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Why Do Companies Hold Cash?

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RDP 2016-03

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Abstract

Over the past quarter century, Australian companies have been increasingly holding assets in the form of currency and deposits, or 'cash', rather than investing in other productive assets. This reflects a global trend and raises the question of whether Australian companies now hold 'too much' cash.

Despite Australian non-financial companies holding high levels of cash by international standards, we find little evidence that the increase has been 'excessive'. Instead, we find that the rise in corporate cash is mostly due to changes over time in observable company characteristics, including an apparent increase in the growth opportunities of publicly listed companies (as proxied by Tobin's Q). We also find some evidence of 'cohort effects' as Australian companies are more likely to be 'born', or come into existence, today in industries that have relatively high levels of cash, such as information technology, pharmaceuticals and biotechnology.

We also find evidence that public companies hold more cash than private companies, on average. This is consistent with agency conflicts between owners and managers playing a role in corporate decisions to hold cash.

Overall, we find that, in the face of financing frictions, some Australian companies have speculative and precautionary motives for holding cash. It follows that high levels of corporate cash do not necessarily indicate a weak outlook for corporate investment but might, in some cases, actually imply more investment opportunities.

JEL Classification Numbers: G30, G32

Keywords: cash, private companies, financing frictions, agency costs

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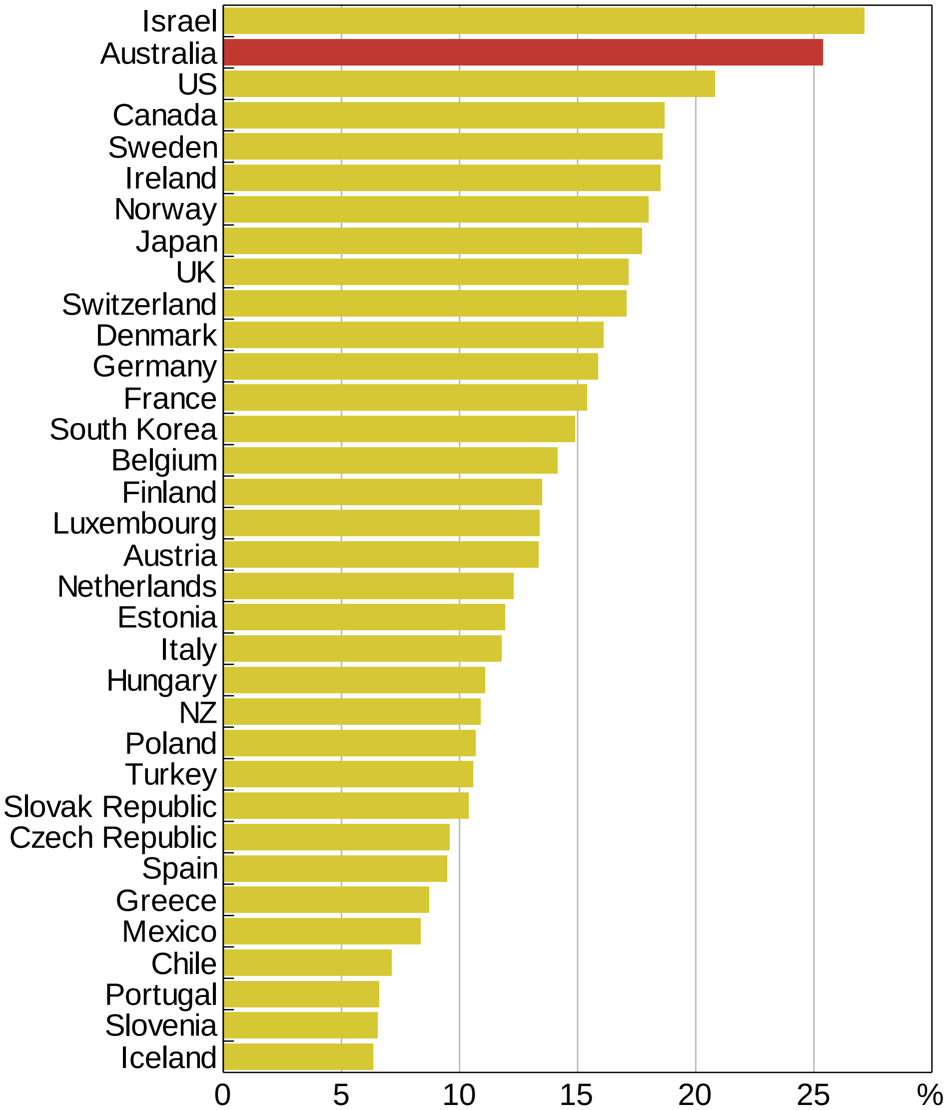
1. Introduction

By international standards, Australian non-financial companies hold relatively high levels of currency and deposits, or 'cash'. Australian publicly listed companies rank second within the Organisation for Economic Co-operation and Development (OECD) in their inclination to hold cash relative to other assets (Figure 1).

Figure 1: Non-financial Corporate Cash

Share of total assets, 1990–2014 average

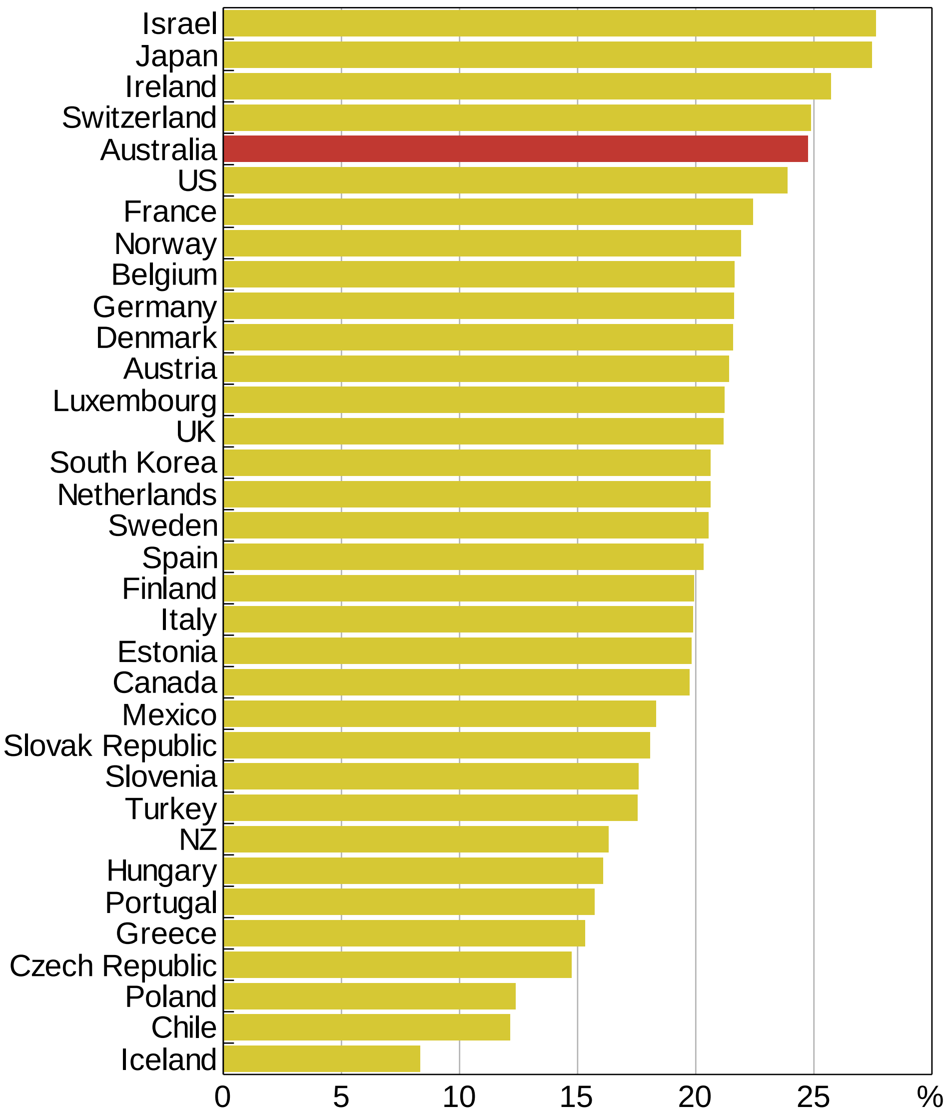


Sources: Authors' calculations; Compustat; Compustat Global

Company-level analysis indicates that Australia's relatively high OECD ranking persists even when controlling for differences across countries in industry composition, average company size, growth, and earnings volatility. On this basis, Australia still ranks within the top five OECD countries (Figure 2).

Figure 2: Non-financial Corporate Cash – Conditional Estimates

Share of total assets, 1990–2014 average



Notes: Based on conditional estimates from a regression with control variables that include size, growth, earnings volatility, industry and year fixed effects; the estimates shown reflect the baseline industry, which is manufacturing, in the baseline year of 2014 and assuming a company of average size, growth, and earnings volatility; changes to the baseline will change the average level of cash holdings, but not the relative ranking of countries

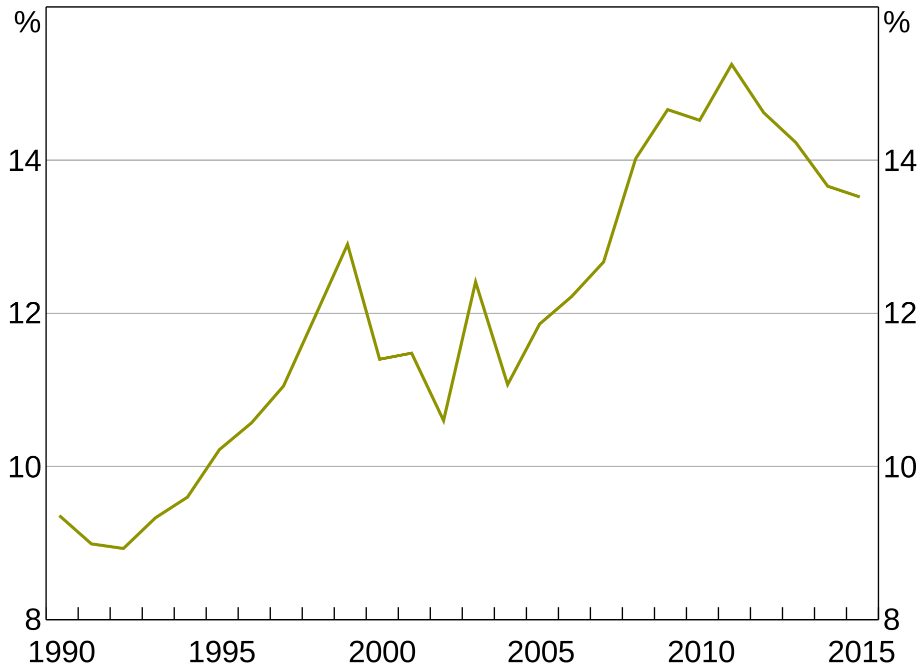
Sources: Authors' calculations; Compustat; Compustat Global

There has also been a secular rise in corporate cash in Australia over the past quarter century. The Australian Bureau of Statistics financial accounts indicate that, in aggregate, the cash-to-assets ratio (hereafter, 'cash ratio') for non-financial corporations rose from 9½ per cent in 1990 to 13½ per cent in 2015 (Figure 3).[1] Company-level analysis indicates that the rise in cash has been broad-based across industries. Moreover, the trend increase in corporate cash holdings in Australia has outpaced that of the OECD average.

1 The aggregate financial accounts estimates of the cash ratio are much lower than that based on the listed public company data shown in Figure 1. This is because the financial accounts measure is an asset-weighted average, whereas the company-level average is unweighted. As smaller companies tend to hold higher levels of cash relative to assets, the unweighted average is therefore much higher. The financial accounts also include private companies and unlisted public companies, which typically hold lower shares of cash than listed public companies.

Figure 3: Aggregate Non-financial Corporate Cash

Share of total assets



Notes: Ratio to total assets (including fixed assets); cash includes: cash, government bonds, deposits and commercial paper

Sources: ABS; Authors' calculations

Despite Australia's international ranking in non-financial corporate cash holdings there has been, to the best of our knowledge, little research into the reasons why Australian companies hold cash.[2] According to Google Scholar, since 1990 there have been close to 10 000 research articles related to 'corporate cash', but only a handful have studied Australian companies.[3]

We aim to fill this gap in the existing literature by exploring the determinants of Australian corporate cash holdings. We also explore why Australian corporate cash holdings have risen over time and examine whether this rise has been 'abnormal' (in the sense that it cannot be explained by fundamentals, such as company size, age and earnings volatility).

Following Keynes (1936), several corporate finance theories have developed to explain why companies hold cash. First, the 'trade-off' theory (Miller and Orr 1966) postulates that a company's optimal cash holdings are determined by the balance between the benefits and costs of holding liquid assets when cash flows are uncertain. The benefits of holding cash include minimising the transaction costs associated with raising external funds or liquidating assets ('the transactions motive') and being able to finance projects in case other sources become too costly ('the precautionary motive'). The main cost of holding cash is the opportunity cost of the money held in liquid assets.

2 Fang, Kosev and Wakeling (2015) provide a detailed overview of recent trends in Australian corporate financing, but do not explicitly consider the long-run determinants of corporate cash.

3 We can find only a few references to Australian corporate cash in international cross-country studies (Iskander-Datta and Jia 2012; Horioka and Terada-Hagiwara 2013).

Second, the 'pecking order' (or 'financing hierarchy') theory (Myers and Majluf 1984) states that to minimise asymmetric information costs, companies should finance their investment first with internal cash then with debt and finally with equity. This theory suggests that companies use cash as a buffer between retained earnings and investment needs.

Third, the 'free cash flow' (or 'managerial excess') theory (Jensen 1986) argues that business managers are prone to pursue their own interest over the interests of owners and creditors, and hence have an incentive to divert resources to activities that personally benefit them. By holding cash, managers increase the amount of assets under their control and gain discretionary power over the company's investment decisions.

We will refer to the first two theories under the broad heading of the 'financing frictions hypothesis'. Under both theories, companies hold cash as a buffer against being financially constrained (either now or in the future). We will refer to the third theory as the 'agency costs hypothesis'.[4] The financing frictions and agency costs hypotheses are not necessarily competing hypotheses; in fact, the two hypotheses are perfectly compatible with each other. Our aim is to gauge the weight of evidence for each hypothesis in explaining why Australian companies hold cash.

These hypotheses are tested using longitudinal information on a large sample of both private and public companies from a database provided by Dun and Bradstreet (D&B). There are important differences between private and public companies that are likely to help shed light on cash management behaviour. Public companies can raise capital from the general public and can have an unlimited number of shareholders. In contrast, private companies cannot raise funds from the public because disclosure is required.[5] The organisational differences between private and public companies are used to directly test the two main hypotheses for holding cash:

1. **Financing frictions hypothesis:** public companies have greater access to external finance than private companies and should hold *less* cash, on average.

2. **Agency costs hypothesis:** public companies typically have greater separation of ownership and management than private companies and should hold *more* cash, on average.

To understand the determinants of the trend increase in cash holdings over the past quarter century, we turn to a separate source of company-level information from Morningstar. We focus on publicly listed companies as the existing evidence suggests that the rise in cash holdings has been largely concentrated among publicly listed companies and long-run panel data are only available for listed companies.

4 Agency costs usually refer to the conflicts between a public company's shareholders and managers. In a public company, agency costs occur when the company's management (or 'agent') puts their own interests above those of shareholders (or 'principals'). In the case of cash holdings, agency costs can include the costs incurred if the manager uses cash to overinvest in negative net present value projects or the costs involved in aligning the incentives of managers with shareholders through appropriate remuneration packages.

5 There are certain specific circumstances when private companies can raise funds without disclosure, for example, when it is a personal offer made to investors that do not need disclosure because of their financial capacity. This notwithstanding, there are still binding limits to the number of shareholders.

Our main contribution to the existing literature is to provide the first detailed analysis of why Australian companies hold cash. A large (and growing) body of international research has analysed the determinants of company cash holdings for the United States (Opler *et al* 1999; Dittmar and Mahrt-Smith 2007; Foley *et al* 2007; Harford, Mansi and Maxwell 2008; Bates, Kahle and Stulz 2009), the United Kingdom (Ozkan and Ozkan 2004), Japan (Pinkowitz and Williamson 2001), east Asia (Horioka and Terada-Hagiwara 2013) and Europe (Riddick and Whited 2009).

The rise in US corporate cash holdings has been described as a 'puzzle' (Pinkowitz, Stulz and Williamson 2013).[6] But, as the international comparison suggests, Australian companies hold more cash than US companies, on average, and this has become increasingly apparent over time. So the Australian 'corporate cash puzzle' seems worthy of investigation.[7]

A common feature of the existing literature is a focus on publicly listed companies, largely due to data availability. But the literature is increasingly examining the behaviour of public and private companies, as the necessary micro data become available. Recent studies have compared the cash management behaviour of public and private companies for the United States (Gao, Harford and Li 2013; Asker, Farre-Mensa and Ljungqvist 2011), the United Kingdom (Gogineni, Linn, and Yadav 2012) and Europe (Akguc and Choi 2013). We contribute to this expanding literature by comparing the cash management behaviour of public and private companies in Australia.

The other contribution of our paper is to provide an empirical assessment of the investment and financing decisions of private companies in Australia. Private companies are a large and underexplored part of the Australian economy. In Australia, 99 out of 100 companies are privately held and account for over 40 per cent of total corporate assets and sales and about one-third of corporate profits. By considering the behaviour of both public and private companies, our results are likely to be representative of the corporate cash management practices of companies in the economy.

An understanding of corporate cash holdings is important from a policy perspective. First, increases in aggregate corporate cash holdings might be important for understanding the current state of corporate profitability, risk and growth. If companies have a precautionary saving motive and are 'hoarding' cash rather than investing or paying out dividends, then this might be evidence that companies expect the economy to slow. Alternatively, if companies have a speculative motive for holding cash, then an increase in cash might be evidence that some companies expect economic conditions to improve in the future.

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6 Another popular explanation for why US companies hold cash concerns repatriation taxes (Foley *et al* 2007; Sánchez and Yurdagul 2013). However, empirical evidence in favour of the repatriation tax motive for US companies appears mixed. And importantly, the Australian taxation system does not appear to provide Australian companies with an incentive to hold cash in the same way as the US taxation system may do for US companies (see Appendix A for more details).

7 Media reports frequently point to the very high levels of cash held by the largest US companies, such as Apple, Google and Microsoft. Similar to the United States, corporate cash is highly concentrated in Australia. However, the degree of concentration has declined over time. This suggests that the secular rise in corporate cash holdings in Australia is not due to a few very large companies, but is a more broad-based phenomenon. We explore this in more detail in Appendix B.

Second, how companies allocate their financial resources is important to monetary policy to the extent that companies build up stockpiles of cash, which affect the transmission of balance sheet (and cash flow) shocks to corporate investment. We find evidence consistent with companies holding cash to buffer against potential shocks. These precautionary holdings of cash might help companies to avoid financing constraints and thereby lower the sensitivity of investment to monetary policy shocks, though we leave such an investigation to future research.[8]

To understand the policy implications of high cash holdings it is important to first understand why companies hold cash and to identify the extent to which those holdings of cash are 'excessive'. This is our main focus; we leave a more detailed exploration of the links between monetary policy, interest rates and corporate cash to future research.

To preview our main results, we find that:

1. Public companies hold more cash, on average, than private companies, suggesting that agency costs play some role in determining cash holdings.

2. The trend increase in the cash holdings of publicly listed companies can be largely explained by changes in observable company characteristics. In particular, relative to their counterparts of 25 years ago, publicly listed companies today have better growth opportunities (as measured by Tobin's Q) and are more likely to operate in 'risky' industries (with relatively high earnings volatility), and these characteristics are correlated with higher levels of corporate cash. This suggests that financing frictions are important too, and that some companies have precautionary and speculative motives for holding cash.

3. By historical standards, cash holdings of Australian publicly listed companies are not 'excessive' after accounting for observable company characteristics.

2. Institutional Background

There are differences in the organisational structure of private and public companies.[9] For our purposes, the most important differences are:

1. **Public companies have more financing channels:** public companies can raise equity from the general public via share offers with prospectuses, while private companies cannot.

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8 Alternatively, high levels of cash might make the economy *more* sensitive to monetary policy. Adão and Silva (2015) suggest that high levels of cash might make the economy more sensitive to monetary policy because it lowers the speed at which the real interest rate adjusts back to its equilbrium level. The real effects occur because companies use their cash in different ways, according to their cash holdings at the time of the shock. Companies with little cash adapt faster to the shock while companies with large cash holdings take longer to adapt. The different reaction in spending makes the price level move slowly after an increase in the nominal interest rate. Therefore, monetary policy has a more protracted effect on the economy.

9 Public and private companies are distinguished by their ownership structure and their disclosure requirements. There are also differences between companies (incorporated businesses) and unincorporated businesses. Companies have a separate legal identity and are owned by shareholders, who have limited liability for business debts. In contrast, unincorporated businesses are not separate legal entities, so their owners are personally liable for any business debts incurred. Unincorporated businesses include sole proprietors, partnerships and trusts. The aggregate financial accounts data indicate that unincorporated business cash holdings have been rising over time (relative to GDP), though not as much as company cash holdings.

2. **Public companies have a more dispersed ownership structure:** public companies have no limit on the number of shareholders, while private companies must have no more than 50 non-employee shareholders.

3. **Public companies have greater disclosure requirements:** compared to public companies, small private companies are not generally required to report their financial statements to shareholders, and all private companies are not required to hold annual general meetings (AGMs) unless it is in their constitution (Table 1). The accounts of private companies are therefore generally less visible to owners than public companies, giving private company managers potentially more discretion in decision-making

Table 1: Company Disclosure Requirements

Under the *Corporations Act*

	Private		**Public**	
	Small	Large	Unlisted	Listed
Reports?	No[(a)]	Financial report Directors' report	Financial report Directors' report	Financial report Directors' report Remuneration report
Audit?	No	Yes	Yes	Yes
Reporting to members?	No	+4 months[(b)]	+4 months[(b), (c)]	+3 months[(b)]
AGM?	No[(d)]	No[(d)]	Yes	Yes (≥ 28 days' notice)
Constitution?	No	No	Yes	Yes
Directors voting on personal interests?	Yes	Yes	No[(e)]	No[(e)]

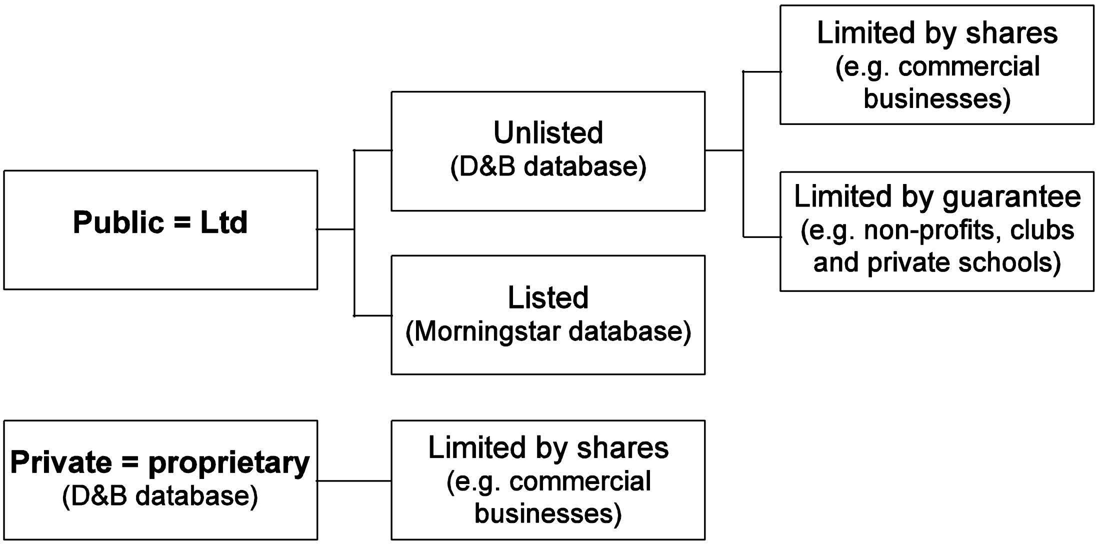
Notes: (a) Members holding 5 per cent or more of the votes, or the Australian Securities and Investment Commission, can require a financial and directors' report for a financial year (and direct them to be audited), and send them to all shareholders
(b) After company's financial year end
(c) Or 21 days prior to AGM, whichever is earlier
(d) Unless in constitution
(e) Unless the other directors are satisfied that the interest should not disqualify the director from voting

Source: Governance Institute of Australia

As Figure 4 highlights, public companies can be further divided into listed companies and unlisted companies (i.e. companies that issue shares that are not traded on a public exchange). An example of a private company in Australia is the transport company Linfox; an example of an unlisted public company is the food company Bundaberg Sugar; and an example of a listed public company is the conglomerate Wesfarmers.

Figure 4: Public and Private Companies in the Databases

Under the *Corporations Act*



Source: Governance Institute of Australia

3. Identification

We take two separate approaches to identify the determinants of company cash in Australia. First, we compare the cash management behaviour of public and private companies. This allows us to directly test the relative importance of the financing frictions and agency costs hypotheses. Second, we focus on the long-run cash management behaviour of publicly listed companies. This provides further insight into the drivers of the secular rise in aggregate cash and allows us to examine whether the long-run rise is in line with fundamentals or not.

3.1 Comparing Public and Private Company Cash

To the extent that private companies disclose less financial information than public companies, the lower transparency of private companies is likely to be associated with greater asymmetric information, and hence more costly external finance for private companies (Table 1). This, in turn, implies that private companies may face higher financing frictions than public companies, and hence have a higher precautionary (and speculative) demand for cash.

This give rise to our first hypothesis:

- **H1:** Private companies should have higher levels of cash, on average, than public companies if there are financing frictions, all else equal.

Agency costs occur when corporate managers and shareholders have conflicting interests. Private companies should have fewer agency conflicts than public companies; they have more concentrated ownership structures and are typically more reliant on debt creation to fund investments. A greater reliance on debt effectively forces private companies to pay out future cash flows in interest and principal repayments and gives managers less discretion in the use of funds (Jensen 1986). Higher agency costs among public companies – resulting from a separation of ownership and control – could encourage the financial managers of public companies to hold more cash and to accumulate more cash in good times. Such behaviour would enable these companies to exercise more discretion in financing future investments.

This give rise to our second hypothesis:

- **H2:** Private companies should have lower levels of cash, on average, than public companies if agency costs affect corporate cash policies, all else equal.

In the presence of agency costs *and* financing frictions it is unclear whether public or private companies should hold more cash. But, the finding that the cash holdings of public companies are higher and/or more sensitive to cash flows compared to private companies provides evidence in support of agency costs.

Our modelling approach and hypotheses are similar to that of Gao *et al* (2013) for the United States.[10] Although Gao *et al* focus on the level of cash holdings across public and private companies in the United States, in our extensions we also examine the sensitivity of cash holdings to cash flows across public and private companies.

To begin, we estimate the following company-level panel regression model:[11]

$$CASH_{it} = \beta PUBLIC_i + \gamma CONTROLS_{it} + \alpha_i + \varepsilon_{it} \tag{1}$$

where the dependent variable is the cash-to-assets ratio ($CASH_{it}$) of company i in year t. We define 'cash' as the stock of currency, deposits and other liquid securities, such as government bonds. This definition captures all financial instruments that a company can use to buffer against adverse shocks or to respond quickly to new investment opportunities.

The key explanatory variable in Equation (1) is a dummy variable ($PUBLIC_i$), which is equal to one if company i is public and is equal to zero if the company is private. This dummy variable captures the average difference in cash holdings for public and private companies, conditional on other observable company characteristics.

Our choice of control variables ($CONTROLS_{it}$) is guided by theory and previous studies (Gao *et al* 2013). We include the following, which are all normalised by total assets except company size and age:[12]

10 Other studies have also examined the effect of agency costs on public companies' liquid asset holdings by exploiting variation in agency conflicts across different types of corporate governance, but with mixed results. Dittmar *et al* (2003) study cash holdings across different economies and find that in places where investor protection is lower companies hold more cash. On the other hand, Harford *et al* (2008) find that companies with more entrenched managers actually hold comparatively less cash than otherwise similar companies.

11 All of the results are robust to the inclusion of time fixed effects that control for the overall business cycle. For simplicity, they are excluded from the notation here.

12 As robustness, however, we employed several alternative definitions, including taking the natural logarithm of the variables and normalising them by total assets *less* cash. The results (available upon request) are not affected in a material way when using these alternatives.

- Company size (*SIZE*): measured as the natural logarithm of real assets. This captures the transactions demand for cash; there are economies of scale in cash holdings such that larger companies tend to use cash more efficiently.

- Company age (*AGE*): measured as the difference between the current reporting year and the year of registration. This should partly reflect financing frictions as younger companies are typically less well known and therefore more likely to find it difficult to raise external funds from creditors.

- Cash flow (*CASHFLOW*): measured as earnings before interest, tax, depreciation and amortisation. This potentially captures financing frictions as financially constrained companies will be more sensitive to cash flows. It may also capture agency costs if managers aim to increase their decision-making control by saving cash out of earnings.

- Industry cash flow risk (*RISK*): measured as a rolling standard deviation of cash flows divided by assets and averaged across industries.[13] This captures the precautionary demand for cash as companies operating in riskier industries are more likely to hold cash.

- Leverage (*LEVERAGE*): measured as total debt divided by assets. According to the financing hierarchy, cash (internal finance) is a cheaper alternative to debt in financing investment, implying a negative correlation between cash and leverage.

- Capital spending (*CAPEX*): measured as spending on property, plant and equipment. This captures the precautionary demand for cash, as companies with large capital spending commitments face larger costs if financing conditions deteriorate, so we would expect a positive correlation with cash holdings.[14]

- Net working capital (*WORKINGCAPITAL*): measured as the stock of inventories and short-term receivables outstanding. Inventories and trade credit should be negatively correlated with cash to the extent that they are substitutable forms of liquidity.

As Gao *et al* (2013) recognise, sample selection is likely to be an issue in modelling cash holdings because companies are not randomly assigned to being either public or private. Rather, the decision to be a public company might be correlated with unobserved company characteristics that determine the level of cash holdings.

To the extent that the choice to be public is determined by company characteristics that are fixed over time, we control for this endogenous sample selection through the inclusion of company fixed effects (α_i) in Equation (1). The company fixed effect controls for unobserved time-invariant company characteristics that explain why some companies hold more cash than others on average (e.g. the company's business model or its level of risk aversion).

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13 The variable *RISK* is constructed in two steps. First, for each company, a rolling standard deviation of cash flows (net cash flows from operating activities) to assets is calculated using the previous two years of data. Second, for each year, these company-specific measures of cash flow risk are averaged by industry.

14 If capital spending creates assets that can be used as collateral, then capital spending could increase the borrowing capacity of the company and reduce the demand for cash.

However, the inclusion of the company fixed effect creates an issue in estimation as it will be perfectly collinear with the dummy variable for whether a company is public or not. To circumvent this, we estimate a 'correlated random effects' (CRE) model (Mundlak 1978; Chamberlain 1982). Given the model is not commonly used, particularly in the corporate finance literature, it is useful to provide a detailed outline. Suppose the true model is:

$$CASH_{it} = \beta PUBLIC_i + \gamma X_{it} + \alpha_i + \varepsilon_{it} \tag{2}$$

where X_{it} is a set of time-varying explanatory variables, $PUBLIC_i$ is the time-invariant explanatory variable (of most interest here) and α_i is the unobserved fixed effect. Assume:

$$E\left[\varepsilon_{it} \middle| X_{it}, PUBLIC_i\right] = 0$$

$$E\left[\alpha_i \middle| X_{it}, PUBLIC_i\right] \neq 0$$

we can explicitly model the non-zero correlation between the unobserved fixed effect and the observed explanatory variables. Given the fixed effect only varies in the cross-section, if it is correlated with X_{it} in period t, then it will be correlated with X_{is} in period s (where $s \neq t$). In this case, we need to model its correlation with the explanatory variables that do vary over time (e.g. $SIZE$). Assuming that the relationship is linear:

$$E\left[\alpha_i \middle| X_{it}, PUBLIC_i\right] = \theta_1 X_{i1} + \theta_2 X_{i2} + \theta_3 X_{i3} + \ldots + \theta_T X_{iT} + \chi PUBLIC_i$$

Furthermore, if we assume that the correlation between the fixed effect and the explanatory variables is the same in each period (i.e. that $\theta_1 = \theta_2 = \theta_3 = \theta$) then the above reduces to:

$$E\left[\alpha_i \middle| X_{it}, PUBLIC_i\right] = \theta \bar{X}_i + \chi PUBLIC_i$$

where $\bar{X}_i = \Sigma_t X_{it} / T_i$ is the temporal mean of the explanatory variable X and T_i is the total number of observations for company i (this can vary by company because of the unbalanced nature of the panel).

Now define a new (unobserved) fixed effect, $\alpha_i^* \equiv \alpha_i - \theta \bar{X}_i - \chi PUBLIC_i$. Therefore:

$$E\left[\alpha_i^* \middle| X_{it}, PUBLIC_i\right] = E\left[\alpha_i \middle| X_{it}, PUBLIC_i\right] - \theta \bar{X}_i - \chi PUBLIC_i = 0$$

By construction, this new fixed effect is not correlated with any explanatory variables. Equation (2) can be rewritten as:

$$CASH_{it} = \left(\beta + \chi\right) PUBLIC_i + \gamma X_{it} + \theta \bar{X}_i + \underbrace{\alpha_i^* + \varepsilon_{it}}_{\nu_{it}}$$

where $\nu_{it} = \alpha_i^* + \varepsilon_{it}$ is the new error term. This modified model satisfies the assumption that the explanatory variables and the company fixed effect are uncorrelated (i.e. $E\left(\alpha_i^* \middle| X_{it}\right) = 0$).[15] So we can run random effects on this model and obtain a consistent estimate of the effect of the binary indicator for whether the company is public or not.[16]

3.2 The Secular Rise in Publicly Listed Company Cash

We follow a more standard approach to examine the determinants of the long-run trend in corporate cash holdings (Opler *et al* 1999; Bates *et al* 2009). The model is estimated on a sample of publicly listed companies covering the period from 1990 to 2014. The regression model is specified as:

$$CASH_{it} = \rho CONTROLS_{it} + \delta_i + \lambda_t + \nu_{it} \tag{3}$$

where the variables are defined similarly to Equation (1). In particular, the dependent variable is the cash-to-assets ratio ($CASH_{it}$) for each listed company in each year. The set of control variables ($CONTROLS_{it}$) includes a slightly broader range of variables than before as listed companies provide more detailed balance sheet information. In addition to the control variables listed earlier, we include two explanatory variables that are designed to capture growth opportunities (but are only available for listed companies):

- Market-to-book ratio or Tobin's Q (TQ): companies with greater investment opportunities are thought to value cash more since it is costly for these companies to be financially constrained. Tobin's Q is measured as the company's market value (shares outstanding $\times$ share price) divided by the book value of net assets. A company's book value is assumed to capture the value of its existing assets, while the market value captures both the value of its existing assets and its growth opportunities.[17]

- Research and development expenditure-to-assets ratio ($R\&D$): we expect a positive correlation with cash holdings as research and development spending is typically correlated with growth opportunities and company-level risk.

4. Data

To examine corporate cash holding behaviour we utilise two unique sources of Australian company-level panel data that cover both public and private companies and are provided by D&B and Morningstar.

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15 As noted, this model relies on the assumption that the correlation between the fixed effect and each of the explanatory variables does not change over time. If the correlation did vary over time, a key assumption of the CRE model would be violated. To address this possibility, we also estimate a Hausman-Taylor (HT) model in Appendix D.

16 In this example, the binary variable $PUBLIC_i$ has a direct effect (captured by β) and an indirect effect (captured by χ) on cash holdings.

17 We recognise that the literature is divided as to whether Tobin's Q is a good measure of corporate performance. Some studies suggest that it is an appropriate indicator after correcting for measurement error (Erickson and Whited 2012), while others suggest it is not a good measure (Dybvig and Warachka 2015). We have experimented with an alternative measure of growth performance based on current sales growth and our key results are unaffected.

4.1 The Dun and Bradstreet Database

In the D&B data there are around 4 000 private companies and 1 400 *unlisted* public companies (those with shares that are not traded on a public exchange), and the annual data cover a 10-year sample window from 2005 to 2014.[18]

The D&B sample of companies is based on its primary business as a credit bureau. Companies in the database are likely to be those that apply for credit, and D&B can most easily obtain financial information on relatively large private and unlisted public companies, which are required to file their financial reports with the Australian Securities and Investment Commission (Table 1). As a result, compared to the population of all private and unlisted public companies in Australia, the sample is biased towards larger companies, though it does still have some coverage of very small companies (those with revenue less than $0.5 million).

The slant towards larger companies that want to borrow does not necessarily undermine the motivation for our work. In fact, it is not clear how this will bias our results (see Appendix C). Moreover, the selection criteria and variables of interest included in the database are consistent across public and private companies, which allows us to make direct comparisons.

In the unbalanced D&B panel of private and public companies, about 75 per cent of companies are observed for two years or more; 50 per cent of companies are observed for three years or more; and 25 per cent of companies are observed for five years or more.

Summary statistics for the D&B data are presented in the first two blocks of Table 2. Unlisted public companies are smaller than private companies, on average, though for both groups of companies holdings of total assets are unevenly distributed, with the mean level of assets above the 75th percentile of the distribution.

Table 2 shows that cash ratios are higher for unlisted public companies compared to private companies and that unlisted public companies tend to be older than private companies. Likewise, capital spending as a share of total assets is generally larger for unlisted public companies.

The ratio of cash flows (or earnings) to assets is quite similar across public and private companies.[19] Cash flows are more volatile for private companies as measured by the standard deviation in company-level cash flows (averaged across industries). The ratio of working capital (measured as the stock of inventories and short-term receivables outstanding) to assets is substantially larger for private companies. Finally, private companies are more leveraged as they are more reliant on debt, while public companies are able to tap public equity markets.

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18 In this paper, financial companies are excluded because they may carry cash to meet capital requirements that are unrelated to the reasons investigated in this paper. Likewise, utilities companies are dropped because their cash holdings – in part – may be determined by regulations. In most cases the data used are financial year-ended; however, in some instances companies report calendar year-ended figures, or annual figures ended in other months.

19 It may seem surprising that the cash flow-to-assets ratio for listed public companies is negative, on average. However, this appears to reflect a relatively large share of Australian listed companies that are small mining exploration companies that typically report losses. The high share of companies reporting losses can also be observed in Australian Taxation Office data on company profitability.

Table 2: Summary Statistics

	Mean	25th percentile	Median	75th percentile
Private D&B companies: 2005 to 2014				
Real total assets ($m)[(a)]	80.1	14.8	27.2	63.4
Cash ratio (%)	11.4	1.8	6.5	15.9
Age (years)	23	11	19	30
Capex ratio (%)	3.8	0.7	1.9	4.6
Cash flow ratio (%)	8.9	1.1	8.0	16.3
Risk (ppt)	18.4	9.3	13.2	18.3
Working capital ratio (%)	46.2	24.6	46.9	68.2
Leverage ratio (%)	62.6	40.7	60.3	79.9
Number of observations		14 646		
Number of companies		4 085		
Unlisted public D&B companies: 2005 to 2014				
Real total assets ($m)[(a)]	70.3	6.3	15.8	43.1
Cash ratio (%)	16.3	3.3	8.6	21.7
Age (years)	35	18	34	43
Capex ratio (%)	6.6	1.8	4.4	8.8
Cash flow ratio (%)	7.4	2.5	6.9	12.0
Risk (ppt)	13.7	7.0	9.1	13.9
Working capital ratio (%)	12.7	1.3	3.5	14.1
Leverage ratio (%)	40.7	19.7	34.6	55.2
Number of observations		5 038		
Number of companies		1 402		
Listed public Morningstar companies: 1990 to 2014				
Real total assets ($m)[(a)]	623.2	8.0	23.5	104.6
Cash ratio (%)	26.2	4.4	14.4	40.7
Age (years)	17	6	12	23
Capex ratio (%)	5.3	0.3	2.0	6.6
Cash flow ratio (%)	–7.1	–10.3	–1.5	5.7
Risk (ppt)	12.8	7.0	12.5	15.2
TQ (ratio)[(b)]	2.1	0.8	1.2	2.1
Research and development ratio (%)	8.1	0.1	0.9	6.5
Working capital ratio (%)	–3.6	–6.9	–1.1	5.9
Leverage ratio (%)	31.1	5.0	20.1	45.1
Number of observations		23 562		
Number of companies		1 954		

Notes: (a) June 2013 dollars
(b) Tobin's Q is equal to the company's market value (shares outstanding multiplied by share price) divided by the company's book value (net assets)

Sources: Authors' calculations; D&B; Morningstar

4.2 The Morningstar Database

For the longer-run analysis, we use detailed financial statement information for Australian *publicly* listed companies provided by Morningstar. This database covers a narrower sample of companies (at around 2 000 companies) than the D&B database, but a much longer sample window of 1990–2014. This allows us to better gauge the determinants of the long-run trend increase in corporate cash holdings.

About 75 per cent of companies are observed for 7 years or more; 50 per cent of companies are observed for 11 years or more; and 25 per cent of companies are observed for 17 years or more.

While it is difficult to make direct comparisons between the listed public companies and unlisted public companies as some of the data definitions vary across databases (see Appendix C), generally speaking listed public companies are much larger than their unlisted counterparts (Table 2, third block). The cash ratios of listed public companies are also larger than unlisted public companies.

5. Stylised Facts

In this section we document some stylised facts about Australian corporate cash holdings. We use both company-level databases to examine the associations between corporate cash holdings and various company-level characteristics, with a particular focus on three key characteristics: the size, 'riskiness' and 'age' of the company. Because private and unlisted public companies are directly comparable within the same database, we also look for any interesting differences between the cash management behaviour of unlisted public versus private companies.

Trends in the cash-to-assets ratio of unlisted public, private and listed public companies are provided in the top panel of Figure 5. Since the mid 2000s, the unlisted public company cash ratio has been broadly unchanged, while for private companies, it appears that the cash ratio has been edging higher. Interestingly, the global financial crisis did not have a discernible effect on corporate cash holdings, at least in aggregate.

Looking at the longer-term trend for listed public companies, the mean cash ratio peaked in 2007 at 36 per cent, about three times higher than the trough in 1990.[20] Since 2012, however, listed public companies' cash holdings have decreased relative to total assets.

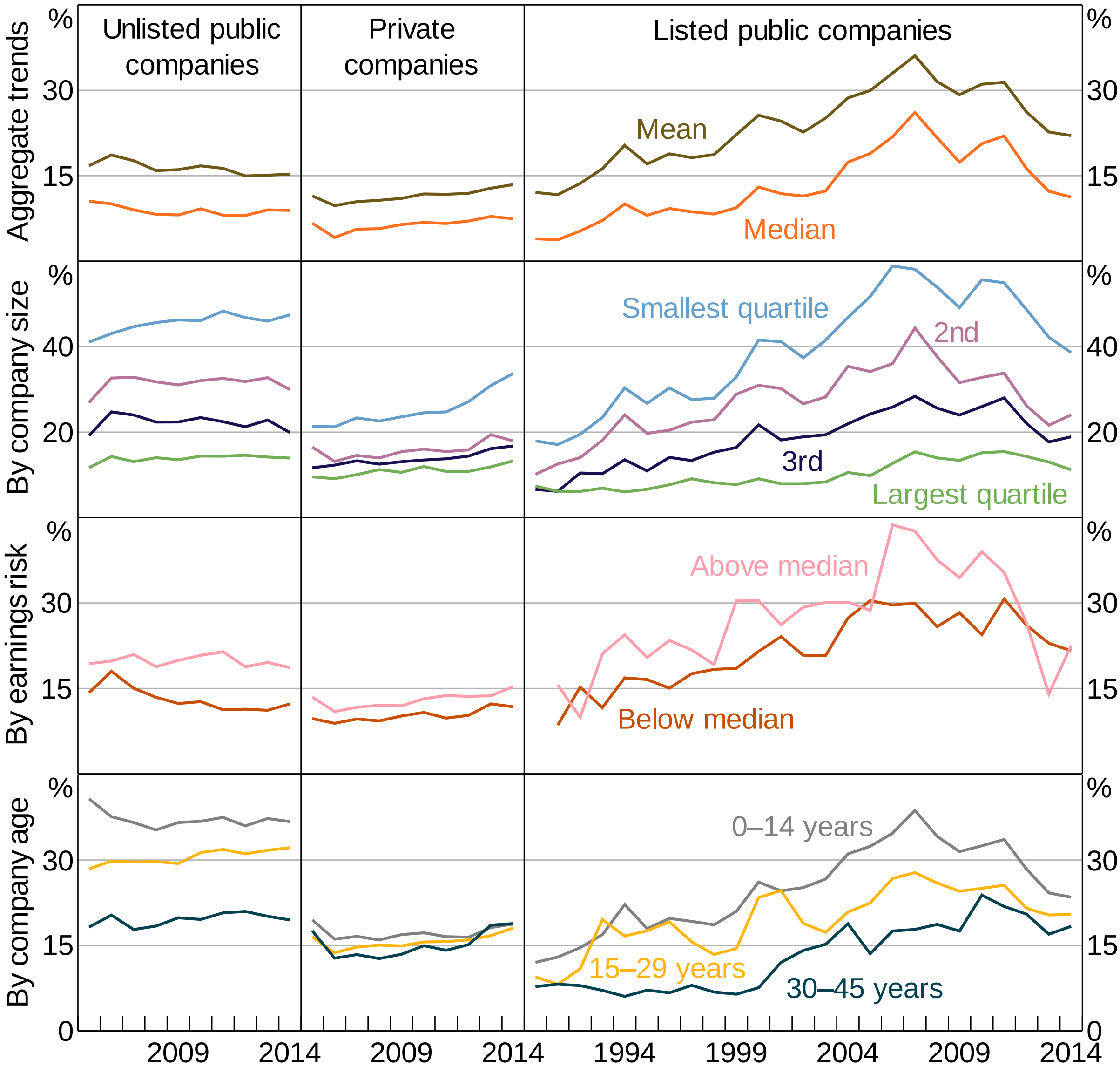
To examine the role of size we split companies into quartiles based on their real assets (Figure 5, second panel). Small companies tend to hold relatively more cash than large companies, on average. This is true regardless of whether they are a public (unlisted or listed) or private company. For example, within unlisted public companies, the cash ratio of the smallest companies is over 30 percentage points higher than the cash ratio of the largest companies, on average. Similarly, the mean cash ratio of the smallest private companies is over 20 percentage points higher than that of the largest private companies. These differences are, at least in part, explained by the fact that larger companies – and in particular, larger public companies – are more likely to have a credit rating and an established reputation in debt markets, thereby making it cheaper to

20 The mean plotted here is an unweighted mean across all companies. The asset-weighted cash ratio exhibits a less-pronounced run up, peaking at 10 per cent in 2009, 4 percentage points higher than the trough in 1994.

tap outside funds.[21] This points to some preliminary evidence in favour of the *financing frictions hypothesis*.

Industry risk also appears to be important to average cash holdings, which is consistent with the presence of financing frictions and a precautionary saving motive (Figure 5, third panel). Companies in industries with riskier cash flows typically hold more cash (where *RISK* is measured using a rolling standard deviation of the cash flow-to-assets ratio). This is generally true for all company types. Also consistent with the precautionary saving motive, it appears that younger public companies tend to hold more cash than their older counterparts. However, the relationship between age and cash is noticeably weaker for private companies.

Figure 5: Cash Ratios



Notes: For each company type (unlisted public, private and listed public), size quartiles are constructed from the real total asset distribution, deflated by the GDP deflator; risk groups are constructed for each year from the company type's cash flow risk distribution

Sources: Authors' calculations; D&B; Morningstar

21 They are also more likely to have lines of credit, thereby making them less reliant on liquid asset holdings. For example, Sufi (2009) finds that size is a strong predictor of the use of credit lines among US companies.

Finally, we directly compare the cash ratios of unlisted public and private companies within the D&B database. We find that unlisted public companies hold more cash than private companies, on average. This is true even within size, risk and age groups (Table 3). This provides some preliminary evidence in support of the idea that agency costs affect corporate cash holdings.

Table 3: Cash Ratios of Unlisted Public and Private Companies

	Unlisted public	Private	Difference	*p-value*
Size quartile				
Smallest	22	14	8	0.00
2nd	15	11	4	0.00
3rd	12	11	1	0.05
Largest	9	10	0	0.28
Risk				
Below median	13	10	3	0.00
Above median	21	13	8	0.00
Age				
Young (0–14 years)	21	11	10	0.00
Middle (15–29 years)	20	12	8	0.00
Old (30–45 years)	13	12	1	0.01

Sources: Authors' calculations; D&B

6. Results

6.1 The Determinants of Corporate Cash

The results of estimating Equation (2) are shown in Table 4. The pooled ordinary least squares (OLS) estimates indicate that public unlisted companies hold 1 percentage point more of their assets in cash than private companies, on average. The effect is estimated to be slightly stronger in the CRE model, with public companies having a cash-to-assets ratio that is 2 percentage points higher than that of their private counterparts, on average. The results are even stronger when we employ nearest neighbour matching techniques (Section 7.2) and when using a Hausman-Taylor (HT) model as a further robustness check (Appendix D). Each of the coefficient estimates are statistically significant. Taken together, the relatively high share of assets held in cash by public companies is evidence in favour of the agency costs hypothesis and is consistent with recent overseas research.

Turning to the control variables, we find, as expected, that size is inversely related to cash holdings; as a company grows larger, the cash-to-assets ratio typically declines, suggesting that there are costs in holding cash. However, the statistical significance of this result is sensitive to the specification of the model. The inclusion of company fixed effects in the CRE and HT models leads to the correlation becoming statistically insignificant. This suggests that size is correlated with the unobserved company fixed effect.

Table 4: The Role of Company Characteristics
Public and private companies

	OLS	CRE
Unlisted public (β)	**0.01*****	**0.02*****
SIZE	–0.02***	–0.00
AGE	–0.00***	–0.00**
CAPEX	–0.44***	–0.18***
CASHFLOW	0.13***	0.12***
RISK	0.05***	–0.00
WORKINGCAPITAL	–0.11***	–0.13***
LEVERAGE	–0.04***	–0.03***
Number of observations	20 381	20 381
R^2	0.14	
Within R^2		0.13
Company fixed effects	No	Yes

Notes: Sample includes all company-year observations with non-missing values for the independent variables; outliers excluded; robust standard errors clustered at the industry level used to accommodate within-industry serial correlation; ***, **, and * denote significance at the 1, 5 and 10 per cent level, respectively

Sources: Authors' calculations; D&B

The negative coefficient estimates on age indicate that companies typically reduce their cash holdings as they become older, on average. This might point to the presence of financing frictions for younger companies. However, the economic effect of age is relatively small – an increase in age of 10 years is associated with cash holdings falling by around ½ to 1 percentage point relative to assets, on average.

Industry-level risk is positively associated with cash holdings, though the effect is only statistically and economically significant in the pooled OLS specification. This suggests that most of the company-level risk is idiosyncratic and absorbed by the company fixed effects. We also find evidence that working capital is a substitute for cash, with a one standard deviation increase in the share of assets devoted to working capital being associated with a 3 percentage point decline in average cash holdings.[22] Also, higher levels of capital spending and leverage are associated with lower levels of corporate cash, on average.

Finally, the positive correlation between cash flow and cash holdings across all models is consistent with the 'pecking order' theory of financing sources, with companies saving at least some of the cash flow generated by their operations as a potential source of future internal funding. For every 1 percentage point increase in cash flows as a share of assets, companies save around 13 basis points in cash.

22 This finding is consistent with the theory outlined by Gao (2013) who suggests that improvements in inventory management, such as the adoption of just-in-time technology, have reduced inventory holdings and increased cash holdings over time.

6.2 The Determinants of Listed Company Cash Holdings over Time

The regression output from estimating Equation (3) is provided in Table 5. In general, the coefficients on the key explanatory variables are of the expected sign and statistically significant. Moreover, the estimated correlations are generally consistent with that observed in the broader sample of public and private companies. This is true when we estimate the model using a pooled OLS regression and when we allow for company fixed effects (FE). (In unreported results, we also find very similar coefficients when estimating the model separately for resource and non-resource companies.)

Table 5: The Role of Company Characteristics
Publicly listed companies

	OLS	FE
SIZE	–0.02***	–0.04***
AGE	–0.00***	0.00
CAPEX	–0.30***	–0.26***
CASHFLOW	–0.14***	–0.04
RISK	0.09***	0.00
TQ	0.03***	0.02***
R&D	1.22***	0.16
WORKINGCAPITAL	–0.13***	–0.13***
LEVERAGE	–0.34***	–0.32***
Number of observations	16 993	16 993
R^2	0.65	
Within R^2		0.18
Company fixed effects	No	Yes
Year fixed effects	No	Yes

Notes: Sample includes all company-year observations with non-missing values for the independent variables; outliers excluded; robust standard errors clustered at the industry level used to accommodate within-industry serial correlation; ***, **, and * denote significance at the 1, 5 and 10 per cent level, respectively

Sources: Authors' calculations; Bloomberg; Morningstar

For example, larger companies hold less cash, on average. In terms of economic significance, the coefficient on company size in the OLS estimates implies that a doubling in the level of real total assets (a 70 per cent increase in the log level) decreases cash holdings by around 2 percentage points. An increase in *RISK* from the 25th percentile to the 75th percentile (around 8 percentage points) is associated with the cash ratio being higher by around 2 percentage points. These results are consistent with the financing frictions hypothesis. Also consistent with the financing frictions hypothesis (and the speculative demand for cash), companies with better investment opportunities (proxied by *TQ*) hold relatively more cash as do companies with higher research and development expenditure, though the *R&D* effect is insignificant in the FE regression.

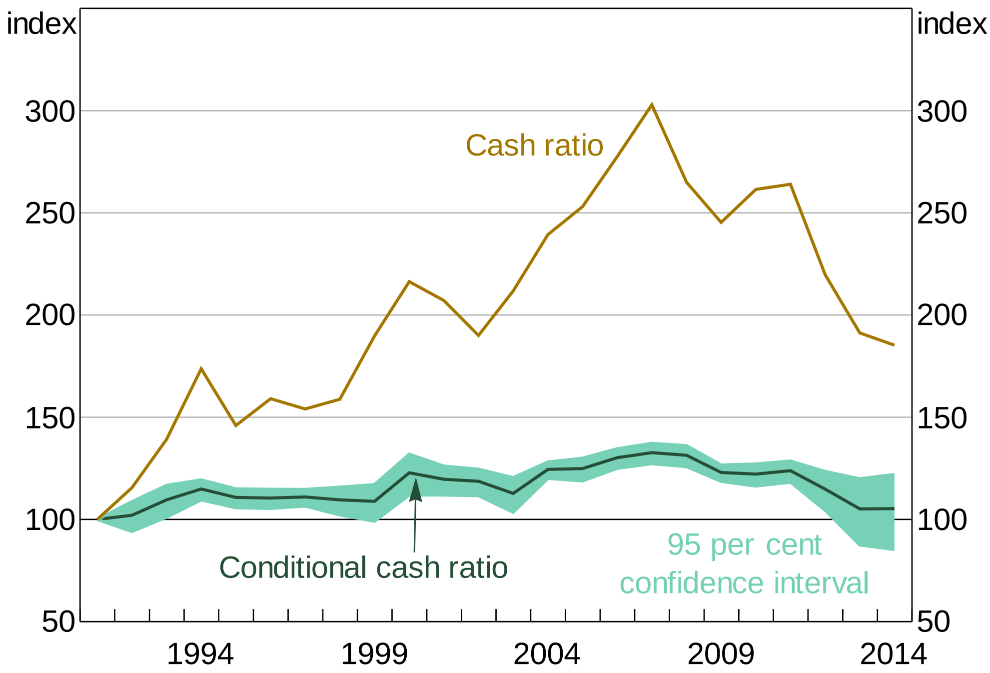
6.3 Are Australian Company Cash Holdings 'Abnormal'?

To examine whether Australian corporate holdings of cash are 'abnormal' we compare the observed cash-to-assets ratio each period to 'fundamental' in-sample determinants of corporate cash. Any differences between actual and fundamental cash holdings provide a gauge of how much cash holdings are out of line with fundamentals, or abnormal. We do this by comparing the estimated year dummies ($\hat{\lambda}_t$) (the 'conditional cash ratio') to the observed mean of cash holdings each year (the 'unconditional cash ratio'). Any differences in the trends for these estimates are due to variation over time in observed company-level characteristics.

Figure 6 plots the unconditional cash ratio against the conditional cash ratio (i.e. the time dummies from Equation (3) as estimated in column 2 of Table 5). The secular increase in the conditional cash ratio is far less pronounced than for the unconditional cash ratio, suggesting that much of the increase in the cash ratio can be explained by changes in company characteristics. Across all companies, the trough-to-peak increase in cash holdings over 1990 to 2008 is around 30 per cent based on the conditional estimates, which is much smaller than the 200 per cent increase based on the unconditional estimates. At its peak the unconditional cash ratio is over three standard deviations above the conditional estimates. This indicates that we can explain much of the 'puzzle' of the secular rise in corporate cash through changes in the observable factors that drive corporate decisions to hold cash.

Figure 6: Cash Ratios

Publicly listed companies, 1991 = 100

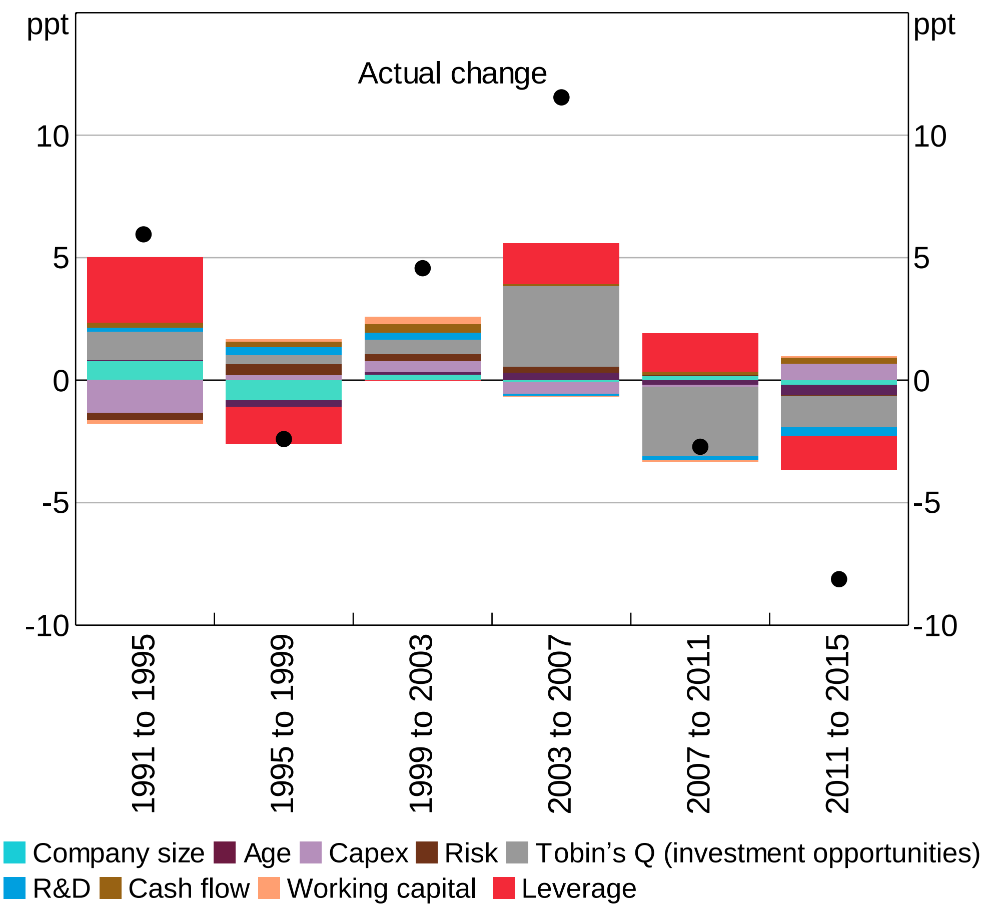


Sources: Authors' calculations; Bloomberg; Morningstar

The largest contributors to the secular rise in cash are better growth opportunities (as measured by Tobin's Q), which are positively associated with cash holdings, and, to a lesser extent, changes in leverage that occurred over the early 1990s and throughout the 2000s (Figure 7). Other factors, such as changes in the average company size and age, played less of a role.

Figure 7: Change in Cash Ratio

Fitted contribution to change



Sources: Authors' calculations; Bloomberg; Morningstar

It is not clear what has driven these underlying trends, but the dynamic of Tobin's Q seems to follow the evolution of corporate profitability (IMF 2014). The positive correlation between our estimates of Tobin's Q and corporate cash holdings suggests that some companies have a speculative motive for holding cash; these companies hold cash in expectation of investment opportunities arising in the future. In other words, high corporate cash might not be symptomatic of a weak corporate outlook but actually evidence of expected strength in the economy.

Likewise, aggregate trends in corporate leverage also tend to follow the investment cycle as well as shifts in the use of different forms of external funding, which in turn are affected by the differential between the (real) cost of debt and equity (Fang *et al* 2015). This notwithstanding, there are many factors that could affect company-level leverage (Shuetrim, Lowe and Morling 1993); a more detailed analysis of the determinants of long-run changes in Australian corporate leverage, and other characteristics, is left to future research.

There are some periods in which the model is less able to explain trends in cash holdings. For instance, the model under-predicts cash holdings in the mid 2000s and over-predicts cash in the period since 2011. This might reflect factors related to the terms of trade boom and bust that are difficult to capture in the observed data (e.g. changes in corporate uncertainty).[23]

6.4 Cohort Effects on Cash Holdings of Listed Companies

In considering the long-run trend in corporate cash holdings, we can also examine whether companies that have listed more recently on the stock exchange hold more cash than companies that listed earlier. These 'cohort effects' can be estimated because we have information on each listed company's initial public offering (IPO).

Previous international research indicates that such cohort effects are important in explaining the rise in average cash holdings among public companies (Begenau and Palazzo 2015). The cohort effects are associated with an increased propensity for riskier companies to list and a trend toward industries with more risky business models (e.g. information technology, pharmaceuticals and biotechnology) (Brown and Kapadia 2007). For Australian companies, the increase in aggregate cash holdings over the mid to late 2000s may have been similarly affected by a trend in listing toward small mining exploration companies during the Australian mining boom.

To construct the cohort estimates we take an unweighted average of the company fixed effects estimated in Equation (3) for each cohort based on its IPO date. These fixed effects essentially capture any unobserved characteristics that the company posesses when it lists and that persist over time. We group companies into cohorts based on five-year windows, with the most recent cohort being based on companies that listed between 2010 and 2014.

The cohort estimates are displayed in Figure 8. The results indicate that recent cohorts hold much higher levels of cash than earlier cohorts. For example, the cash ratio of companies that have listed since 2010 is about 30 per cent higher than the corresponding cash ratio for companies that listed in the late 1980s. These estimates are obtained from the fixed effects in Equation (3) and so are conditional estimates that control for differences between cohorts in other observed characteristics (e.g. size, investment opportunities and leverage).

The trend in the aggregate cash ratio is, at least in part, due to differences in latent factors between companies that list today compared to companies that listed several decades ago. One explanation for this is that companies in recent cohorts are more reliant on intangible capital in their production technology, such as 'knowledge workers', relative to companies in older cohorts. Such capital may be harder to pledge as collateral to raise debt financing, thereby increasing companies' precautionary demand for cash (Falato, Kadyrzhanova and Sim 2013).[24]

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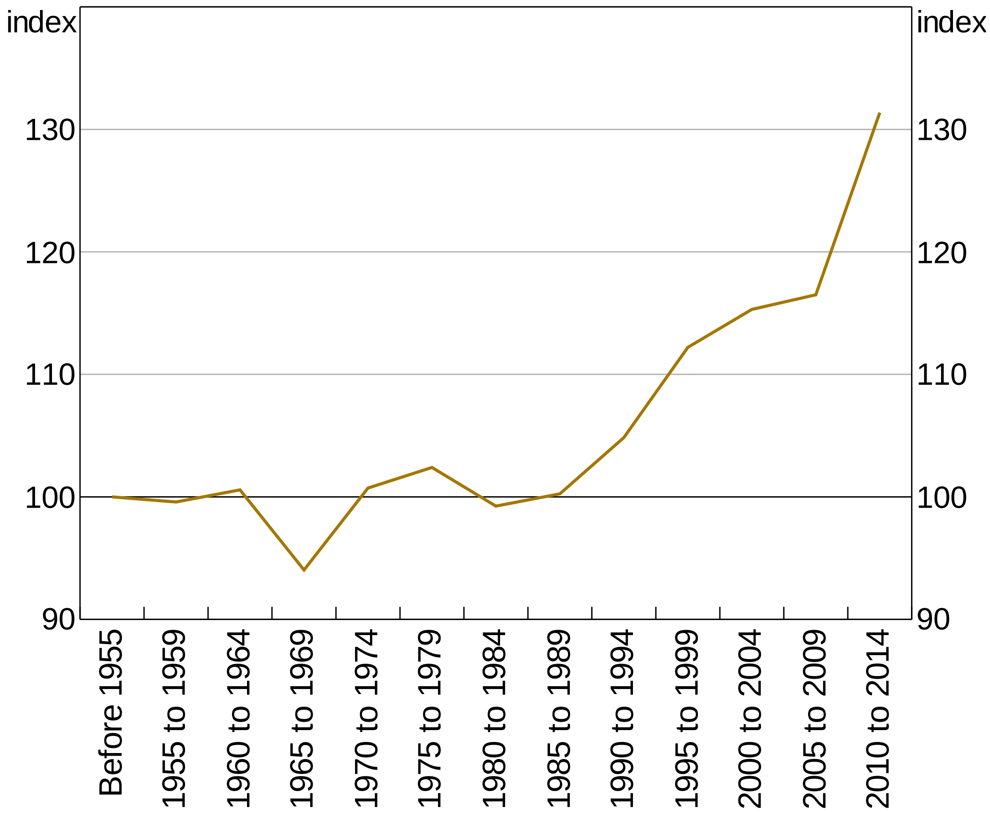
23 The conditional time trend is quite strongly associated with the 'net opportunity cost of cash' – measured as the return on business deposits less the cost of borrowing. This suggests that the 'economy wide' opportunity cost of allocating assets to cash might also play a role in explaining the secular trend in corporate cash holdings.

24 The cohort estimates may also be affected by sample survivorship bias. In unreported results, we find that there is a positive correlation between cash holdings and the probability of failure. This suggests that surviving companies have lower cash holdings than the average company in their own cohort. This, in turn, implies that some of the observed increase in cash holdings across cohorts might be due to survivorship bias.

Figure 8: Cash Ratios
By cohort, 'Before 1955' = 100



Note: Estimated as the average of the company fixed effects from Equation (3) by listing cohort
Sources Authors' calculations; Bloomberg; Morningstar

7. Extensions and Robustness Tests

7.1 The Cash Flow Sensitivity of Corporate Cash

In this section we further examine the role of agency costs and financing frictions in determining corporate cash holdings by extending the literature that looks at the 'cash flow sensitivity' of cash (Almeida, Campello and Weisbach 2004). Almeida *et al* focus primarily on the role of financing frictions. They develop a model to show that financially constrained companies have a positive propensity to save their cash flows due to their restricted access to external capital markets, while unconstrained companies do not. They test their model by examining how US public companies adjust their cash holdings in response to shocks to cash flows (referred to as the cash flow sensitivity of cash).

We apply their framework to the Australian data and broaden their analysis to incorporate agency costs by comparing the cash flow sensitivity of cash for private companies to that of public companies. Public companies may be more likely than private companies to accumulate cash out of cash flows during good times because they face higher agency costs. Similar to before, in the presence of agency costs *and* financing frictions, it is unclear whether the cash holdings of public or private companies should be more sensitive to shocks to cash flows. But, the finding that the cash holdings of public companies are relatively more (less) sensitive to cash flows provides evidence in support of agency costs (financing frictions).

To examine the cash flow sensitivity of cash we make a slight adjustment to the company-level model estimated in Equation (1). In particular, rather than look at the correlation between the level of cash (to assets) and cash flows, we now look at the correlation between the *change* in cash holdings and cash flows (Almeida *et al* 2004; Bao, Chan and Zhang 2012). Moreover, we estimate the model separately for private companies ($j = PRIV$) and unlisted public companies ($j = PUB$):

$$\Delta CASH_{it}^{j} = \beta CASHFLOW_{it}^{j} + \gamma CONTROLS_{it}^{j} + \alpha_{i}^{j} + \varepsilon_{it}^{j} \qquad (4)$$

We are particularly interested in differences in the estimated coefficient on the variable $CASHFLOW$ (β). If companies respond to positive cash flow shocks by raising the rate at which they save cash out of cash flows then we would expect the coefficient estimate to be positive ($\beta > 0$). Furthermore, if agency costs matter, then public companies should have a significantly higher propensity to accumulate cash out of cash flows ($\beta^{PUB} > \beta^{PRIV}$). Alternatively, if financing frictions matter, the sensitivity to cash flow should be greater for private companies ($\beta^{PRIV} > \beta^{PUB}$).

The results presented in Table 6 shows that both private and unlisted public companies have a positive propensity to save cash out of cash flows. This suggests that both financing frictions and agency costs could motivate companies to accumulate cash out of earnings in good times.

Moreover, we find that the coefficient on cash flow is nearly twice as large for public companies as for private companies. And a nested regression that combines the two samples reveals that this difference is statistically significant. This provides further evidence in favour of the agency costs hypothesis.

Table 6: The Role of Company Characteristics

Public and private companies, fixed effects model

	Unlisted public	Private
SIZE	–0.01	0.02**
AGE	–0.00	–0.00***
CAPEX	–0.41***	–0.31***
CASHFLOW	0.34***	0.19***
RISK	0.02	–0.01
WORKINGCAPITAL	–0.07***	–0.12***
LEVERAGE	0.02	0.04***
Number of observations	3 522	9 757
Within R^2	0.22	0.17
Company fixed effects	Yes	Yes

Notes: Sample includes all company-year observations with non-missing values for the independent variables; outliers excluded; robust standard errors clustered at the industry level used to accommodate within-industry serial correlation; ***, **, and * denote significance at the 1, 5 and 10 per cent level, respectively

Sources: Authors' calculations; D&B

7.2 Comparing Private and Public Company Cash Holdings Using Propensity Score Matching

To control for potential sample selection issues, we also employ matching techniques to examine differences in the level of cash ratios across public and private companies.

In an ideal world, these selection concerns would be overcome by designing an experiment that assigns companies randomly to being either public or private. But, the choice to go public is confounded with a number of company characteristics that are likely to be correlated with the level of cash holdings (Brav 2009). As such, we implement propensity score matching to compare the cash holdings of public and private companies after matching them on observable company characteristics.

Specifically, we use 'nearest neighbour' matching that uses an average of the cash ratio from the 'nearest' private companies to impute an estimated counterfactual cash ratio for each public company. The set of nearest private companies is obtained by estimating the 'distance' between pairs of observations with regard to a set of company characteristics. A public company's nearest private company(s) is obtained using a weighted function of the covariates for each observation. In this application the Mahalanobis distance is used, where the weights are based on the inverse of the covariates' variance-covariance matrix. The difference between observed cash holdings and the imputed counterfactual level of cash holdings for each public company then yields an estimate of the selection effect.

For robustness, we use two sets of company characteristics to perform a match: the first uses all of the variables in Equation (2); the second uses $SIZE$ as defined in Equation (2) and industry $\times$ year fixed effects. The results are provided in Table 7.

Model (1) is based on the first set of company characteristics and suggests that the average treatment effect (ATE) – the level of cash holdings one would have observed had all companies been public – is 4.6, meaning that the cash ratio would have been 4.6 percentage points higher if all companies were public. Model (2) is based on the second set of company characteristics and suggests the ATE is 2.5 percentage points.

In sum, the evidence from this exercise supports the idea that public companies hold higher levels of cash compared to otherwise similar private companies. This again suggests that agency costs affect corporate cash holdings, with the effects being statistically significant and similar in economic magnitude to the estimates presented earlier.

Table 7: Matching Cash Ratios

Public (treated) versus private (control) companies

	Model (1)	Model (2)
ATE (ppt): cash ratio	4.6***	2.5**

Notes: In Model (1), the nearest-neighbour estimator is augmented with a bias-correction term to account for the use of more than one continuous company-level covariate; ***, **, and * denote significance at the 1, 5 and 10 per cent level, respectively

Sources: Authors' calculations; D&B

8. Conclusion

Our analysis of corporate cash holdings in Australia indicates that public companies hold more cash than otherwise similar private companies, on average, and their cash holdings are more sensitive to cash flows. These findings suggest that agency costs play some role in determining cash holdings in Australia.

We also find that the trend increase in cash holdings of public companies over recent decades is largely explained by changes in observable company characteristics. In particular, relative to their counterparts of 25 years ago, publicly listed companies today have better investment opportunities (as measured by Tobin's Q) and are more likely to operate in industries with more volatile profits – such as information technology, pharmaceuticals and biotechnology – and these characteristics are correlated with higher levels of corporate cash. After accounting for these factors, our estimates indicate that, by historical standards, corporate cash holdings of Australian publicly listed companies are not unusually high.

Overall, we find that, in the face of financing frictions, some companies have precautionary and speculative motives for holding cash. To the extent that the speculative motive matters, high levels of corporate cash could be taken as evidence that economic conditions are expected to improve in the future, rather than being a sign of perceived weakness in the economy.

Appendix A: Tax Minimisation and Cash Management Behaviour of Multinational Companies

Media reports and academic research have suggested that the high cash holdings of US companies can be explained by the nature of the US corporate tax system and, in particular, the repatriation taxes that apply to multinational companies. However, there are reasons to suspect that this hypothesis does not explain the high cash holdings of Australian companies.

Broadly speaking, under both the US and Australian corporate tax systems, multinational companies pay taxes based on their worldwide income. In effect, the tax paid on foreign-sourced revenue is determined by the difference between the taxes actually paid abroad and the taxes that would be paid if the revenue had been generated domestically. However, there is an important difference in the timing of when these taxes are paid. In the United States, taxation takes place when earnings are *repatriated* (i.e. returned from overseas), while in Australia, taxation applies when earnings are *earned*. (That is, assessable foreign income needs to be included on the company's Australian tax return. The way in which an Australian company deals with the issue of 'double taxation' largely depends on the foreign jurisdiction within which the company operates.)

This tax structure provides some incentive to US companies to keep foreign earnings abroad in order to minimise their tax. These funds will tend to be held in cash in times of limited foreign investment opportunities.[25] Australian companies have less incentive to do this.

Despite the media attention, the academic literature is mixed on the effect of repatriation taxes on cash holdings, even for the United States. Foley *et al* (2007) looked at the contribution of repatriation taxes towards corporate cash holdings and found that companies that are subject to higher repatriation taxes hold significantly more cash. But, this finding was challenged by Bates *et al* (2009). The authors were able to identify companies with foreign pre-tax income and found no evidence that cash holdings increase more for companies with foreign pre-tax income. Pinkowitz *et al* (2013) also found limited evidence for the tax repatriation hypothesis. They compared US multinationals to other US companies and showed that the multinationals did not experience a greater increase in cash holdings. They also showed that the 2009 US corporate tax holidays – designed to temporarily reduce the tax cost of repatriation – did not reduce the cash holdings of multinationals.

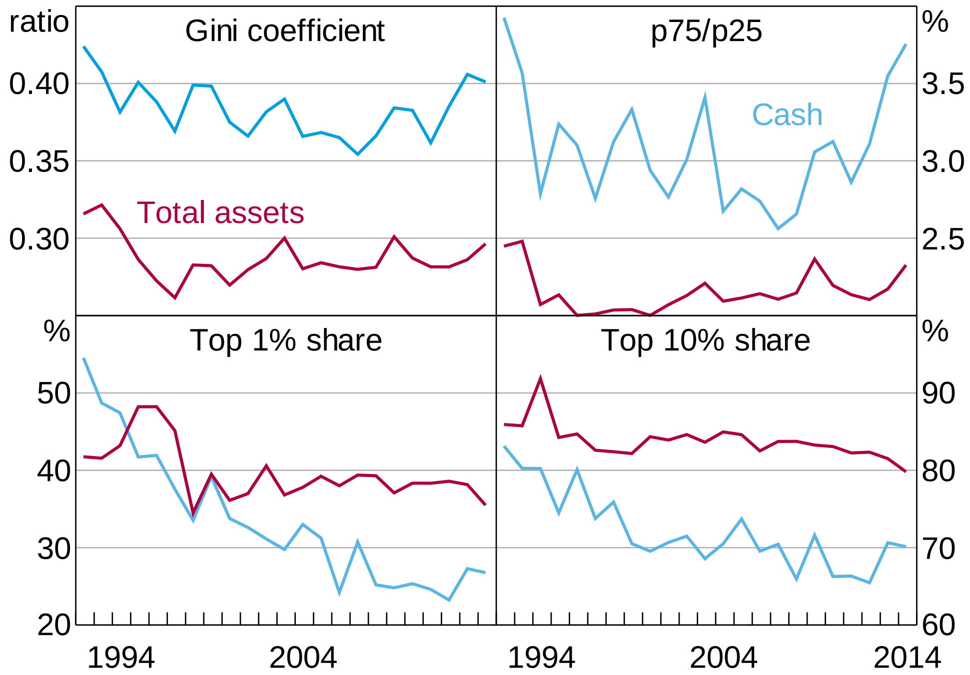
While the repatriation tax motive may not apply in Australia, more broadly, Australian companies may still have incentives to accumulate cash reserves offshore for tax minimisation purposes. To examine this, we compared the conditional cash ratios of companies identified as having the lowest average annual effective tax rates (low tax companies) to the cash ratios of all other publicly listed companies in the Morningstar sample. The results (available upon request) suggest that the cash ratios of these two company groups were very similar, which suggests that tax avoidance is not a significant determinant of aggregate cash holdings in Australia.

25 US companies may also have a tendency to hold these funds in liquid instruments to give them flexibility to respond to changes to tax legislation that would enable them to repatriate their earnings, such as the US corporate tax holidays that were enacted in 2004.

Appendix B: Corporate Cash and Asset Concentration

This appendix explores the concentration of corporate cash and total asset holdings in Australia (Figure B1). We consider a range of different indicators of concentration (or 'inequality') in cash holdings.

Figure B1: Corporate Cash and Asset Concentration



Note: Log levels of real cash holdings and real total assets are used

Sources: Authors' calculations; Morningstar

Our findings indicate that some of the high concentration of cash simply reflects the fact that the distribution of company size is highly skewed, with a few large companies and many small companies; that is, not only is cash very concentrated, but all other types of assets too. For example, the share of cash held by the top 1 per cent of companies by assets is quite similar to the share of assets held by the same top 1 per cent (although the Gini coefficient and the ratio of the 75th percentile to 25th percentile suggest that cash is more unevenly distributed across companies than total assets).

More importantly, all the indicators show that the concentration of cash holdings has declined over time. Indeed, unlike the situation in the United States, where as of year-end 2013, the largest 1 per cent held 36 per cent of total cash, up 9 percentage points over the last five years, we find that the largest 1 per cent of Australian companies have been holding a decreasing share of cash (and total assets). In 2004, for example, the largest 1 per cent of companies held 33 per cent of cash, whereas the latest estimates show they now hold 27 per cent. This suggests that the secular rise in cash is not due to just the behaviour of the largest companies in Australia.

Appendix C: Estimates of Sample Selection Bias

The D&B company database is not a census of companies. Rather, the sample of companies may be biased given that companies are typically selected into the database because they have applied to D&B for a credit report. It follows that sample selection bias could be a problem if the cash management behaviour of companies that apply for credit is different to those companies that do not.

To gauge the importance of this bias, we match the sample of publicly listed companies in the D&B database to the sample of publicly listed companies in the Morningstar database. We then look for differences in the sample composition and, more importantly, differences in cash management behaviour that could affect our main results. This test relies on two key assumptions: 1) the Morningstar companies are assumed to be representative of the population of listed companies; and 2) the selection rules for companies appearing in the D&B database are the same for listed and unlisted companies.

Summary statistics of the two separate samples are shown in Table C1.

Table C1: Summary Statistics for Publicly Listed Companies
2005 to 2014

	D&B		Morningstar	
	Mean	Median	Mean	Median
Size	3.6	3.3	3.4	3.1
Cash ratio (%)	22.9	11.9	27.5	16.2
Age (years)	19	13	17	12
Growth (%)	10.5	6.1	12.3	7.1
Number of observations	10 619		13 957	
Number of companies	1 830		1 900	

Note: Size measured as the natural logarithm of total assets and growth measured as the annual change in the logarithm of total sales

Sources: Authors' calculations; D&B; Morningstar

Morningstar listed companies are very similar to their D&B counterparts in terms of size, age and sales growth, on average. The only notable difference is that Morningstar companies appear to have slightly higher cash-to-asset ratios on average. To more formally test for selection bias, and differences between the two samples, we estimate the following regression model:

$$CASH_{ijt} = \alpha + \beta MORNING_i + \gamma X_{ijt} + \delta\left(MORNING_i * X_{ijt}\right) + \mu_j + \lambda_t + \varepsilon_{ijt}$$

where the dependent variable is the cash-to-assets ratio of company i in industry j in year t. Our key explanatory variable is a dummy variable ($MORNING$) that is equal to one if the listed company is in the Morningstar database and is zero otherwise. The estimated coefficient on this dummy variable captures the mean difference in cash holdings between the Morningstar and D&B companies. It therefore directly captures any selection bias inherent in the D&B database, to the extent that the Morningstar database is representative of the population of Australian companies. We also include a set of control variables (X), including size, age and sales growth, as well as industry dummies (μ) and year dummies (λ). We also interact the dummy $MORNING$ with each of the control variables to gauge whether the relationship between cash holdings and its determinants varies across the two samples.

As Table C2 highlights, the cash-to-assets ratio of Morningstar companies is larger than that of comparable D&B companies by about 5 percentage points on average (column (1)). However, this result disappears when we control for observed company characteristics (column (2)). The sensitivity of cash holdings to sales growth varies across the two samples, but otherwise there are no significant differences between the two samples. This gives us some comfort that our results are not particularly sensitive to sample selection bias.

Table C2: Sample Selection Bias Estimates

	(1)	(2)
MORNING	0.05***	–0.017
SIZE		–0.04***
AGE		–0.00
GROWTH		0.01***
*MORNING*SIZE*		0.00
*MORNING*AGE*		0.00
*MORNING*GROWTH*		–0.02***
Constant	0.23***	0.38***
Number of observations	24 576	14 264
Within R^2	0.01	0.21
Industry fixed effects	Yes	Yes

Notes: Robust standard errors clustered at the company level used to accommodate within-company serial correlation; ***, **, and * denote significance at the 1, 5 and 10 per cent level, respectively

Sources: Authors' calculations; D&B; Morningstar

Appendix D: Comparing Public and Private Company Cash: Hausman-Taylor Estimates

The CRE model assumes that the correlation between the fixed effect in Equation (1) and each of the explanatory variables does not change over time. But it is possible, for instance, that a company's (unobserved) willingness to take risk (as captured by the fixed effect) is correlated more with past shocks to cash flow than with current shocks (perhaps because a company's management learned from its past 'mistakes'). In this case, the correlation would vary over time. To address this possibility, we also estimate an HT model.

This model provides an alternative way in which to estimate the effect of time-invariant variables, such as the $PUBLIC$ dummy, while also allowing for an unobserved fixed effect in corporate cash decisions.

Given the HT model is non-standard it is helpful to sketch out the model in some detail. The model relies on the assumption that the unobserved fixed effect is correlated with some explanatory variables, but not others.[26]

We re-write Equation (2), but partition the time-varying explanatory variables X_{it} into two sub-sets – a sub-set that is assumed to be correlated with the fixed effect (X_{1it}) and one that is uncorrelated with the fixed effect (X_{2it}):

$$CASH_{it} = \beta PUBLIC_i + \gamma_1 X_{1it} + \gamma_2 X_{2it} + \alpha_i + \varepsilon_{it}$$

where all the other variables are as before. Assume:

$$E\left[\alpha_i \middle| X_{1it}, PUBLIC_i\right] \neq 0$$

$$E\left[\alpha_i \middle| X_{2it}\right] = 0$$

We can obtain consistent estimates of the effects of the time-varying explanatory variables, γ_1 and γ_2, using a standard fixed effects estimator that relies on differences from the 'temporal' mean:

$$CASH_{it} - \overline{CASH_i} = \gamma_1\left(X_{1it} - \bar{X}_{1i}\right) + \gamma_2\left(X_{2it} - \bar{X}_{2i}\right) + \left(\varepsilon_{it} - \bar{\varepsilon}_i\right)$$

where $\bar{X}_{1i} = \Sigma_t X_{1it} / T$ is the temporal mean of the explanatory variables that are assumed to be correlated with the fixed effect (α_i) and $\bar{X}_{2i} = \Sigma_t X_{2it} / T$ is the equivalent mean for the explanatory variables that are uncorrelated with the fixed effect. By assumption, the temporal mean ($\bar{X}_{2i}$) can act as an instrument for the $PUBLIC$ dummy and produce an unbiased estimate of its causal effect (β).

The model is estimated in two steps, with the last step similar to a 2-stage least squares regression model. In the first step, the model is estimated using the FE estimator. From this we

26 Under the random effects model, the fixed effect is assumed to be uncorrelated with any explanatory variables. Under the fixed effects model, the fixed effect is assumed to be correlated with all the explanatory variables.

obtain the residuals, which capture the variation in cash holdings that are not due to either the fixed effect or the time-varying observable characteristics (e.g. size, age, cash flow, etc). In the second step, we regress the estimated residuals on an instrumented *PUBLIC* dummy. The *PUBLIC* dummy is instrumented using the temporal means of the variables that are assumed to be uncorrelated with the fixed effect. Because we only have one time-invariant explanatory variable of interest (*PUBLIC*), we only require one 'exogenous' variable at this stage. In this instance, we choose *AGE* as an instrument for the *PUBLIC* dummy, as all other variables are likely to be governed by explicit company-level choices, which could be correlated with the unobserved company-level decision to hold cash (captured by the fixed effect).[27]

Turning to the results, relative to the CRE estimates presented in Table 4, the results are even stronger in the HT model, with a significant difference between public and private companies' cash-to-assets ratios of 10 percentage points. This provides complimentary evidence in favour of agency costs playing a role in the determination of corporate cash polices.

27 The variable *AGE* also appears to be reasonably well correlated with the *PUBLIC* dummy (correlation of 0.3), thereby allaying some concerns over weak instrumentation.

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