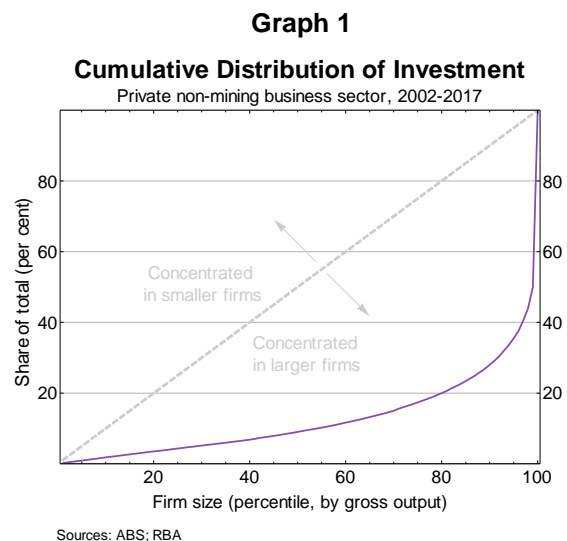
For the analysis in this note, I draw upon the BLADE database (primarily the tax data) and focus on private businesses (incorporated and unincorporated) in the non-mining sector, from financial years 2002 to 2017. The mining sector is excluded as it is well known that a handful of very large firms dominate the sector, whereas very little is known about the non-mining sector. I only include data up to 2017 because from 2018 onwards small businesses (those with annual revenue less than \$2 million) were no longer required to report capital expenditures to the ATO in their BAS'.³

There are a range of approaches to classifying firms by size; the chosen metric can vary between revenue (hereafter referred to as gross output), employee count, wage bill and other alternatives. In addition, once a metric is chosen, firms may be ranked (such as by percentiles) or categorised into pre-defined categories or buckets (such as small, medium, etc.). In this note I classify firms by gross output, which helps to easily link different parts of the analysis. I rank firms by percentiles for each respective year of the sample period, according to their annual gross output. In addition, I classify firms into defined size categories according to output; Small, Medium, Large and Very Large. These size categorisations are useful not just because of their familiarity, but also help to better understand where these categorisations lie in the overall distributions of business counts, investment and output.⁴

Large firms account for a very large share of investment

Investment is highly concentrated in the economy's largest businesses. The top 20 per cent of firms by output represent around 80 per cent of all investment, while the top 1 per cent of firms represent around half of all investment activity (Graph 1).

By business size categories, around 93 per cent of all firms can be classified as Small businesses (annual gross output less than \$2 million), and a further 6 per cent are considered Medium-sized (annual gross output less than \$50 million; Graph 2 & 3).^{5, 6} Together, small and medium enterprises (SMEs) represent more than 99 per cent of all private firms, but only around 60 per cent of non-mining investment.



² BAS (tax) data contains information on firms' output (revenue), capital purchases (investment), wages, and operating expenses.

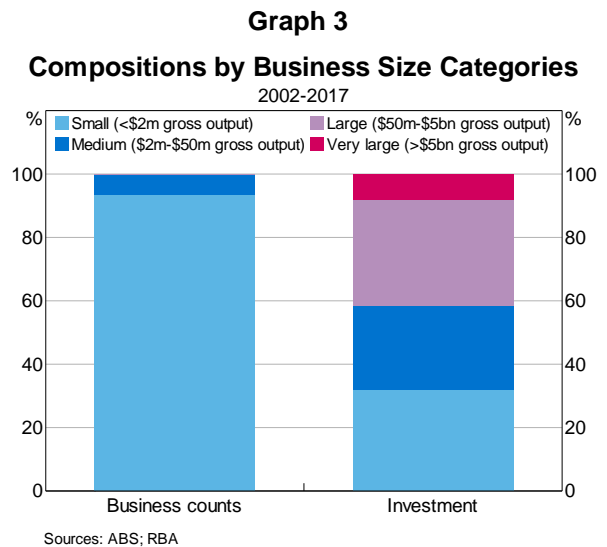
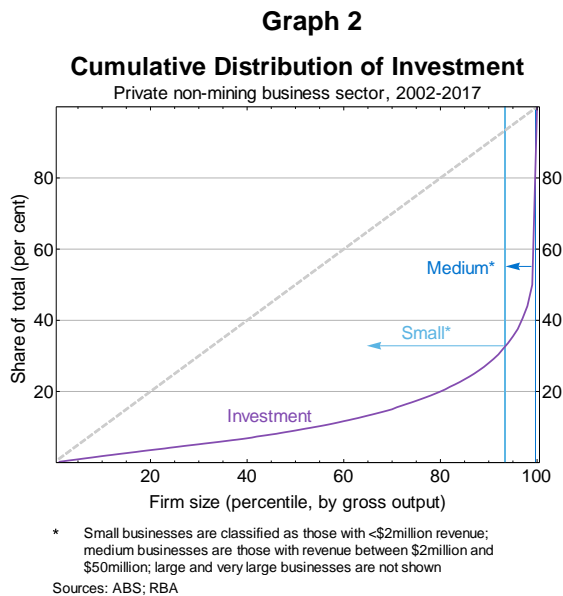
³ In cleaning the data, I exclude firms with annual output less than \$10,000 to remove barely active or extremely small firms.

⁴ A slight disadvantage of size categorisations is that they may be susceptible to upward drift in firm classifications over time due purely to inflationary effects on firm output. However, these effects appear to have only had a modest impact on the subsequent analysis (see footnote 7 for more discussion).

⁵ The definition for small business according to revenue is drawn from the [ATO's definition](#) in place till 2016/17. For medium-sized firms, and SMEs more broadly there is no universally agreed definition, however, by revenue (or gross output), \$50 million appears the most agreed-upon threshold (See [APRA](#), [NAB's SME business surveys](#), and the recent government [SME grantee scheme](#)). The threshold for very large businesses is somewhat arbitrary, but also partly informed by recent investment incentives which [excluded firms with revenue greater than \\$5billion](#).

⁶ The small business share of business counts and gross value added in this analysis is broadly consistent with previous work by [Connolly et al \(2012\)](#), who found that small businesses represent around 96 per cent of businesses and around a third of economic activity. I find a similar share of businesses are small firms, and that small firms represent around 27 per cent of gross profits or gross value added (shown in [Appendix](#) Graph A4).

Meanwhile, Large firms (\$50 million to \$5 billion gross output) represent just 0.3 per cent of all firms, but more than a third of investment. And Very Large non-mining firms (>\$5 billion annual gross output), of which there were only around 30 in 2017 (or 0.005 per cent of firms), accounted for just under 10 per cent of all investment activity.



The distribution has remained quite consistent over the sample period, although investment became slightly more concentrated amongst larger firms from 2008 onwards. Prior to 2008, SMEs represented an average of 63 per cent of investment, but this dropped to 57 per cent from 2008-2017 (See [Appendix](#) Graphs A1 & A2).⁷

Large firms are the major driver of the growth patterns and volatility in aggregate investment

The concentrated nature of investment has meant that the economy's largest firms play a significant role in dictating the patterns in aggregate non-mining investment over time, in terms of both growth and volatility. The time series data constructed using the microdata within BLADE matches the patterns in the annual national accounts relatively closely (Graph 4; and the equivalent by size categories in [Appendix](#) Graph A3).⁸ Investment by the top 1 per cent of firms (dominated by Large and Very Large firms) not only represents a large share of investment (around 50 per cent), but also tends to be more volatile compared with the investment behaviour of smaller firms.⁹

Why the difference in volatility? A large part of the difference is likely to be simply due to the number of firms being aggregated in these two groups; firm-level investment is often characterised as being 'lumpy', 'volatile' or 'intermittent', and this volatility is less likely to 'wash out' for the top 1 per cent of firms simply due to the significantly smaller number of firms being aggregated.¹⁰ Consequently, investment activity by the top 1 per cent of firms has been the major driver behind the patterns seen in aggregate investment over recent decades (Graph 5).¹¹

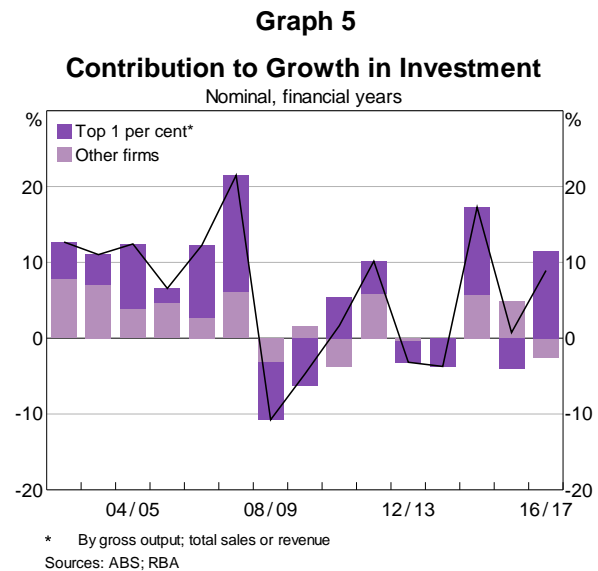
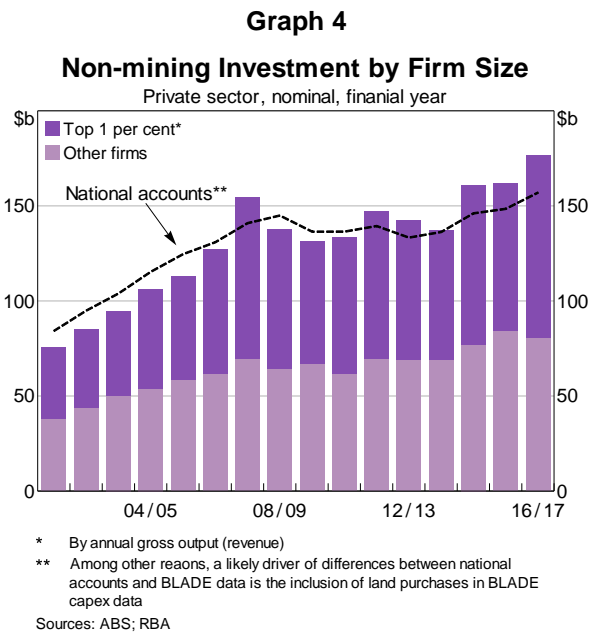
7 While a small part of the decline in the SME share of investment over time is attributable to a slight increase in the share of firms classified as large or very large (in part simply due to inflation), the distribution by percentiles shows a similar decline in the share of investment by the lower end of the distribution from 2008 (See [Appendix](#) Graphs A1 & A2).

8 There are a number of potential reasons for any differences between BAS (and thus BLADE) data and the national accounts. A few of the most notable reasons are: BAS data on investment includes land purchases, while the national accounts does not; most components of national accounts investment draw upon ABS survey data, rather than economy-wide sources; and, mining and non-mining classifications of investment may differ to some degree (further detail can be provided on this at request).

9 Over the sample period, the standard deviation in annual growth of the top 1 per cent of firms was around twice that of other firms.

10 Investment has long been documented in the literature as being characteristically 'lumpy' at the firm level; see the references in footnotes 12 & 13 for examples. In this work, some of the evidence below (Graph 7, and associated commentary) suggests that there is a high degree of lumpiness at small firms, and this may decrease with firm size. This would support the notion that lumpiness increasingly 'washes' out with greater firm numbers given the relative smoothness of aggregate small firm investment. That said, I have not carried out a full, firm-level analysis of investment 'lumpiness' by firm size; potentially a useful avenue for future work.

11 Correlation analysis for the above results was not suggestive of a clear leading-lagging pattern in aggregate investment between the two groups in the annual data; for example, the evidence does not clearly suggest larger firms' investment leads smaller firms (which might be suggestive of spill overs). However, we cannot rule out this possibility; evidence of leading-lagging behaviour may be more apparent at quarterly frequencies, using different firm size groupings, or by looking within industries.



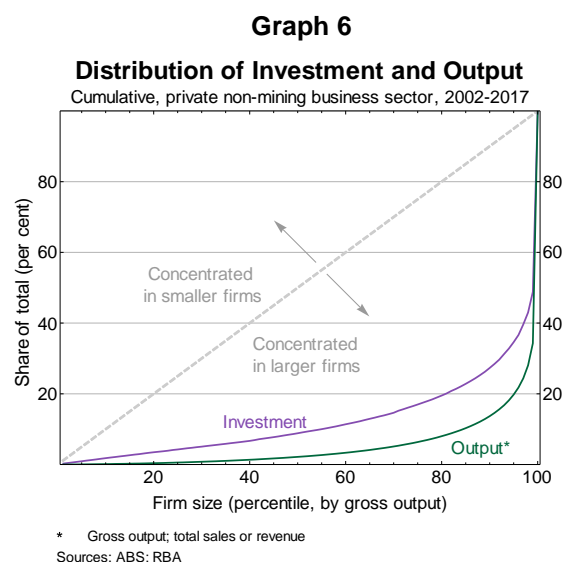
These results seem broadly consistent with the relevant international literature in the area, which emphasises the importance of firm-level investment behaviour at the economy's largest firms in explaining aggregate investment growth.¹² As well as the drivers of growth, these results further our understanding of why aggregate investment is notoriously volatile. Investment is known to be among the most volatile of GDP components, a feature which is often a major hurdle in modelling efforts, and this work suggests that this is likely to at least partly be a consequence of the skewed nature of the firm size distribution; if investment is 'lumpy' at the firm-level (including at large firms), this is unlikely to 'wash-out' at the aggregate level due to the right-skewed investment distribution.^{10,13}

The concentrated nature of investment broadly reflects the concentration in output

A natural question is why the investment distribution is so skewed towards the largest firms. Do larger firms invest proportionally more of their output than small firms? Or do large firms simply have a large share of economic activity?

The answer appears to be the latter – large firms have an extremely large share of economy-wide output. In fact, the distribution of output is more concentrated compared to investment (Graph 6). The largest 1 per cent of firms accounted for almost 70 per cent of output, compared with 50 per cent for investment. The more concentrated nature of the output distribution compared to investment suggests that overall, small firms actually invest more heavily than large firms (relative to their output).

The highly right-skewed nature of the output distribution is consistent with empirical evidence on firm size distributions globally. The literature has generally found that the firm size distribution can be explained by a power law, and that similar distributions are found in natural & biological phenomena, languages (word frequency), network theory, city sizes, and more¹⁴.



12 For example, see Doms and Dunne (1998), Gala & Julio (2012), or on economic activity more broadly see Gabaix (2011), or Nicholls & Hansen (internal note) in the Australian context.

13 There are a number of papers which document and attempt to explain firm-level 'lumpiness' in investment; see Doms and Dunne (1998), Caballero et al (1995) and Cooper & Haltiwanger (2006), among others. Efforts at linking the firm-level to the aggregate data vary. In the Australian context, Cockerall & Pennings (2007) note the difficulties lumpy aggregate investment presents for modelling.

14 For example, see Axtell (2001) and Gaffeo et al (2003)

In the Australian case, there has been some work in the area of firm size distributions such that by Swanepoel & Harrison (2015) which focussed on the distribution of employment by firm size, or that of Connolly et al (2012) and Gilfillan (2018) which focussed on the SME share of economic activity and employment. However, there appears to be no work so far that has constructed full, continuous distributions of output (or economic activity) by firm size for the Australian economy, likely due to the only recent availability of CURF data.

On the investment distribution, Gala & Julio (2012) highlight the importance of the firm size distribution for explaining US aggregate investment dynamics, while others note the importance of firm-level ‘lumpiness’ in investment for aggregate investment (though efforts to link this to aggregate data vary).¹³ However, to our knowledge, there don’t appear to be any clear examples of papers which have actually constructed and presented the investment distribution by firm size, internationally or domestically, making direct comparisons difficult.

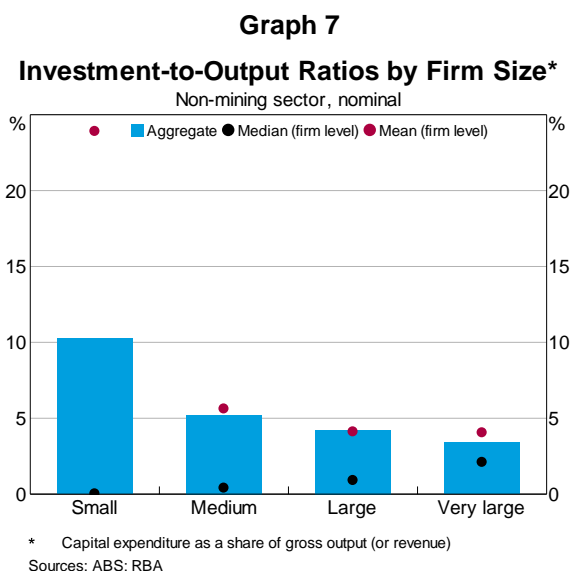
Firm-level investment behaviour by size

The aggregate investment and output distributions (in Graph 6, above) suggested that overall, smaller firms spend a larger share of their output on capital investment. But at the firm-level the picture is more mixed (Graph 7).

The aggregate and mean firm-level investment-to-output ratios are highest amongst small firms, and decline with firm size, suggesting that on average, smaller firms appear to be more capital intensive than larger firms. This is consistent with findings based on US data (See Gala & Julio (2016)). Gala & Julio (2016) argue that this is because firm size acts as a proxy for firms’ unobservable real investment opportunity set, and that technological decreasing returns to scale reduce investment opportunities available to larger firms. Another potential, partial explanation is that smaller firms are more likely to be younger firms, and younger firms are found to be more capital-intensive (See Hambur & Jenner 2019). Future work using the BLADE database could further investigate this.¹⁵

Meanwhile, Graph 7 also shows the median firm investment-to-output ratio is zero for small firms, and *increases* with firm size. The gradual convergence of the aggregate, mean and median investment-to-output ratios with increasing firm size suggest that the investment distribution is more skewed amongst small firms, but becomes less skewed as firm size increases. It is not immediately obvious what kind of behaviour these results suggest, but a couple of possible explanations are that:

- Small and medium-sized firms don’t appear to make capital expenditures as frequently as larger firms (the majority of small firms record zero capital expenditure in any given year). However, when small firms do choose to invest, they may concentrate their capital expenditure into one purchase or particular year (making investment ‘lumpy’). This in turn may be reflective of liquidity constraints on small firms, which might prevent them from investing smaller amounts on a more regular basis.
- Business models, financial health, and firm characteristics more broadly may simply be much more heterogeneous amongst small and medium enterprises, which make up 99 per cent of all firms. And this leads to more heterogeneous investment behaviour. Meanwhile, the small number of large and very large firms may be far more homogenous in terms of financial health and other characteristics which leads to more consistent or narrowly distributed investment behaviour.



¹⁵ Further work could, for example, draw on more granular information on firm industry classifications contained in BLADE.

Conclusions, policy implications and directions for future work

- The firm size distribution is highly right-skewed in Australia; the largest firms make up extremely large shares of aggregate economic activity, consistent with international literature, and investment (though international comparisons are limited for investment).
- Consequently, firm-level idiosyncratic shocks at the economy's largest firms and their responses to those shocks are likely highly important in explaining the growth patterns and volatility seen in aggregate data (such as investment, profits, and possibly even GDP).
- These findings point to the importance of monitoring the economy's largest firms, through liaison and company reports, for helping Economic Group in analysing and forecasting economic aggregates.
- The clear policy implication is that the conditions faced by the economy's largest firms – the economic, fiscal (tax) and financial environments these firms face – are likely to be an important influence on aggregate investment.
- Small and medium firms (SMEs) collectively still count for a sizeable share (just under 60 per cent) of investment. Furthermore, small firms actually invest more heavily than large firms, as a share of their respective outputs, consistent with international evidence.
- While this work has provided answers on some important questions, it also suggests many possible avenues for further work with this dataset. Some potential avenues may be:

Furthering our understanding of firm-level investment behaviour:

- What are the drivers and characteristics of investment at the firm level, including: can we better understand how 'lumpy' investment is by firm size; and, what role do financing constraints (internal and external) play for firms of different sizes?¹⁶
- Why do smaller firms invest a larger share of output, and how does this vary across the business cycle, industries and other firm characteristics (other than size)?

The COVID shock and policy interventions:

- How did firms of differing size and industries adjust their investment behaviour in response to the COVID shock, and can we disentangle the effects of the demand and uncertainty shocks?¹⁷
- How did policy measures like accelerated depreciation allowances and JobKeeper influence investment behaviour across the firm distribution?

Structural questions:

- Can we better understand the links between investment behaviour and productivity by firm size, and how this relates to smaller firms being more investment intensive?
- We are very open to feedback, suggestions and discussion around future avenues of work in this area.

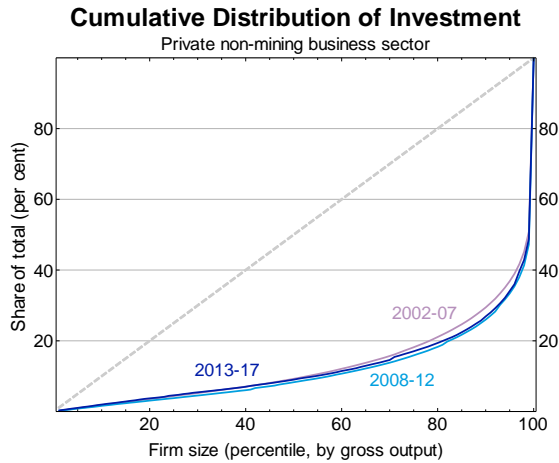
Lachlan Dynan
Economist
Business and Trade
16 February 2020

16 This would be building on La Cava's (2005) work on larger (listed) firms, by looking over the entire distribution. La Cava found that for listed firms: gross output growth was a significant determinant of corporate investment, as was the user cost of capital (including both debt and equity financing costs); and, that cash flows mattered for the investment of both financially constrained and unconstrained firms.

17 Quarterly data for the 2019/20 financial year was just recently added to BLADE, which should allow for analysis of the initial impacts of the crisis (March and June quarters 2020).

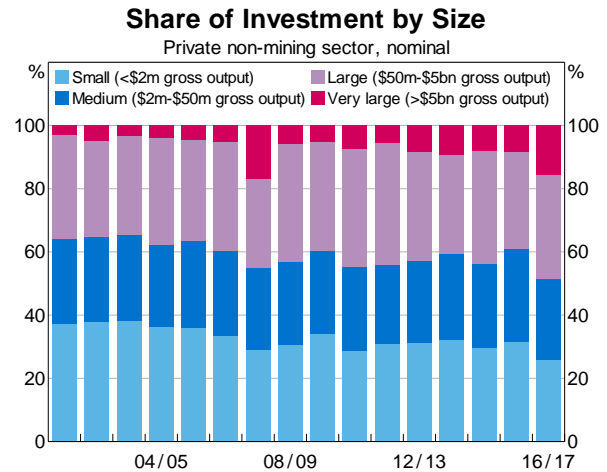
Appendix

Graph A1



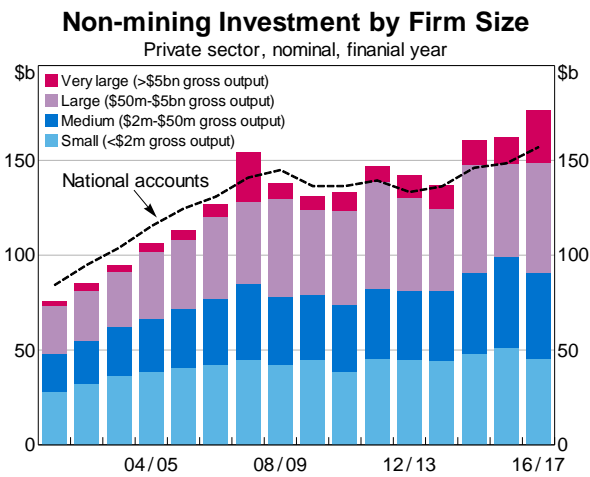
Sources: ABS; RBA

Graph A2



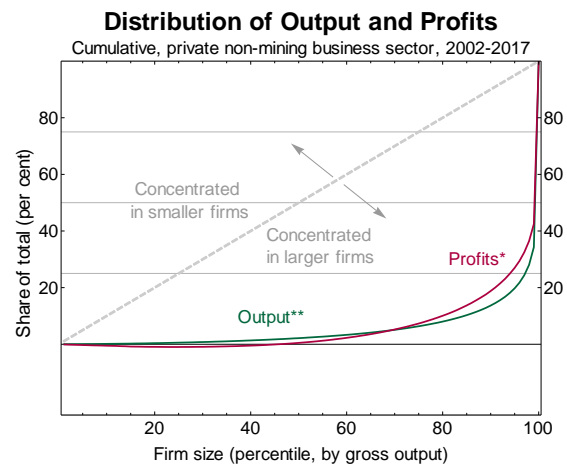
Sources: ABS; RBA

Graph A3



Sources: ABS; RBA

Graph A4



* Gross profits or gross value added are calculated as a firm's revenue minus total wages and operating expenses

** Gross output; total sales or revenue

Sources: ABS; RBA