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Article

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Abstract
Undervaluation is often offered as an important consideration in private equity transactions. This study analyzes the importance of undervaluation, vis-à-vis information asymmetry, as a determining factor in 'going-private' transactions in Australia. Using a matched sample of firms from 1990 to 2012, we test a predictive choice model. The empirical results show that market undervaluation is a dominant factor in private equity takeovers. These results are robust to alternative measures of valuation, prevailing market conditions, money flows and subperiods.

JEL Classification: **G11, G15**

1. Introduction

In February 2007, a consortium of private equity investors known as Airline Partners Australia launched a private takeover bid for Qantas, one of the largest and best known public corporations in Australia. In response, the Qantas board recommended that its shareholders should accept the bid, citing low share-market valuation as the primary reason. In a letter to the shareholders, Qantas chairperson Margaret Jackson indicated that the private equity-led bid was at a substantial premium on the existing share price range: 'Qantas has delivered year-on-year profits, growth and diversification,' Ms Jackson said, 'But while the business had prospered, the Qantas share price has not. The offer is the best available option to enable Qantas shareholders to realise significant value for their investment.'[1] Although the bid later collapsed due to mounting pressures of political

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concerns and rival bidding, it brought to the fore the most often-cited reason for a public corporation going private: undervaluation.

Despite the major role of pre-transaction valuation and its effect on private equity takeovers, the extant research in this area has been limited. The literature in this area is largely silent on the triggers of these transactions, such as the low valuation in the public market as examined in this paper. A recent paper by Chapple et al. (2010) examines private equity in the Australian context, with a focus on an exploratory investigation into characteristics of private equity transactions. A related paper is by Bugeja and Sinelnikov (2012), which compares the effect of listing status of bidders on premiums paid to acquire the targets. Overall, however, the general nature of information asymmetry and undervaluation and their interplay in the private equity context remain an unexplored area. This paper investigates information asymmetry and undervaluation of Australian firms as a basis for going private.

The rationale to take a firm private due to low valuation in the public market emanates from the undervaluation hypothesis of leveraged buy-outs and private equity takeovers (Opler and Titman, 1993). The undervaluation hypothesis postulates that takeovers and private equity transactions in particular are crafted to create value for shareholders, with the underlying proposition that the firm's public value is substantially below its true asset worth. In order to shed light on this proposition, we examine the extent to which going-private transactions are motivated by valuation characteristics of these public firms. Evidence that going-private transactions are undertaken where firm values are lower would support the undervaluation hypothesis.

We provide evidence that market undervaluation is a dominant factor in the likelihood of firms being involved in private equity transactions in Australia. Specifically, we find several valuation metrics of firms undergoing private equity transactions to be significantly lower than those of a group of comparable firms undergoing public takeovers. We estimate a binary choice model and find that undervaluation of a firm significantly increases the probability of a going-private transaction. Once valuation is introduced as an explanatory factor, the likelihood of private equity takeover (as compared to a merger transaction) changes significantly. For example, a one-half standard deviation decrease in the market-to-book ratio of a firm contributes to more than 50% increase of the probability that the firm will undergo a private equity transaction. This result holds for alternative measures of valuation, effects of prevailing market condition and money flows and various subperiods. Overall, the present study's empirical analysis supports the undervaluation hypothesis of private equity takeovers (Bugeja and Sinelnikov, 2012; Opler and Titman, 1993, Renneboog et al., 2007) in Australia.

Although valuation measures are likely to be primary determinants of the choice to take a firm private, information asymmetry between public investors and informed insiders (which includes private equity investors) can cause the public valuation to be low and contribute to the going-private decision. We conduct comparative tests to ascertain the importance of undervaluation vis-à-vis information asymmetry reasons for going private. Our findings suggest that information asymmetry per se is not a sufficient condition for firms going private, but undervaluation is. The analysis in this paper shows that the relation between undervaluation and the likelihood of private equity takeover is much stronger than the corresponding association between private equity takeover and levels of information asymmetry.

In other results, we find that the level of institutional holdings and the probability of private equity transactions are negatively related. The evidence of negative association between institutional holding and private equity transaction could be indicative of the control and information production effects of institutional shareholders. It may be likely that private equity investors avoid paying a control premium in a possible control fight in a bidding contest. Alternately, it also provides support for the importance of information gathering costs to a firm's choice between being private or public (Bharath and Dittmar, 2010).

To date, empirical research of firms undertaking private equity transactions has primarily focused on resolution of agency conflicts, tax benefits and control issues as motivators of these transactions. Our paper is related to a recent paper by Bharath and Dittmar (2010), who show that the decision to go private can be seen in an information framework in which a publicly listed firm weighs costs and benefits of staying public. Our primary contribution in this article is to empirically show that public valuation in itself is an important driver of private equity transactions. Our empirical results thus validate the idea that firms choose to exit the public market when the high cost of equity due to low valuation, one of the costs of remaining public, possibly becomes more important than the benefits derived from public markets, such as liquidity and access to capital. In addition, the interaction between information asymmetry and undervaluation has not been previously considered in the private equity literature. In this sense, the current study potentially provides a more comprehensive and rigorous test of the undervaluation hypothesis concerning private equity takeovers.

The next section (Section 2) of the paper provides a discussion of the role of undervaluation and information asymmetry in private equity transactions that underpins our research question. Section 2 also provides a background of private equity activity in Australia and research findings with respect to international private equity research. Section 3 explains the data, valuation methods and our empirical model. Section 4 presents the results and Section 5 concludes the paper.

2. Hypothesis development and private equity transactions in Australia

2.1. Valuation and information asymmetry in private equity takeovers

Private equity takeovers, in their most common form, involve a public-to-private transaction that takes place when a publicly quoted company is taken over by a specialist fund or consortium and the target company goes private through a delisting from the stock market. The reasons and decision to go private are complex with myriad issues, such as information, liquidity, control, agency and other considerations in interplay. Research into private equity takeovers has traditionally focused on the control and value creation aspects of these takeovers. Among others, the influential studies in this area are Lehn and Poulsen (1989) and Kaplan (1989b) for agency costs, DeAngelo et al. (1984) for control and Kaplan (1989a) for tax benefits. Palepu (1990) provides a review of these motivations and explores the effect of takeovers. Nonetheless, the role of public valuation as an independent impetus for private equity transactions has drawn scant attention in the literature. We aim to fill this gap. In this section we draw upon extant theories to focus on the valuation aspects of private equity takeovers to generate empirical propositions of how information asymmetry and undervaluation affect the going-private decision.

A key aspect of a firm's decision to go public via initial public offering (IPO) and stay listed on the stock exchange is to make information about the firm available to the outside investors. Nonetheless, several information asymmetry models highlight the costs associated with information production and dissemination, which can lead to reversing the decision to stay public and push the firm to go private. In the information-theoretic model of Chemmanur and Fulghieri (1999), set in the IPO context but applicable in general, these costs are related to duplicative information production when a firm is faced with a large pool of outside investors, and are ultimately borne by the firm. In order to reduce this cost, a firm may choose to go private if production costs of outside investors increase or the stock price does not reflect accurate information (Bharath and Dittmar, 2010). A related issue in this context is a firm's product market environment and its effect on information dissemination (Campbell, 1979). If disclosure requirements in a public market are likely to

force a firm to divulge its competitive information in the product market, they will become an important consideration for the firm to opt out of the public capital market and go private.

The effect of information asymmetry between management and outsiders is that the true worth of a corporation is plagued with valuation errors. The maximum value that can be realized from the assets in place and future investment opportunities is difficult to determine due to lack of publicly available information and the ensuing information asymmetry. Managers, who are likely to have superior private information, often perceive that the share price is undervalued and does not reflect the true potential of their firm. The information asymmetry and the concomitant undervaluation problem are further exacerbated in the capital market. For example, it is difficult to use the equity market to obtain financing, since a low share price is a deterrent in attracting the interest of institutional shareholders and fund managers. The lack of institutional interest, in itself, creates trading illiquidity in the equity market (Bharath and Dittmar, 2010). It is hurdles from low valuation such as those outlined above that provide the incentives, for firm managers and private equity investors alike, to take the firm private in order to 'capture the full value' of an ongoing public corporation.

It is important to note here that we do not distinguish between private equity takeovers initiated by the management and those by outsiders. In private equity takeovers, the material effect of information asymmetry is the perceived undervaluation by the insiders or the private equity consortiums or by both. The effects of information asymmetry are reflected in observable and comparative valuation metrics that are likely to act as key drivers of private equity takeovers. The primary focus in our paper is the effect of information asymmetry and undervaluation per se that is likely to bring forth these takeovers, as illustrated in the anecdotal evidence of the Qantas takeover. In this context, the lack of effective corporate governance structure of a firm can be indicative of the likelihood of a firm being targeted by private equity investors. Clarkson et al. (2015) provide evidence that the governance structure of private equity targets is less effectual as compared to conventional corporate targets. We contend that these governance deficiencies are also likely to be reflected in valuation measures to the extent that private equity investors are motivated to exploit this on a post-takeover basis. Thus, in this study we argue and empirically test the view that firms that are undervalued by the market, perhaps as a result of information asymmetry, are likely to engage in private equity transactions.

The asymmetric information environment between insiders and outside investors in a public capital market is partially mitigated by signaling methods used by the insiders. However, information signaling coupled with a moral hazard creates the well-known adverse selection or 'lemon' problem for all investors (Akerlof, 1970). The adverse selection problem imposes an unavoidable cost on all firms by lowering the average observed firm value in the public market. This cost is particularly severe for young, less well-known firms, which suffer from less market visibility and poor investor recognition. For these young firms, trying to convey information regarding the future investment opportunity set through credible signaling is likely to be more costly than for similar firms in private hands. Thus, in this paper we also propose that firms with smaller, younger and lower visibility profiles (proxies for high information asymmetry) are likely to be the main candidates in facing excessive adverse selection costs and, therefore, likely to prefer to go private to avoid these costs.

Although valuation metrics are the triggers of private equity takeovers, the degree of information asymmetry is the basis of undervaluation. Indeed, some private equity firms pride themselves in creating value for their investors by investing in relatively 'little understood' firms (Metrick and Yasuda, 2011). Regardless of valuation measures, which are relative and transient, firms with a higher degree of information asymmetry should be expected to have a higher private takeover probability, as well. Thus, the relation between undervaluation and the likelihood of private equity takeover is likely to be stronger at high levels of information asymmetry.

2.2. Private equity activities in Australia

Private equity investment activity in Australia has grown to record levels in recent years. According to the yearbooks of the Australian Private Equity and Venture Capital Association Limited (AVCAL), private equity funds raised in Australia have increased from A\$585 million in 2001 to A\$3,094.74 million in 2012, with commensurate levels of growth over the same years in going-private deals. Over this period, the growth in the Australian private equity market has mirrored the general pattern of growth in private equity activities in active private equity markets, such as in the US and UK (Cumming et al., 2007).

The evolution of the private equity market in Australia in the last two decades has paralleled that of the European market, primarily in response to the easier availability of debt capital and gradual recognition of its value creation mechanism (Cumming, 2007). In recognition of the value-enhancing roles of venture capital in the capital markets, in 1997 the Australian government established the Australian Innovation and Investment Fund (IIF) in partnership with private venture capitalists. The establishment of these funds is in line with similar government strategies in Canada and the UK in order to stimulate early stage and new technology firms. As in comparable private equity markets (the US and the UK), there is no standard structure of private equity funds in Australia, with most private equity transactions carried out through the limited partnership funds.[2] In terms of the features of these funds, Australian private equity funds are generally smaller in size than those operating in the US and the UK, given the relative sizes of these markets. However, the Australian private equity funds are comparable to those in other markets in terms of investment strategy, portfolio industry focus and sophistication of investor base.

The growth of these transactions in the Australian market has attracted regulatory concerns, especially with regard to economy-wide effects of private equity restructurings, with the Australian Senate holding a parliamentary inquiry into private equity investment.[3] In a recent paper, Cumming and Johan (2012) outline the economic impact of venture capital and private equity backed firms in Australia. Overall, their findings indicate that venture capital activity in general has beneficial effects on the Australian economy in the form of higher employment and investments.

Osborne et al. (2012) find that Australian (along with firms in other developed countries, including the US) firm characteristics are influential factors in private equity acquisitions. Kend and Katselas (2013) do a survey of private equity partners and professionals and find that motivations for going private are not well understood in Australia. Given the size and growth of this market, it is important to understand motivations of going private in Australia, especially from a valuation perspective. From an international perspective, the Australian private equity market structure, activities and share markets are similar to those in the UK and US markets with minor differences. Hence, the implications derived from this study will be applicable in an international context.

In an important study on private equity takeovers in Australia, Bugeja and Sinelnikov (2012) conduct a thorough analysis of the importance of private equity's role in public-to-private transactions. Focusing on the bidder listing status (private equity versus public) and the share price reactions on announcements, they find that private equity targets are more undervalued than public bidder targets and conjecture that the private equity bidders are indeed not 'barbarians at the gate' and leave money on the table for the target shareholders. They attribute this result to the fact that although non-operating private equity bidders are unlikely to extract operating synergies following a going-private transaction, they are willing to pay a substantial market premium to acquire the target. Our results support this in an indirect way in that the market participants view private equity bidders to be astute in selecting their targets. Although the target firm may not benefit from operational efficiency following a private takeover, ours and Bugeja and Sinelnikov's (2012) results,

taken together, suggest that undervaluation is a trigger for private equity bidders to take a public firm private.

3. Research design

3.1. Data

The sample consists of all successful going-private transactions involving companies listed on the Australian Securities Exchange (ASX) and made between 1 January 1990 and 31 December 2012. The sample was formed by utilizing a variety of databases and resources. Specifically, the initial sample of all takeovers was collected from the Securities Data Corporation (SDC) Platinum ANZ Mergers and Acquisitions Database. A total of 4070 completed takeover deals (mergers and going-private transactions) were identified that took place on the ASX. Of these, a preliminary sample of 524 successful going-private transactions was identified. We included only the consummated transactions in our sample, since the announcements often can be ambit claims by the firm to shore up the valuation. This group of 524 firms was further screened for bids involving an acquirer with a status of 'Joint Venture' or 'Subsidiaries'. Also, firms belonging to the financial, real estate or utility industries were excluded as the firm characteristics were likely to be different to the general population of firms.

The criterion for a going-private transaction of those included in the final sample was that the bid be wholly financed by a private equity firm or syndicate. This was to ensure that the firm had, indeed, become private and that acquiring companies were not affiliated with public corporations. These going-private transactions were then re-confirmed through the list of ASX delisted firms from Aspect Huntley Morning Star DatAnalysis Database and the Bureau Van-Dijk ORBIS Global Database. Annual accounting information was obtained from the Aspect Huntley Morning Star FinAnalysis database. Finally, a requirement of the sampling was that the selected firm going through the private equity takeover had at least three years of accounting information prior to the takeover to ensure that the valuation and information asymmetry characteristics of these firms were not primarily driven by the lack of exposure to a public capital market. This process yielded a final sample of 132 firms.

As part of our robust analysis, we relaxed this criterion to only one year of publicly available data. The number of firms in our sample increased to 178 firms; however, the results remain qualitatively unchanged. We have used the sample with at least three years of public life (132 firms), since this sample is more likely to represent a group of firms for whom the going-private decision is a considered choice, due likely to low valuation and information asymmetry issues, as compared to that for the younger set of firms for whom the going-private transaction is likely to be a response to the post-IPO share price adjustments (Loughran and Ritter, 1995).

Panel A of Table 1 provides the frequency distribution of these going-private transactions. Stromberg (2007) notes that the going-private deals have increased considerably since 2000. This study's sampling suggests a pattern for Australia where the majority of the going-private deals took place between 2001 and 2007, a pattern similar to that exhibited in the Australian private equity sample of Chapple et al. (2010).

Panel B of Table 1 classifies the sample into various industry groups. The ASX groups its listed companies into 25 different industries. In addition to ASX industry classification, Panel B also shows the industry classification of these 132 firms according to the Global Industry Classification System (GICS). Chapple et al. (2010) find a very low concentration of Australian private equity transactions within the mining sector. In contrast, the evidence presented here in Table 1 shows that approximately 18% (23 out of 132) of the sample is concentrated in the mining industry. A possible reason for this difference could be due to the differences in the sample periods and sample sizes.[4]

Table 1. Sample.

Panel A: frequency of mergers and the matched sample.

| | Merger | | Going private | |
| | Transactions | | Matched sample | |
Year	Number	Percent	Number	Percent
1990–1992	171	4.20	0	0.00
1993–1995	340	8.35	1	0.76
1996–1998	462	11.35	5	3.79
1999–2001	341	8.38	19	14.39
2002–2004	777	19.09	33	25.00
2005–2007	799	19.63	52	39.39
2008–2012	1180	28.99	22	16.67
All	4070	100%	132	100%

Panel B: industry concentration.

ASX industry classification	N	Global Industry Classification System (GICS)	N
Mining	23	Consumer Discretionary	34
Oil and Gas exploration	7	Consumer Staples	11
Equipment Production/Supplies	9	Energy	24
Construction Services	7	Health Care	11
Food, Drink and Kindred Products	6	Industrials	7
Transportation Services	4	Information Technology	9
Communication Supplies/Services	12	Materials	21
Media, Audio/Video Distribution	8	Telecommunications	15
Amusement/Recreation Services	13		
Miscellaneous Trade	10		
Business Services	17		
Hotels and Motels	6		
Health and Allied Services	10		
Total	132		132

Considering the GICS industry categorization, however, it is apparent that the sample, other than the consumer discretionary sector, is fairly well distributed across the industries. Chapple et al. (2010) also show a predominance of consumer discretionary firms in their sample. To the extent that the ASX is dominated by mining firms due to the natural bias of the Australian economy, the industry concentration pattern in the present sample is consistent with the idea that private equity firms and syndicates in Australia are 'opportunistic' and do not rely on any particular industry sector for their target firms (Chapple et al., 2010).

A key aspect of the proposed hypotheses in the earlier section of this paper is that undervaluation is a primary motivation for going-private transactions. Since takeovers by public companies (i.e. public-to-public takeover transactions) are also governed by similar aspects of valuation and information asymmetry arguments, the current study constructs a matching sample of firms that are taken over in the public market via acquisition by a publicly listed firm and in which their assets stayed public. As our focus is in ascertaining the role of undervaluation and asymmetry in going-private

takeovers, which also prompts takeovers in general, the matching control sample thus provides a base case comparison.

Our methodology closely follows that of Weir et al. (2005a) and is known as choice-based sampling (Cosslet, 1981). This sampling procedure classifies the population into groups based on outcomes (going private). This procedure is likely to be more appropriate when the outcomes are relatively small as compared to the population (Amemiya, 1985). Logistic regression is used in our analysis, in which Maddala (1991) argues that any bias present in the sampling will affect only the constant of the regression.[5]

This set of matching firms is termed 'MA' (mergers and acquisitions) firms and it is used throughout the study for comparative analysis with the 132 going-private transactions, termed 'PE' (private equity transactions) firms. For each PE firm, a two-dimensional scoring method is used to match to a MA firm. Firstly, the PE firm is matched in the same industry sector that has a public-to-public takeover transaction and, secondly, in the same year as the PE firm. The study then uses the weighted-average matching-score of total assets and market value of equity in the year prior to the takeovers to pick the best match among the available MA firms. The MA firms are also screened for three-year accounting information availability. Finally, the institutional shareholding of the total 264 PE and MA firms is manually collected from company annual reports.

3.2. Valuation metrics

A key aspect of our research design is the measurement of the valuation metrics. These metrics need to account for the *relative* disparity of public valuation between the firms undergoing going-private transaction as compared to other firms in the market. An important argument for a firm going private (discussed in Section 2) is that the managers and private equity syndicates for these firms perceive the relative valuations to be the catalysts in taking the firm private. In addition to the available public information, private equity firms conduct their own due diligence process of valuation, which vary from firm to firm and are usually proprietary. Damodaran (2008) provides a case study evaluation of the Harman leveraged buy-out by KKR and Goldman and concludes that these proprietary valuation measures, however they may have been arrived at, can be mistakes. Since our focus is on the public undervaluation of these firms, we rely on valuation measures based on public information and imposed in the market and therefore are relative to other similarly public firms.

Five valuation metrics are constructed that are relevant in the private equity literature and thought to trigger private equity transactions and takeovers in general. These are as follows: (1) market-to-book ratio of assets (MTB); (2) Q ratio (Q); (3) price-to-book value of equity (PB); (4) industry-based price-to-earnings ratio (INDPE); and (5) growth in enterprise value (LNEVR).[6] It is important to note here that the clean-surplus-accounting based residual-income valuation metrics of Ohlson (2005) is not feasible for the present sample as we lack appropriate proxies for future earnings (and dividends) and ex-ante measures of discounting rates. Earnings estimates are not available for most of the firms selected. The most common proxy for ex-ante discounting rates is the ex-post market-risk adjusted return. Since the firms in the sample do not exist in the public market following takeovers, applying other uncommon proxies could lead to erroneous valuation estimates.[7]

MTB is a well-known valuation metric that reflects market value if the assets are relative to its intrinsic book value. The MTB ratio is thought to compose of valuation of assets-in-place and a growth component. To the extent that these two are often perceived to be correlated, an overall low MTB ratio can be regarded as undervaluation (Daniel and Titman, 1997). In any case, MTB ratios are often used by managers to spot overvaluation opportunities to issue equities (Baker and

Wurgler, 2002, Graham and Harvey, 2001). The Q ratio is included as a valuation measure, since it takes into account the collaterization of growth opportunities embedded in intangible assets (Opler and Titman, 1993; Weir et al., 2005a). The PB of equity, similar to the Q ratio, serves as a proxy for the market's expectation of future growth and managerial effectiveness in its ability to generate future earnings. The PB ratio is used by Dong et al. (2006) to measure investor misvaluation that can drive takeover markets. Following Chemmanur et al. (2009), a valuation measure based on the industry average price-to-earnings ratio (INDPE) is also used. Following Weir et al. (2005b), a measure of the growth in the net operating assets or the enterprise value is used (LNEVR).

3.3. Information asymmetry and control variables

For the information asymmetry measures, four variables are chosen that capture the information environment of a firm. Leland and Pyle (1977) show that young firms have substantial difficulty in signaling the value of their firms and face significant adverse selection costs. Firms with low visibility are likely to go private to avoid these costs. In a recent paper, Bharath and Dittmar (2010) find that these factors are important drivers of a firm's decision to go private. In order to proxy for the age and the visibility of the firm, we construct two related variables. The age of a firm is measured as the natural logarithm of years subsequent to its initial listing on the ASX (LNAGE) and the firm's institutional holding (INST) are chosen as our information variables. The INST information is manually collected from annual reports from the 'Top 20 Shareholding' section with careful attention to not include trusts and other holdings that are evidently not institutional. Following Bharath and Dittmar (2010), total revenues of a firm is also chosen as a proxy of information asymmetry. Bharath and Dittmar (2010) argue that sales revenues proxy for a host of factors that relate to investor recognition and information production in a public market. Their argument relies on the Chemmanur and Fulghieri (1999) duplicative information production model in which the information production costs are inversely related to larger well-known firms. Finally, a market liquidity characteristic (LIQ) is chosen that acts as an information asymmetry variable. Bid–ask spreads are an ideal choice of liquidity measure that captures information asymmetry. We were unable, however, to obtain a precise and full set of bid–ask prices. Nonetheless, the relative bid–ask spread is known to be correlated with share price levels and often used to empirically control for market liquidity (Bessembinder, 1997). Accordingly, the average daily closing share price of the firm over a month prior to the takeover announcement is used as the liquidity measure (LIQ).

The control variables are drawn from prior literature of firm-specific accounting variables that may also contribute to the going-private decision. Specifically, following Weir et al. (2005a, 2005b), leverage (LVG), current ratio (CURR), relative free cash flow (RFCF) and capital expenditure (CAPEXTA) are selected to be the control variables. LVG is a measure of the debt condition of the firm. CURR is a measure of the financial operating efficiency of the firm. CAPEXTA proxies for a company's future investment opportunities. In addition, private equity investors are sometimes interested in asset stripping in order to implement the realization of the full value of a firm and may be attracted to higher levels of tangible assets. Accordingly, the logarithm of the plant, property and equipment of the firm (LNPPE) is used as a control variable.

3.4. Empirical model

In addition to univariate analysis, the study's main analysis revolves around a logit model that estimates the likelihood of firms going private with the main explanatory variables being valuation measures, as outlined earlier. Specifically, the model takes the logistic form:

$$Ln\left[\frac{P\left(PrivEq_{i,t}\right)}{1-P\left(PrivEq_{i,t}=1\right)}\right]=\left(a_{0j}+a_{1j}Val_{j,it-1}+\sum\nolimits_{k=1}^{k}b_{1j}C_{k,it-1}\right) \tag{1}$$

where P represents the probability of a takeover through private equity transaction and $PrivEq_{i,t}$ takes the value of 1 if the firm underwent a private equity transaction and 0 if it engaged in a public takeover in year t. $C_{k,it-1}$ denotes predetermined lagged control variables that have been known to affect the takeover choice. $Val_{j,it-1}$ is the jth valuation characteristic of the firm.

A potential limitation of this framework is the difficulty in disentangling the endogenous relationship between valuation and choice for takeover transactions. It is possible that the private equity organizations are attracted towards firms with lower valuations. A traditional approach to address this issue is to use the Two-stage Least Squares (2SLS) procedure. The dependent variable in the second stage of this study, however, is binary, which precludes the standard approach. Therefore, an alternate strategy is employed similar to econometric designs in studies involving a binary choice (e.g. Chang et al., 2006, 2009) that use methods suggested by Wooldridge (2002).

To control for endogeneity of valuation, initially a first-stage Ordinary Least Squares (OLS) regression is conducted with each of our valuation measures as an independent variable. In this regression, the set of information asymmetry variables (defined in an earlier section) is introduced plus another variable that is known in prior literature to affect valuation. The control for endogeneity requires that at least one variable in the first stage is unrelated to the error term in the second stage. In order to control for the endogeneity, following Greene (2002), we chose the rank (RANK) of the valuations metrics as the instrumental variable. RANK serves as an instrumental variable for the second-stage regression in that it is likely to be uncorrelated with the residuals in the second-stage regression. As discussed earlier, information asymmetry variables may also be related to the firm's choice of going private. Specifically, the first-stage regression takes the form of

$$Val_{j,it}=\alpha_j+\sum\nolimits_{k=1}^{4}\beta_k IAS_{k,it}+RANK_{it}+\in_{j,it} \tag{2}$$

In Equation (2), *IAS* denotes the set of four information asymmetry variables defined earlier. Note that the Equation (2) is not being used to identify a functional form of valuation, but is there merely to establish a relationship to form the basis for our procedure to control for endogeneity.

Finally, we use the lagged values of predicted levels of valuations, $\widehat{Val_{j,it-1}}$, in the second stage as follows:

$$Ln\left[\frac{P\left(PrivEq_{i,t}=1\right)}{1-P\left(PrivEq_{i,t}=1\right)}\right]=a_{0j}+a_{1j}\widehat{Val_{j,it-1}}+\sum\nolimits_{k=1}^{k}b_{1k}C_{k,it-1}+\in_{j,it} \tag{3}$$

4. Results

4.1. Univariate analysis

Table 2 presents the univariate analysis of the two groups of matched samples. Amongst the firm characteristics, it appears that leverage (LEV), current ratio (CURR) and plant, property and equipment (LNPPE) are higher for the PE sample. For example, the mean and median of the current ratio for PE firms are 4.049 and 2.24, respectively, and both values are significantly higher than those for the MA sample ($p = 0.001$ and $z = 0.000$, respectively). To the extent that private equity

Table 2. Univariate analysis.

This table shows the results of the t-test for difference of means and Fisher's exact test for difference in medians for two matched samples of 132 firms, each drawn over the period from 1990 to 2012. PE represents private equity sample and MA represents a matched public merger sample. LVG is the leverage ratio calculated as total liabilities divided by total assets. CURR is the current ratio calculated as current assets divided by current liabilities. RFCF is the free cash flow scaled by total assets. Free cash flow is calculated as operating cash flow minus interest, taxes and dividends. CAPEXTA is the spending on new buildings, property and equipment minus depreciation, scaled by total assets. LNEVR is the natural log of enterprise value ratio calculated as enterprise value at time t divided by enterprise value at time $t-1$. Enterprise value is market capitalization plus debt minus cash. LNPPE is the natural log of property, plant and equipment. MTB is the market-to-book ratio calculated as total assets minus total liabilities plus market value (of equity) divided by the book value of assets. Q ratio is market capitalization divided by total assets. PB is the price-to-book ratio calculated as market price per share divided by the book value per share. INDPE is the share price multiplied by median industry price–earnings ratio. INST is the percentage of ordinary shares held by the institutional holders. LIQ represents the average one-month share price prior to the takeover announcement. LNSA is the natural log of total sales. LNAGE is the natural log of the number of years between the firms' initial public offering and their being taken over.

	Mean				Median			
	PE	MA	Diff.		PE	MA	Diff.	
			t-stat	*p*-value			Chi-sq.	*p*-value
Firm characteristics								
LVG	0.494	0.380	−2.874	0.004	0.47	0.38	8.727	0.003
CURR	4.049	1.355	−3.314	0.001	2.24	1.25	42.563	0.000
RFCF	0.098	0.038	−1.420	0.157	0.10	0.09	0.061	0.806
CAPEXTA	0.085	0.108	1.038	0.300	0.04	0.04	0.242	0.622
LNPPE	17.509	16.613	−2.615	0.009	17.78	16.81	8.266	0.004
Valuation variables								
MTB	1.041	4.468	9.153	0.000	1.06	3.32	167.055	0.000
Q	1.037	3.594	4.284	0.000	0.67	1.73	29.333	0.000
PB	1.915	2.790	2.520	0.012	1.33	1.67	6.682	0.010
INDPE	20.070	24.816	1.145	0.253	11.1	8.31	0.242	0.622
LNEVR	0.320	1.024	7.407	0.000	0.16	1.00	87.515	0.000
Information variables								
INST	0.254	0.423	7.999	0.000	0.22	0.40	49.230	0.000
LNSA	18.035	17.230	−2.346	0.020	18.30	17.48	7.333	0.007
LIQ	1.611	2.052	1.296	0.196	0.93	0.82	0.061	0.806
LNAGE	2.129	2.140	0.104	0.917	2.20	2.20	0.547	0.459

investors are astute and view the operating efficiency characteristics to be significant attributes for investment, higher levels of CURR and LNPPE reflect this. The leverage is likely to be higher for PE firms as well, if undervaluation is a primary motive for private equity transaction.[8] The two samples appear to be similar, however, in terms of the relative free cash flow (RFCF) and available future investment opportunities (CAPEXTA).

As for the study's valuation and information variables, the striking evidence in Table 2 is that the mean values of the valuation characteristics of all firms of the PE sample are lower than those of the MA sample. Further, these averages are significantly lower for four (MTB, Q, PB and LNEVR) of the five valuation characteristics. The median comparisons of the two samples also show a similar pattern, but less prominently with the INDPE and LNEVR having higher estimates

Table 3. Determinants of valuation.

This table reports the determinants of firm valuation. The coefficients are from estimating the first-stage regression of two-stage instrumental variable regressions. The first step involves a regression model wherein valuation is estimated. RANK is the rank of each of the valuation variables when sorted in ascending order. The predicted values of valuations are used in the second-stage models in other tables. Other variables are defined in Table 2. Figures in the parentheses represent the standard error of estimate and are adjusted for clustering at the firm and year levels. Results reported are heteroskedasticity consistent with ***, ** and *, denoting significance levels at 1%, 5% and 10%, respectively.

	MTB (1)	Q (2)	PB (3)	INDPE (4)	LNEVR (5)
INST	−0.941** (0.088)	−0.355 (1.060)	−0.788 (0.663)	−0.545 (2.356)	−0.339*** (0.110)
LNSA	−0.044** (0.032)	−0.098* (0.050)	−0.049*** (0.002)	−0.402*** (0.127)	0.011* (0.004)
LIQ	−0.013*** (0.004)	−0.020*** (0.005)	−0.024 (0.053)	11.564*** (0.375)	−0.005* (0.001)
LNAGE	−0.283 (0.262)	−0.360 (0.316)	−0.272 (0.268)	0.063 (0.658)	0.018 (0.016)
RANK	0.031*** (0.005)	0.029*** (0.006)	0.027*** (0.003)	0.027* (0.014)	0.010*** (0.001)
Intercept	0.694 (0.832)	2.033** (0.786)	0.592 (1.160)	5.149 (3.941)	−1.083*** (0.228)
Ind. dummies	Yes	Yes	Yes	No	Yes
Adj-R^2	0.444	0.234	0.505	0.971	0.859
F	22.82	8.320	14.19	220.7	112.8
[prob. > F]	0	0	0	0	0
Obs.	264	264	264	264	264

for the MA sample. Since the study's matching procedure involves matching across industry and size, it is perhaps not unsurprising that the mean and median values are indistinguishable in these two dimensions.

The information variables also appear to be at lower levels for the PE sample. It is not surprising that the information asymmetry variables are also lower for PE firms, since the effect of information asymmetry is likely to result in lower valuation. It is interesting, however, to note that the institutional holding for PE firms is substantially lower than that for the MA firms (25.4% versus 42.3% on average). This could be due to the difficulty in securing a successful private equity transaction in the presence of a heavily institutional owner-dominated ownership structure. The overall evidence in Table 2 suggests that the two samples differ in valuation measures. In the next section, this is investigated in a multivariate binary choice framework.

4.2. Valuation and likelihood of going private

Before the multivariate analysis is conducted, a check is done for correlations among the independent variables. High correlations among independent variables can indicate the possibility of multicollinearity, which means that the resultant analysis may not provide valid results about individual predictors. The correlation matrix is presented in Table 3. Although there are some significant correlations between variables, none exceeds 80%. High correlations exist between the two valuation measures of MTB and Q (0.79), and between INDPE and LIQ (0.68). Hair et al. (1995) suggest that a bivariate correlation of around 0.9 and above is a strong indicator of multicollinearity in a model, while Tabachnik and Fidell (1996) contend that bivariate correlations over 0.7 may suggest redundant variables in a model. In any case, the pairs of correlated variables mentioned above do not appear in the same regression as independent variables. Accordingly, all the variables are retained for the next stage of analysis.

The study now proceeds to test the empirical choice model that relates the choice of private equity transaction with important valuation characteristics. Table 3 reports estimates of the

first-stage instrumental variable regression model (Equation (2)) for each of the selected valuation measures. The RANK variable is strongly related to the valuation measures and thus validates this variable as a suitable instrumental variable. The coefficient estimates of the four information asymmetry variables (INST, LNSA, LIQ and LNAGE) indicate that these variables are related to the valuations of the firm. For example, LNSA and LIQ are significantly related with the five valuation metrics. In addition, INST and LIQ are related to market-to-book (MTB), Q ratio (Q) and the LNEVR at conventional levels of significance. The regressions therefore confirm the role of information asymmetry in valuation.

As argued in Section 2, it is expected that firms having low valuation characteristics are likely to engage in private equity takeover transactions. To test this more formally, it is estimated in the second-stage logit model (Equation (3)). Table 4 reports the estimation results.[9] The first specification of this regression is a base case regression without the valuation measures in which the control variables are the only independent variables.

In all regressions, the base case, leverage (LVG) and current ratio (CURR) are significantly related to the going-private transaction. The positive relationship of leverage to the going-private choice supports the financial distress hypothesis in which the firm and the private equity organizations actively collaborate to take distressed (and possibly undervalued) firms out of the public market (Weir et al., 2005a). The measure of a firm's financial operating efficiency, that is, the current ratio, is also strongly related to the firms going private, suggesting that private equity investors, who are likely to be better informed and more astute than ordinary investors, are likely to put strong emphasis on efficiency characteristics.

The variables of primary interest in this table are the firm's valuation characteristics. Table 4 shows that all valuation characteristics are negatively related to the choice of going-private transaction. In other words, amongst similar firms undergoing takeover transactions, a firm with higher valuations is less likely to engage in a private equity transaction than in a public merger. To illustrate this point further, the study also reports the economic impact of one-half standard deviation change in each valuation variable on the probability of going private. Note, as presented in the last row of the table, that the predicted probability of going private (Pr. (Going Private = $1|x$)) for all regressions is between 56.9% and 61.9%. Using the market-to-book ratio as an example, a one-half standard deviation increase in the MTB reduces the probability of a going-private transaction by 34.65%, more than half of the overall predicted probability (56.9%). Compared across all the valuation metrics, the market-to-book ratio seems to have the maximum effect on a firm's likelihood of going private. This pattern of the strong negative effect of valuation on going private is evident for all our valuation measures. These results provide evidence not only of the choice of takeover transaction (going private versus public merger) but also of the role of valuation.

Overall, the analysis presented in Table 4 conveys the strong explanatory power of valuation in a firm's choice in takeover transaction and suggests that high (low) valuations decrease (increase) the probability of going private. The study now focuses on a better understanding of the relative importance of information asymmetry and valuation as the determining factors in going private. Although valuation is the manifestation of firm information asymmetry attributes that can lead to the decision to go private, information asymmetry alone can provide sufficient stimulus to both the firm and the private equity organizations to engage in going-private transactions. In order to investigate this issue empirically, we construct a binary variable *lowval* that takes the value of 1 if the firm has low valuation characteristics and 0 otherwise. The valuation metrics are sorted to designate a firm to have a *lowval* of 1 if the firm appears below the median value of *only one* of the metrics. (The following tests are also conducted designating the *lowval* variable as 1 if the firm belongs to the lower-half of *all* valuation metrics. As expected, the results are much stronger and are not reported.) We interact *lowval* with each of our information asymmetry variables (INST,

Table 4. Likelihood of going private.

This table reports the results of logit regressions on the likelihood of going private. The dependent variable is 1 if a firm goes private and 0 for a matching firm undergoing a public merger. The coefficients are from estimating the second-stage regression of a two-stage instrumental variable regression using the predicted values of valuations. The first-stage regression estimates the determinants of valuation in Table 3. Variable definitions are as in Table 2. Prob. change is the change in probability of going private for a one-half standard deviation increase around the mean of the explanatory variables. Figures in the parentheses represent the standard error of estimate and are adjusted for clustering at the industry and year levels. Reported results are heteroskedasticity consistent with ***, ** and *, denoting significance levels at 1%, 5% and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	Prob change
MTB		−1.478*** (0.163)					−0.3465
Q			−0.459*** (0.109)				−0.3279
PB				−0.097 (0.0865)			−0.0232
IND					−0.014** (0.006)		−0.0033
LNEVR						−1.647*** (0.309)	−0.3738
LVG	1.360* (0.758)	0.581** (0.086)	1.032** (0.234)	1.300* (0.712)	1.343* (0.794)	1.224** (0.615)	
CURR	1.431*** (0.177)	0.989*** (0.359)	1.459*** (0.273)	1.438*** (0.182)	1.475*** (0.205)	1.464*** (0.230)	
RFCF	0.416 (0.365)	1.156 (1.069)	−0.199 (0.391)	0.421 (0.392)	0.690* (0.403)	0.282 (0.324)	
CAPEXTA	−0.959 (0.739)	2.141* (1.133)	0.603 (0.875)	−0.875 (0.758)	−0.917 (0.811)	−1.142 (0.760)	
LNPPE	0.118* (0.0639)	−0.004 (0.076)	0.006 (0.095)	0.114* (0.067)	0.187*** (0.069)	0.0783 (0.076)	
Intercept	−5.201*** (1.176)	1.705 (1.462)	−2.247 (1.587)	−4.898*** (1.251)	−6.156*** (1.245)	−3.409** (1.469)	
Pseudo Rsq	0.289	0.682	0.385	0.293	0.310	0.437	
Log-Lik	−177.4	−177.4	−177.4	−177.4	−177.4	−177.4	
Prob all 0	0	0	0	0	0	0	
Pr. (Priv.=1|x)	0.615	0.569	0.619	0.615	0.619	0.611	
Obs.	264	264	264	264	264	264	

LNAGE, LNSA and LIQ) and run logit regressions with specifications containing with and without the interaction term. The results are presented in Table 5.

The role of valuation as the dominating characteristic is clear from the signs of the interaction coefficient estimates. These are strongly positive in all regressions, suggesting that low valuation as a firm characteristic significantly contributes to the choice of a firm going private. Further, in economic terms, the size of the *lowval* interaction term coefficient estimate is much larger than the information asymmetry coefficient estimate. For example, the estimate for the interaction term for LNAGE is almost five times larger (–0.206 versus 1.112) than the LNAGE estimate in absolute value.[10]

The information asymmetry variables in themselves appear to be negatively related to the going-private transaction, but the results are not strong, with two of the variables (LNSA and LNAGE) being statistically close to zero. The table also reports the change in probability of going private due to a one-half change in the standard deviation of the information asymmetry variables. (The reported probabilities are from the even-numbered specifications containing interaction terms.) The evidences from the probability change analysis support the general determining role of valuations—all probability changes for information asymmetry variables are less than those when the interaction terms are considered. Overall, the results in Table 5 support the notion that undervaluation, vis-à-vis information asymmetry, plays a much stronger role.

4.3. Effect of market conditions

Gompers and Lerner (2000) show that inflows of capital into venture funds increase the valuation of new investments. Competition for a limited number of available deals could increase prices being paid for attractive investments. In order to examine the effects of fund inflows and the market condition in general, following Gompers and Lerner (2000), we develop measures of fund inflows and market conditions and use these as control variables in our primary regression specification (Equation (3)).

Our first set of variables is indexes of the performances of industry-specific shares. If the pricing of firms in takeovers reflects equity valuation levels in the public market, it should be reflected in these indexes. We use Datastream to obtain the value-weighted and equal-weighted returns of the monthly indexes of the 10 industries as classified by the GICS. We normalize the indexes to 1.00 at January 1990, use the logarithms to cumulate the returns in our analysis and label the series as LNVWIND and LNEWIND, respectively. We then match the index returns to the firm by matching on industry and the month of takeover. Since takeovers in general (private equity and public included) involve negotiation and due diligence, there is a lag between the agreed price and the closing of deals. To address this issue, we lag the indexes in alternate regressions.

Panel A of Table 6 reports the results of regressions containing LNVWIND and LNEWIND (with six-month lag) as additional controls for the effects of valuations on private equity takeover likelihoods. These additional controls have very little effect on the probability of takeover. In addition, compared to previous analyses, the valuation coefficients remain undiminished in their effect on takeovers. All five coefficients measuring the effects of valuation are negative and significant at conventional levels of significance indicating that the lower the valuation, the higher the propensity of private equity takeover. Lagging the indexes by three, nine and 12 months does not change the results in any material way.

We also gauge the effect of the general market condition by using IPO activities as proxies. Since our matched sample contain firms going private and public mergers, IPO activities captures the general pattern of new money flowing into the capital market and affecting valuation levels. We construct two variables, LNPRCD and LNDEALS, which are logarithms of dollar amounts (in

Table 5. Likelihood of going private, information asymmetry and valuation. This table reports the results of logit regressions on the likelihood of going private. The dependent variable is 1 if a firm goes private and 0 for a matching firm undergoing public merger. Variable definitions are as in Table 2. *lowval* is a binary variable (1,0) if the firm belongs to the lower half of the sorted sample in only one of the sorts of valuation variables. Prob. change is the change in probability of going private for a one-half standard deviation increase around the mean of the explanatory variables and is reported from estimates in regression specifications containing the interaction term. Figures in the parentheses represent the standard error of estimate and are adjusted for clustering at the industry and year levels. Reported results are heteroskedasticity consistent with ***, ** and *, denoting significance levels at 1%, 5% and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	Prob. change
INST	-5.820*** (1.184)	-7.108*** (1.356)							-0.3032
INST*lowval		6.174*** (1.417)							0.1862
LNSA			-0.0072 (0.081)	0.015 (0.079)					0.0090
LNSA*lowval				0.145*** (0.034)					0.2133
LIQ					-0.184*** (0.059)	-0.181*** (0.066)			-0.0641
LIQ*lowval						5.936*** (1.698)			0.7014
LNAGE							-0.093 (0.181)	-0.206 (0.199)	-0.0467
LNAGE*lowval								1.112*** (0.307)	0.2214
LVG	0.904 (0.618)	1.014 (0.635)	1.576** (0.768)	1.544* (0.821)	1.569** (0.777)	1.527** (0.759)	1.580** (0.728)	1.628** (0.791)	
CURR	1.384*** (0.234)	1.443*** (0.270)	1.540*** (0.230)	1.570*** (0.255)	1.605*** (0.258)	1.648*** (0.287)	1.543*** (0.228)	1.565*** (0.248)	
RFCF	-0.0659 (0.561)	-0.119 (0.583)	0.440 (0.576)	0.467 (0.599)	0.715 (0.588)	0.752 (0.621)	0.418 (0.556)	0.452 (0.586)	
CAPEXTA	-0.234 (1.312)	0.0519 (1.360)	-1.015 (0.891)	-1.103 (0.981)	-0.929 (0.904)	-0.963 (0.971)	-0.972 (0.888)	-1.064 (0.986)	
LNPPE	0.275*** (0.0852)	0.264*** (0.0884)	0.121 (0.0751)	0.0727 (0.0798)	0.194*** (0.0728)	0.148* (0.0789)	0.122* (0.0666)	0.0983 (0.0707)	
Intercept	-5.591*** (1.345)	-5.405*** (1.433)	-5.371*** (1.363)	-5.260*** (1.414)	-6.547*** (1.329)	-6.105*** (1.439)	-5.339*** (1.158)	-5.005*** (1.216)	
Pseudo Rsq	0.406	0.469	0.306	0.373	0.331	0.413	0.307	0.368	
Log-Lik	-105.4	-94.23	-123.0	-111.2	-118.8	-104.2	-122.9	-112.2	
Prob. all 0	6.93e-11	1.33e-10	2.55e-09	7.15e-11	2.28e-08	1.15e-08	1.98e-09	1.68e-10	
Pr. (Priv. = 1|x)	0.6227	0.6333	0.6339	0.6695	0.6396	0.8526	0.6346	0.6685	
Obs.	264	264	264	264	264	264	264	264	

millions) and the number of IPO deals in the 12 months prior to the delisting of the firm. Panel B of Table 6 reports the regression results employing these variables. Similar to the indexes, these controls have little impact on the coefficients measuring the effect of valuation and the private equity takeovers. The overall implication of the regression analysis in Table 6 is that market conditions have negligible effect and the firm-level valuation characteristics remain as primary triggers of private equity takeovers.

4.4. Subperiod analysis

As a robustness check, we analyze our results across three subperiods. Our first subsample period is confined to the early period of 1990–2011. This period is generally associated with the development stage of the private equity market in Australia (Cumming and Johan, 2012) and therefore valuation characteristics may not have been as important a consideration for investments as during the later years. The second subperiod comprises the period from 2005 to 2007, which constitutes about 40% of our sample (Table 1) and marks the most active three-year period for private equity activities in Australia. It is possible that during this period, private equity investees accorded less significance to valuation metrics. The third subperiod examines the specific effect on the overall result arising from the sample of firms that were subject to takeovers during the Global Financial Crisis (GFC). As the number of firms in the sample during the early and the GFC period are quite small, to conduct meaningful regressions, we draw comparative inferences from a subsample that omits these observations.[11]

Table 7 presents the regression results for these three subperiods. During the early period, the effect on going-private transactions is still negative for all valuation measures, although only the MTB, PB and INDPE coefficients are statistically significant at conventional levels. For the active period of 2005–2007, the valuation effect is generally negative on the private equity takeover probability. The coefficient estimates are generally negative, confirming that private equity investees perhaps paid careful attention to valuation measures during these periods. However, interestingly, the predicted probabilities of the logit regressions (Pr. Priv. = 1|x) are quite high, ranging from 88.3% to 93.2%. During this active period, it appears that private equity investors select deals by paying careful attention to firm characteristics (control variables). This could be due to the competition for a limited number of attractive investments arising from possible increased fund inflows during this period (Gompers and Lerner, 2000). Finally, excluding the GFC subsample has very little effect on our previous results. Overall, the subperiod analyses show that the result of the effect of valuation on the private equity takeover is not driven by any particular subperiod.

4.5. Further analysis

To complement the previous analyses, the sample is stratified according to its valuation and information asymmetry characteristics. If valuation is the measure that drives private equity transactions, it should show a clearer picture when the data is separated into PE and MA firms. Accordingly, the two groups of firms (PE and MA) are sorted and placed into quintiles according to a valuation or information asymmetry characteristic. The results are tabulated in Table 8. Q1 represents the lowest quintile group and Q5 represents the highest group in each of the variables.

Amongst the valuation variables, the market-to-book ratio (MTB), Q ratio (Q) and the enterprise growth ratio (LNEVR) show a clear pattern of clustering in the lower quintiles for the PE group of firms. This is most evident for the MTB variable, for example, in which the lowest quintile (Q1) contains all of the firms belonging to the private equity sample and the highest quintile contains none. For the information variables, except for the institutional holding (INST), there is no discernible pattern between the two groups when separated into quintiles.

Table 6. Likelihood of going private with controls for money flow.

This table reports the results of logit regressions on the likelihood of going private. The dependent variable is 1 if a firm goes private and 0 for a matching firm undergoing public merger. The coefficients are from estimating the second-stage regression of a two-stage instrumental variable regression using the predicted values of valuations. The first-stage regression estimates the determinants of valuation in Table 3. Variable definitions are as in Table 2. 'Other controls' are controls as in the primary regression specification in Table 4. LNEWIND and LNVWIND are the logarithms of two indexes (equally and value weighted, respectively, and normalized as 1.00 at January 1990) for public market valuations of publicly listed firms in the same industry and at the beginning of the month as that for the going private firm. LNPRCD and LNDEALS are logarithms of dollar amounts (in millions) and the number of initial public offering (IPO) deals in the 12-month period prior to the firm going private. Reported estimates are heteroskedasticity consistent with ***, ** and *, denoting significance levels at 1%, 5% and 10%, respectively.

	LNEWIND	LNVWIND	LNPRCD	LNDEALS	MTB	Q	PB	INDPE	LNEVR	Other controls	Pseudo Rsq	Pr. (y=1|x)
Panel A: adding capitalization index												
(1)	9.519*				−1.545***					Yes	0.694	0.561
(2)	3.997***					−0.459***				Yes	0.390	0.619
(3)	4.228*						−0.095			Yes	0.300	0.613
(4)	4.636***							−0.015**		Yes	0.318	0.617
(5)	1.522								−1.627***	Yes	0.438	0.611
(6)		9.445*			−1.532***					Yes	0.614	0.558
(7)		3.909***				−0.437***				Yes	0.383	0.617
(8)		4.118*					−0.074			Yes	0.253	0.603
(9)		4.523**						−0.014**		Yes	0.317	0.618
(10)		1.411							−1.608***	Yes	0.419	0.605
Panel B: adding controls for IPO deals												
(11)			0.521		−1.459***					Yes	0.684	0.576
(12)			0.560			−0.477***				Yes	0.389	0.626
(13)			0.352				−0.095			Yes	0.293	0.619
(14)			0.275					−0.013**		Yes	0.307	0.623
(15)			0.481*						−1.659***	Yes	0.441	0.618
(16)				0.116	−1.462***					Yes	0.680	0.575
(17)				0.179		−0.465***				Yes	0.381	0.628
(18)				0.057			−0.091			Yes	0.289	0.618
(19)				−0.003				−0.013**		Yes	0.304	0.622
(20)				0.085					−1.640***	Yes	0.434	0.616

Table 7. Likelihood of going private – subperiod analysis.

This table reports the results of logit regressions on the likelihood of going private based on samples drawn from various subperiods. The dependent variable is 1 if a firm goes private and 0 for a matching firm undergoing public merger. The coefficients are from estimating the second-stage regression of a two-stage instrumental variable regression using the predicted values of valuations. Control variables are included in regressions but not reported. The first-stage regression estimates the determinants of valuation in Table 3. Variable definitions are as in Table 2. Prob. change is the change in probability of going private for a one-half standard deviation increase around the mean of the explanatory variables. Figures in the parentheses represent the standard error of estimate and are adjusted for clustering at the industry and year levels. Reported results are heteroskedasticity consistent with ***, ** and *, denoting significance levels at 1%, 5% and 10%, respectively.

	(1)	(2)	(3)	(4)	(5)	Prob. change
Panel A: excluding early period of 1990–2001 (N = 214)						
MTB	−1.364***					−0.6964
	(0.227)					
Q		−0.463***				−0.2906
		(0.0957)				
PB			−0.086			−0.0465
			(0.079)			
INDPE				−0.013**		−0.0903
				(0.006)		
LNEVR					−1.801***	−0.3303
					(0.299)	
Controls	Yes	Yes	Yes	Yes	Yes	
Pseudo Rsq	0.681	0.407	0.310	0.320	0.479	
Log-Lik	−146.300	−146.300	−146.300	−146.300	−146.300	
Prob. all 0	0.000	0.00	0.000	0.000	0.000	
Pr. (Priv.=1$\|x$)	0.583	0.623	0.615	0.616	0.627	
Panel B: active period, 2005–2007 (N = 104)						
MTB	−1.353***					−0.2472
	(0.238)					
Q		−0.963***				−0.1149
		(0.328)				
PB			−0.019			−0.0039
			(0.165)			
INDPE				0.004		0.0130
				(0.016)		
LNEVR					−2.838***	−0.2269
					(0.832)	
Controls	Yes	Yes	Yes	Yes	Yes	
Pseudo Rsq	0.674	0.519	0.391	0.392	0.668	
Log-Lik	−47.74	−47.740	−47.740	−47.740	−47.740	
Prob. all 0	0.000	5.87e-09	1.52e-06	1.48e-06	0	
Pr. (Priv.=1$\|x$)	0.932	0.935	0.883	0.885	0.910	

(Continued)

Table 7. (Continued)

	(1)	(2)	(3)	(4)	(5)	Prob. change
Panel C: excluding the GFC period (*N* = 218)						
MTB	−1.578***					−0.7030
	(0.261)					
Q		−0.446***				−0.2647
		(0.0909)				
PB			−0.087			−0.0377
			(0.091)			
INDPE				−0.012**		−0.0931
				(0.006)		
LNEVR					−1.752***	−0.2999
					(0.292)	
Controls	Yes	Yes	Yes	Yes	Yes	
Pseudo *Rsq*	0.694	0.370	0.268	0.282	0.433	
Log-Lik	−145.600	−145.600	−145.600	−145.600	−145.600	
Prob. all 0	0.000	0.00	0.000	0.000	0.000	
Pr. (Priv.=1|*x*)	0.694	0.673	0.664	0.670	0.669	

In Table 8, the number of firms progressively decreases (increases) across the quintiles for PE firms (MA firms), as the overall sample is sorted according to INST. As noted earlier, this evidence could be indicative of private equity investors avoiding firms with higher institutional holding for at least two reasons. Firstly, private equity investors are unlikely to engage in transactions with a higher expected cost of protracted takeover contest and holdouts. Secondly, firms with a high level of institutional holding (and low valuation) could be correlated with managerial entrenchment, making these firms less attractive for private equity transactions, ceteris paribus.[12] This is a subject for a separate future study. Overall, the results in Table 8 complement the study's main results that undervaluation is a key determinant of the decision to go private.

5. Conclusion

This paper analyses the effect of information asymmetry and undervaluation on going-private transactions through private equity takeovers in Australia from 1990 to 2012. Amongst the main results, it is shown that private equity transactions are possibly triggered due to market undervaluation of firms, rather than information asymmetry. The results of a logit model reveal an inverse relationship between undervaluation and the firm's likelihood to go private, as compared to the likelihood of a public merger. The analysis suggests that private equity firms not only play an active role as investors, but also recognize the underlying value of corporations when capital markets may not. Given the evidence in this paper, it is probably reasonable to argue that the Qantas board and chairperson were correct in their response to the takeover bid of 2007. The evidence presented here is new and adds to prior Australian studies (Chapple et al., 2010; Eddey et al., 1996; Evans et al., 2005) in that the present study explicitly models the interplay between information asymmetry and undervaluation.

It is possible that the firm valuations are affected by characteristics of private equity firms. Cumming and Dai (2011) argue that reputable and large venture capital firms pay a lower price in their investments as these investee firms take advantage of their reputation and size to choose

Table 8. Valuation and information asymmetry by quintiles.

This table compares the quintile distribution of 264 firms undergoing private equity transaction public mergers between 1990 and 2012. PE represents the private equity sample and MA represents a matched public merger sample. Firms are grouped into quintiles according to the value of each of the variables. Variables are defined in Table 2.

	Quintile	Q 1	Q 2	Q 3	Q 4	Q 5	All
	Firms (N)	53	53	53	53	52	264
MTB	Quint. mean	0.64	1.13	1.62	2.98	7.48	
	PE (N, %)	52 (39%)	50 (37%)	27 (21%)	3 (1%)	0 (0%)	132
	MA (N, %)	1 (0%)	3 (2%)	26 (19%)	50 (38%)	52 (40%)	132
Q	Quint. mean	0.33	0.68	1.08	1.84	1.73	
	PE (N, %)	46 (35%)	34 (26%)	22 (17%)	21 (16%)	9 (6%)	132
	MA (N, %)	67(5%)	19 (14.73%)	31 (22%)	32 (24%)	43 (34%)	132
PB	Quint. mean	0.47	1.00	1.50	2.23	6.62	
	PE (N, %)	24 (18%)	34 (26%)	26 (20.16)	24 (18%)	21 (16%)	132
	MA (N, %)	27 (20%)	18 (13%)	25 (19%)	28 (21%)	31 (24%)	132
INDPE	Quint. mean	1.98	4.17	10.36	23.78	73.69	
	PE (N, %)	19 (13%)	25 (19%)	37 (27%)	27 (20%)	24 (18%)	132
	MA (N, %)	34 (26%)	28 (20%)	16 (11%)	26 (19%)	28 (21%)	132
LNEVR	Quint. mean	−0.37	0.21	0.64	1.04	1.86	
	PE (N, %)	47 (36%)	41 (31%)	23 (18%)	11 (8%)	10 (8%)	132
	MA (N, %)	6 (4%)	12 (9%)	29 (21%)	42 (32%)	42 (32%)	132
INST	Quint. mean	0.11	0.36	0.32	0.44	0.63	
	PE (N, %)	49 (36%)	32 (24%)	23 (17%)	14 (10%)	14 (11%)	132
	MA (N, %)	4 (3%)	21 (15%)	30 (22%)	39 (30%)	38 (28%)	132
LNSA	Quint. mean	13.21	16.66	17.98	19.21	21.16	
	PE (N, %)	16 (11%)	26 (19%)	31 (23%)	33 (25%)	26 (20%)	132
	MA (N, %)	37 (27%)	29 (20%)	22 (16%)	20 (14%)	26 (20%)	132
LIQ	Quint. mean	0.09	0.36	0.88	1.90	5.99	
	PE (N, %)	18 (11%)	25 (20%)	39 (28%)	27 (21%)	23 (17%)	132
	MA (N, %)	35 (27%)	28 (19%)	14 (10%)	26 (18%)	29 (23%)	132
LNAGE	Quint. mean	0.85	1.67	2.125	2.69	3.41	
	PE (N, %)	26 (19%)	33 (21%)	24 (20%)	21 (16%)	28 (22%)	132
	MA (N, %)	27 (20%)	20 (18%)	29 (19%)	32 (24%)	24 (17%)	132

among available investments. In the context of this study, it is unlikely that these factors will be significant for two reasons. Firstly, our study is focused on 'triggers' of private equity takeover in which undervaluation acts as a catalyst for the firm in exiting the public market. Thereby the ability of the investee to pay a price for the firm is likely to be moderated by the desire of the firm to go private. Secondly, we are interested in the overall public valuation characteristics *before* the firm goes private, which is likely to be correlated but different from the valuations made by the private equity firms. In other results, at the firm-specific level, the current ratio, leverage and institutional holding are found to be highly significant in their explanatory powers to predict a private equity transaction as opposed to a public merger. This result is consistent with empirical literature, suggesting that going-private firms have a significantly higher level of liquidity (Carroll et al., 1988; Evans et al., 2005). The result pertaining to leverage suggests that private equity investors in Australia are opportunistic (Chapple et al., 2010) in taking advantage of financially distressed firms with low valuations. The fact that institutional holding is much lower for firms going private

reflects the lower probability of successful private equity takeover transactions in the presence of high institutional holdings. No evidence in support of a higher level of free cash flows was found. The analysis also suggests that capital expenditure is not an important driving factor in going private and this is consistent with prior empirical studies in the UK and USA (Opler and Titman, 1993; Weir et al., 2005b).

Funding

Notes

1. Letter to Shareholders, Qantas Corporation, 10 February 2007.
2. Other, less commonly used, structures are syndicates, unit trusts and managed unit trusts.
3. Commonwealth of Australia, Senate Standing Committee on Economics, Private Equity investment in Australia, August, 2007.
4. Chapple et al. (2010) conjecture that private equity consortiums may shy away from the mining sector due to the higher riskiness of mining ventures.
5. Similar matching control firm designs, to avoid self-selection issues, are used in studies of takeovers. See Lehn and Poulsen (1989) and Halpern et al. (1999) for US data, Weir et al. (2005a, 2005b) for UK data and Henry (2004), Chapple et al. (2010) for Australian data, amongst others. Chapple et al. use a matching procedure broader than the one-to-one matching in other studies.
6. All variables are listed in the Appendix.
7. See Penman (2006) for a critique of and implementation issues associated with accounting valuation models in general.
8. An example of private equity bids for debt-induced distressed firms is the bid for Billabong International by the TPG private equity group. 'Billabong Chairman Ted Kunkel who two months ago announced a capital structure review of the debt laden retailer and manufacturer following a downgrade to earnings is understood to have received the offer of at least $3 a share.' (Source: *The Australian Financial Review*, 16 February 2012, p.1.)
9. Our first-pass estimation included fixed effects for a calendar year. As the number of observations in some year groups is quite small, the logit estimation predicts outcomes in these groups perfectly. Given our small sample size, we therefore report the results without the year fixed-effect adjustments.
10. The coefficients are not strictly comparable as the marginal effect of the interaction terms in logit regressions is confounded with other covariates (Ai and Norton, 2003). We report and analyze the marginal effects below.
11. For our analysis, we use September 2007 to June 2009 as the GFC period.
12. An example of the protracted takeover contest of a firm with high institutional holding, which ultimately failed, is the private equity takeover attempt of Qantas in 2007.

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Appendix

Description of variables

The appendix is a list of variables, their measurement and sources used in the article.

Variable name	Description	Source
CURR	Current ratio: current assets divided by current liabilities.	FinAnalysis
INDPE	Industry average price-to-earnings ratio: computed as the firm's 'industry share price' by multiplying the last reported positive earning of the firm by the median price–earnings ratio of the industry in the calendar year prior to the takeover.	FinAnalysis
INST	Institutional shareholdings: the percentage holding of shares outstanding held by institutions in the most recent year prior to the takeover. Information is collected from annual reports from the 'Top 20 Shareholding' section with careful attention to not include trusts and other holdings that are evidently not institutional.	Annual Reports
LIQ	Market liquidity: the average daily closing share price over a month prior to the takeover announcement.	SIRCA, Yahoo finance
LNAGE	Age: logarithm of years subsequent to initial listing on the ASX.	DatAnalysis
LNDEALS	IPO deals: logarithm of the number of IPO deals in the 12- month period prior to the firm going private.	SDC
LNEVR	Enterprise value ratio: the logarithm of the ratio between enterprise value or the net operating assets at period t and $t–1$, where t is the last financial year prior to the takeover. Net operating asset is market capitalization plus debt minus cash.	FinAnalysis
LNEWIND	Index return: logarithm of monthly industry share index, equally weighted, normalized to 1.00 at January 1990.	Datastream
LNPPE	Plan property and equipment: logarithm of property, plant and equipment (in thousand dollars).	FinAnalysis
LNPRCD	IPO proceeds: logarithm of dollar amounts (in millions) of IPO deals in the 12-month period prior to the firm going private.	SDC
LNSA	Sales revenue: logarithm of total revenues in the most recent year prior to takeover (in thousands dollars).	FinAnalysis
LNVWIND	Index return: logarithms of monthly industry share index, value weighted, normalized to 1.00 at January 1990.	Datastream
LVG	Leverage: total liabilities divided by total assets.	FinAnalysis
MTB	Market-to-book ratio: market value of the firm's total assets (total assets minus total liabilities plus market value of equity) divided by the book value of assets.	FinAnalysis
PB	Price-to-book ratio of equity: the PB ratio is measured as the ratio of the share price at the end of the financial year prior to the takeover to the book value of share in that year.	FinAnalysis
Q	Q Ratio: ratio between market value of equity and total assets.	FinAnalysis
RFCF	Relative free cash flow: ratio of the operating cash flow minus interest, taxes and dividends to the total assets.	FinAnalysis