Norwegian School of Economics
Bergen, Fall 2015

Corporate Investment Behavior

An Empirical Comparison of Norwegian Public and Private Firms

Eirik Hjelmeland and Kristian Kaldhol Moldvær

Supervisor: Carsten Gero Bienz

Master Thesis in Financial Economics

NORWEGIAN SCHOOL OF ECONOMICS

Abstract

This thesis examines whether short-termism among Norwegian public firms distorts their investment decisions. We follow the study by Asker, Farre-Mensa and Ljungqvist (2014), using private firms as a counterfactual for how public firms would invest absent such short-term pressures. By relying on exact and propensity score matching, we do so by identifying public and private firms similar on dimensions thought to affect corporate investment. We find that public firms invest significantly less than their private counterparts. In addition, public firms invest in a way that tend to be less sensitive to changes in investment opportunities. These findings are not due to how we measure investment, nor to sampling or matching choices. Our findings suggest that short-term pressures distort the investment behavior of public firms, thus consistent with the study by Asker, Farre-Mensa and Ljungqvist (2014) of U.S. firms. Our thesis can thus be seen as one of the first linking short-termism to Norwegian corporate investment, and highlight a potential trade-off related to the going-public decision in Norway.

Table of Contents

Introduction

A major concern of public firms is that they tend to be too short-term oriented. Going back as far as Narayanan (1985) and Stein (1989, 2003), several studies emphasizes the concern that public managers tend to make decisions that yield short-term gains at the expense of long-term interest of shareholders. More recently, Asker, Farre-Mensa and Ljungqvist (2014) find that agency costs induce short-term pressures among U.S. public firms, causing them to invest less, and in a way that is less responsive to changes in investment opportunities.

This thesis examines whether short-termism among Norwegian public firms distorts their investment decisions. Our study follows Asker, Farre-Mensa and Ljungqvist (2014) in using private firms as a counterfactual for how public firms would invest absent such short-term pressures. We do so by identifying public and private firms similar on dimensions that theoretically should affect corporate investment. This is interesting for two reasons. First, we see no studies contrasting the investment behavior of Norwegian public and private firms. Secondly, while private firms constitute the majority of the Norwegian economy, existing research is limited. Studies of private firms are thus in and of itself interesting.

We build our study on the underlying assumption that private firms are prone to less agency problems, and that any differences in investment behavior are due to public firm agency costs. A substantial body of literature supports this assumption[1]. By identifying public and private firms equal on characteristics thought to affect investment, our study reveals two patterns. First, we find that public firms invest significantly less than their private counterparts. Secondly, we show that public firms invest in a way that tend to be less sensitive to changes in investment opportunities. We show that our findings are not due to sampling or matching choices, or to how investments are measured, as private firms out-invest public in all of our investment measures. Nor are they due to private firm overinvesting, as we find no evidence of such. Our findings are, however, in line with the agency cost theory of short-termism. Consistent with the study of Asker, Farre-Mensa and Ljungqvist (2014), our findings suggests that short-term pressures among public firms distort their investment behavior. However, we distinguish our thesis by presenting results robust to additional alternate matching characteristics, and by relating short-termism to a tendency of high managerial turnover among Norwegian public managers.

[1] See for example Berle and Means (1932), Jensen and Meckling (1976) and Asker, Farre-Mensa and Ljungqvist (2014).

Though our findings are consistent with the predictions of short-termism, there are other notions of the agency cost theory that potentially could explain the investment behavior of public firms. Instead of running efficient and profitable firms, managers may have preferences for running larger corporations. This theory of so-called *empire building* is supported by Baumol (1959), Jensen (1986, 1993) and Stein (2003). According to Jensen (1986, 1993), a preference for empire building may cause public managers to invest all funds available. Stein (2003) further argues that empire building gives managers incentive to increase firm size irrespective of the expected profitability of the investment. Another theory of the agency conflict suggesting overinvestment by public firms is that of managers being *overconfident.* Gervais, Heaton and Odean (2003) find that overconfident managers hesitate less before making decisions. They further argue that compensating such managers' as if they were rational encourage excessive risk taking not in line with shareholder interest.

However, we also see several notions of the agency cost theory suggesting public firm underinvestment. Bertrand and Mullainathan (2003) present a theory suggesting that managers who prefer the *quiet life* resist taking tough decision. They further argue that such a resistance to change often lead to bad investment decisions, such as a continuation of negative net present value projects. Baker (2000) finds similar evidence. According to Stein (2003), the quiet life theory could lead to underinvestment if the decision concerns entering a new business line. This is consistent with the findings of Aggarwal and Samwick (2006), which relates the theory of quiet life and underinvestment to managerial laziness.

The tendency of managers *herding* their investment decisions relates to the managers career concerns. That is, instead of relying on their own private information about investment payoffs, they copy the decisions of others (Stein, 2003). Scharfstein and Stein (1990) argue that "herding managers" have incentive to copy the choices of others, regardless of the historical or expected payoffs. According to Stein (2003), one way to generate empirical predictions of reputation-based herding models is to look at differences in managers incentives to boost their reputation. Based on their lack of both experience and record of accomplishment, he then suggest that younger managers, as well as younger firms, have more to gain from herding than older[2].

[2] This prediction is also supported by Chevalier and Ellison (1998), Baker (2000), and Hong, Kubik and Solomon (2000).

Short-termism has been defined as "seeking short-term gains to the exclusion of long-term achievement" (Mullins, 1991). That is, firms cut expenditure on items such as R&D, PP&E, training and other factors that might improve long-term performance, in order to maximize current profitability (Edmans, Fang, & Lewellen, 2014). There are two broad strands within the literature of short-termism (Palley, 1997). One strand focuses on imperfections in financial markets, the other on concerns related to managerial careers. Regarding the imperfections in financial markets, Stein (1989) appeals to a greater information asymmetry for long-term, than for short-term investments. He states that because shareholders cannot observe everything managers do, shareholders must rely on some imperfect summary such as reported earnings. He thus argues that short-term behavior may represent a rational response by managers who are initially long-term oriented, but believe that the market attaches to much weight to the current share price. In a more systematic spirit, Laverty (2004) suggests that elements such as organizational culture, processes and routines are important in understanding why firms may undervalue the long-term and pay too much attention to the short-term. He finds that firms are less likely to engage in short-term behavior, when managers are able to create a climate of trust that allows them to take the short-term setbacks necessary to achieve long-term results. In regards to the literature related to managerial careers, Palley (1997) presents a theory of short-termism that rests on the presence of managerial turnover, and can be thought of as an extension of the managerial career literature. He shows that if the managers' future career are closely tied to current profitability, and the probability of managerial turnover is present, firms may engage in projects with higher short-term returns, but with lower net present values. The key lesson from this study is that it links short-termism to wider economic features; firms in economies with higher presence of managerial turnover are more likely to be characterized by short-term behavior (Palley, 1997).

In the process of developing a hypothesis, we note that the theory of both empire building and overconfidence suggest that public firms should investment more, and be more responsive to changes in investment opportunities than their private counterparts. However, public firms are also prone to more short-term pressure than private firms, suggesting the opposite. First, this is supported by the findings of Asker, Farre-Mensa and Ljungqvist (2014) in their study of U.S. public and private firms. Secondly, as private firms are characterized of being illiquid, managers have to hold their equity stakes for a much longer period of time, imposing a longer-term horizon (Stein, 1989). This, according to Bhide (1993), encourage managers of private firms to maximize its long-term value. This yields the following hypothesis:

The short-termism hypothesis

"Public firms invest less, and are less sensitive to changes in investment opportunities than private firms"

Our thesis examines this hypothesis by following Asker, Farre-Mensa and Ljungqvist (2014), in using private firms as a counterfactual for how public firms would invest absent agency costs. We do this under the assumption that private firms are less prone to agency conflicts. This implies that agency problems such as empire building or overconfident managers do not occur among private firms. We thus believe that any differences in investment behavior between public and private firms will reflect agency problems among public firms.

Our findings rely on a matching procedure called Propensity Score Matching ("PSM"), with a nearest-neighbor approach. That is, for each public firm, we find the private firm with the closest propensity score based a pre-decided set of matching characteristics. This procedure allows us to identify and compare public and private firms similar on characteristics thought to affect investment behavior. By implementing a PSM loop, we are able to do exact industry matching, as we run the PSM separately for each industry. We exclude all industries that do not satisfy the underlying PSM assumptions, assuring that all matched public and private firms are empirically comparable. To capture the potential effect of macroeconomic cycles, we conduct a similar procedure by running year loops, allowing us to do exact year matching. All matching characteristics are theoretically deterministic for corporate investment.

First, we examine differences in investment levels between public and private firms. We find that public firms invest significantly less than their private counterparts, even after we control for differences in investment opportunities and lifecycle stages. These findings are not due to how we measure investment, as private firms out-invest public in terms of both gross and net tangible + intangible fixed assets. Nor are our findings due to sampling choices, as we obtain similar results in all of our matching samples. Using alternate matching approaches such as exact year matching does not alter our findings either.

Next, we find that public firms invest in a way that tend to be less sensitive to changes in investment opportunities. Neither these results are due to how we measure investment. Although we present one insignificant matching sample, our findings are not driven by

sampling or matching approach choices. By including retained earnings and age to control for different lifecycle stages, and by applying an alternate matching approach to control for macroeconomic cycles, we show that public firms are significantly less sensitive to changes in investment opportunities.

We then examine which agency costs among public firms that could explain our findings. We immediately discard the possibility of public managers being empire builders or overconfident, as this should have resulted in public firm overinvestment. However, it is possible that our findings are due to a herding-like behavior among public managers, copying each other's defensive investment decisions. We find no evidence of this, as we see no herding tendencies between the youngest and oldest public firms in our sample. Public firm managers enjoying the quiet life is another possible explanation of our findings, as such decision-avoiding preferences often lead to bad investment decisions. Nevertheless, such preferences should result in excessive cash piling, creating a buffer to avoid taking difficult decisions in the future. As we match public and private firms on their respective cash holdings, we find no evidence of public firm managers enjoying the quiet life.

Finally, we consider the possibility that private firms could overinvest, as they do not receive any feedback of such from the stock market. However, by showing that private firms are more profitable, in addition to unaltered results by matching on ROA, we find no evidence of private firm overinvestment. Our findings are, however, supportive of the notion that short-term pressures among public firm managers cause them to invest less, and in a way that is less responsive to changes in investment opportunities. According to Palley (1997) and Laverty (2004), firms may engage in short-term behavior if their manager`s future career are tied to current earnings. We find that 21% of our matched public firms replace their CEO each year on average. The tendency of high managerial turnover among public firms in Norway supports our hypothesis further. Our findings are also consistent with the study by Asker, Farre-Mensa and Ljungqvist (2014) on U.S. public and private firms. Our thesis contributes to the financial literature in several ways. First, we see no similar studies contrasting the investment behavior of Norwegian public and private firms. Secondly, by using private firms as a counterfactual for how public firms would invest absent agency costs, we identify short-termism as a potential driver for public firm investment. Our thesis can thus be seen as one of the first linking short-termism to Norwegian corporate investment, and highlights a potential trade-off related to the going-public decision in Norway.

1. Related Literature

We are aware of several studies contrasting the investment behavior of public and private firms, and the effects of agency problems and short-termism. As presented in the introduction, Asker, Farre-Mensa and Ljungqvist (2014) show that compared to private firms, public firms invest substantially less and are less responsive to changes in investment opportunities. These findings are consistent with the notion that short-term pressures distort public firms' investment decisions. Analyzing hand-collected public and private firm data in the U.S. chemical industry, Sheen (2011) finds similar results. Furthermore, Gao, Hsu and Li (2014) links short-termism to corporate innovation, by showing that public firms' patent portfolios are more exploitative (i.e. making use of existing knowledge) and less exploratory (i.e. pursuing new knowledge) than private firms' patent portfolios.

While these studies focus on the extensive margin, most prior studies focus on the intensive margin[3]. By using CEO's stock and option grants of public U.S. firms, Edmans, Fang and Lewellen (2014) show that short-term pressures lead to reduced spending on R&D, capital expenditures and advertising. Ladika and Sautner (2014) exploit the accelerated option vesting in response to an earlier FAS 123-R[4] compliance date, and find that with more short-term incentives, executives engage in short-term behavior by reducing investments. Wurgler (2000) relate the investment behavior of public firms to differences in corporate governance, while Pagano, Panetta and Zingales (1998) find that investment levels decrease after a firm goes public. Finally, Bhojraj, Hribar, Picconi and McInnis (2009) show that public firms reduce discretionary expenditures to beat analyst forecast, collecting evidence that managers engage in myopic behavior to beat short-term benchmarks.

[3] Extensive research exploits variation along the public-private firm margin, while intensive focus on the public firm margin only.
[4] Accounting standard adopted by the Financial Accounting Standards Board (FASB) in December 2004. This accounting standard required all firms to expense stock option grants at fair value (Ladika & Sautner, 2014).

2. Sample and Data

Our dataset covers accounting and company data for all Norwegian firms and consolidated groups for the years 1992 to 2013. The data was obtained using the Institute for Research in Economics (SNF) database, available for both students and faculty at the Norwegian School of Economics (NHH) for research based on companies' accounts. The data files are formatted to Stata 14, structured as 22 yearly files with company accounts, group accounts and company- and industry information, totaling to 44 files. The data are on a yearly basis delivered from the Brønnøysund Register Centre[5] through Bisnode D&B Norway AS, and are revised and standardized by Aksel Mjøs[6]. Although accounting variables are standardized both between and within firm year observations, SNF cannot guarantee complete consistency. This is due to continuous policy changes and different implementation paces among firms. Based on changes in regulations, the standardization of accounting variables are divided into two parts, 1992 – 1999 and 2000 – 2013. For consistency and relevance purposes, we only use data from the latter[7]. Note that all amounts are in NOK 1000.

To construct market values for public firms, we have merged data containing yearly closing share prices from NHH Børsprosjektet[8] into to our sample. We obtained these data using Amadeus 2.0, available for both students and faculty at NHH.

2.1 Cleaning and Sample Construction

The dataset contains 2,990,184 public and private firm year observations. We exclude 185,840 observations with missing or negative total assets, 4,950 observations with no listing status and 98,229 observations with no industry specification. We further exclude 205,899 financial firms, as the high leverage for these firms do not have the same meaning as for non-financial firms, where high leverage more likely indicates financial distress (Fama & French, 1992).

Industry-codes are based on the NACE-system. As the standards of this system changed in 2008, each firm has two industry variables, "bransjek_02" and "bransjek_07". However, bransjek_02 is missing firms with startup after 2008, and bransjek_07 is missing firms that only

[5] The Brønnøysund Register Centre contains all relevant Norwegian company information, documentation and history, and develop and operate many of the nation`s most important registers and electronic sources (Brønnøysundregistrene, 2015).
[6] Associate Professor, dr. oecon. Norwegian School of Economics 2007. The latest revision took place in 2013, in cooperation with Endre Berner and Marius Olving, both students at NHH at that time.
[7] By reviewing our dataset, we noticed that some of our firm observations contained missing values. Thus, we have manually added and corrected some of the accounting information through Proff®, a Norwegian provider of firm information. However, we cannot guarantee that all errors or missing values are corrected.
[8] The database containing financial market data at NHH. Registration is required.

existed before 2008. To ensure yearly consistency, we generate a new industry variable called "bransje", which combines the information from the former industry variables. As the former industry variables only overlap to a certain extent, we exclude 2,946 observations that are inconsistent in "bransjek_02" and "bransjek_07". We choose to drop all observations (219,460) within the industries health and social and culture and media for both private and public firms, as these industries contains zero and six public firm year observations, respectively. In addition, these industries are often regulated, and thus not suitable for our analysis. We further exclude 56 duplicate observations, 77,094 observations with non-relevant ownership structures, and 13,972 firms registered as non-active.

Figure 1 in the Appendix show the distribution of public and private observations each year post cleaning. As expected, our dataset contains substantially more private than public firm observations. Figure 2 show the distribution of public and private firm observations within each industry. We see that most public firms are within the general industry, while most private firms are within the consulting and real estate industry.

2.1.1 Adjusting for Outliers

The importance of removing outliers in financial data has historically been heavily discussed (Hadi & Simonoff, 1993). Despite their definition as extreme data points, they are still valid observations, and adjustment for such are largely subjective (Bruni, Fair, & O'Brien, 2012). When we study variables such as ROA, effective interest rate and sales growth, we see that our sample contains some extreme observations[9]. Based on these findings we choose to Winsorize our dataset. This implies putting an upper and lower limit for the value of the observations. Note that the observations are not removed from the dataset, but limited to a certain percentile of their values. The rationale behind this process is that the observations will affect the outcome in the course they otherwise would have done, but not to such an extent that they undermine the analysis.

Empirical evidence suggest that using a Winsorizing level of 95 or 99% leads to small outcome differences (Brandon & Wang , 2012). However, the most common approach when analyzing financial data is a 98% level (Leone, Minutti-Meza, & Wasley, 2014). Despite this, we choose to Winsorize our data at the 99% level[10], which implies that all observations higher than the

[9] We view effective interest rates of more than 50% as examples of such observations.
[10] We follow the approach of Asker, Farre-Mensa and Ljungqvist (2014).

99.5th percentile, and below the 0.05th percentile are set to those respective levels[11]. Thus, approximately 1% of our observations will be modified to either an upper or lower limit. By reviewing our dataset, we see that this process effectively removes the most extreme observations. We base our analysis on the Winsorized dataset. Later, in the discussion of the reliability of our results, we conduct a robustness test where we impose a tighter Winsorizing level.

2.2 Measures of Investment

Firms can increase their assets by either investing in new assets, or acquire other firms. These investments are shown in capital expenditures and by M&A activity, respectively. There are two reasons why we cannot use these measures to compare investment levels of public and private firms. First, our dataset do not specify costs related to mergers and acquisitions. Secondly, as private firms in most cases cannot pay for the acquired firm with stock, they are likely to have higher capital expenditures than public firms (Asker, Farre-Mensa, & Ljungqvist, 2014). To avoid these problems and the potential biased results, we model *gross investment* as the increase in tangible fixed assets, normalized by beginning-of-year total assets. Analogously, we model *net investment*, with the difference being depreciation. As depreciation often can vary considerably both in and between industries, we view gross investments as the preferred measure.

For robustness, we also measure investment as the gross and net increase in both tangible and intangible fixed assets. See our variable definition and construction in the Appendix for a detailed description of these, and all other defined variables. As we are normalizing all investment measures with beginning-of-year total assets, we are left with no investment measures for the year 2000. After the variable construction, we thus exclude all observations in this year.

2.3 Measures of Investment Opportunities

We use *sales growth* to measure firms' investment opportunities, both public and private. Defined as the percentage annual increase in revenue, sales growth is widely used to proxy for investment opportunities[12].

[11] A 99% Winsorizing level sets the bottom 0.5% of the observations to the 0.5th percentile, and the top 0.5% of the observations to the 99.5th percentile, and then averages the data.
[12] For example by Rozeff (1982), Lehn and Poulsen (1989), Michaely and Roberts (2012), and Asker, Farre-Mensa and Ljungqvist (2014).

For robustness purposes, we also construct an alternate variable to measure investment opportunities. By following prior empirical studies, we see Tobin's Q as a frequently applied measure. Defined as the ratio of the firms' market value to its asset replacement costs, Tobin's Q is used to explain a variety of corporate phenomena, such as differences in investment sensitivities and diversification decisions[13]. However, as private firms are not publicly traded, we cannot determine their market value. With inspiration from Asker, Farre-Mensa and Ljungqvist (2014), we solve this problem by designing an *industry Q*, using market values from the share price data for public firms. We then apply this measure to all firms, both public and private. The industry Q is constructed as the size-weighted average Q for each industry and year. As the calculation of Tobin's Q often gets indelicate, we use the "approximate Q" as a proxy[14], denoted as the firms' market value to its book value of total assets (Chung & Pruitt, 1994).

2.4 Matching

To test our hypothesis of short-term pressures among public firms, we need to eliminate differences between public and private firms that are likely to affect investment. We do so by following prior studies such as Saunders and Steffens (2011), Michaely and Roberts (2012), Gao, Hsu and Li (2014), and Asker, Farre-Mensa and Ljungqvist (2014), and apply a matching procedure called *Propensity Score Matching* ("PSM"). The purpose of this matching procedure is to identify samples of private firms that more closely resembles public firms on dimensions affecting investment behavior, enabling us to "compare apples with apples". We give a brief overview of the theory and the general idea behind PSM in the section below. For a detailed description, see Rosenbaum and Rubin (1985), Rubin (2001), and Austin (2011).

2.4.1 Propensity Score Matching

The propensity score is defined as the probability of treatment assignment conditional on observed baseline covariates (Rosenbaum & Rubin, 1983)[15]. The propensity score is essentially a balancing score. Thus, in a set of observations with equal propensity scores, the distribution of observed covariates is the same between treated and control groups. We use this procedure to form matched sets of public and private firms who share similar values of the propensity scores. This allows us to identify public and private firms similar on a pre-decided set of firm characteristics. The propensity scores is most commonly estimated using a logit or probit

[13] See for example Jose, Nichols, & Stevens, (1986) and Malkiel, Furstenberg, & Watson, (1979).
[14] 96,6% of the variability of Tobin's Q is explained by "approximate Q", (Chung & Pruitt, 1994).
[15] $E(x) = P(Z = 1 \mid X)$ where Z = 1 is the treated group, and X is covariates (Rosenbaum & Rubin, 1983).

regression. However, we use Stata's module psmatch2, which apply probit. For syntax and description, see Leuven and Sianesi (2006).

There are, however, some underlying assumptions in the PSM model that needs to be addressed (Rosenbaum & Rubin, 1985). The first is the unconfoundedness assumption, which states that no unobserved characteristics that affect both treatment status (listing status) and outcome variable (investment) can be omitted from the model. As we cannot rule out the possibility of such characteristics, this could limit our results[16]. The second assumption relates to the balance post-matching, which is a measure of how similar treated and control observations are on the pre-decided matching characteristics. Rubin (2001) recommends that B (the standardized difference of means of the propensity scores in the treated and matched control group)[17] should be less than 25%, and that R (the ratio of treatment group variance to control group variance)[18] should be between 0,5 and 2 for the samples to be sufficiently balanced. We discuss this assumption further in Section 2.4.2. The third and last assumption is that of common support. By imposing a common support condition in our matching procedure, we exclude all public firm observations whose propensity score is higher than the maximum or less than the minimum propensity score for private firms – thereby satisfying this assumption.

We apply the nearest-neighbor module in our matching procedure. That is, for each public firm, we find the private firm with the closest propensity score based on our pre-decided matching characteristics[19]. We also match with replacement, meaning that a private firm could be matched with several public firms. This reduces bias, but may also reduce efficiency (Smith & Todd, 2005).

2.4.2 Matching Procedure

To be able to analyze differences in public and private firms' investment behavior, it is important to neutralize dimensions likely to affect investment. In our first matching sample, we follow Gao, Hsu and Li (2014), and Asker, Farre-Mensa and Ljungqvist (2014), matching on industry and size. Gala and Julio (2011) find that size is one of the most important variables, both economically and statistically, when explaining variation in firm investment. We see *total*

[16] In addition, this assumption is not directly testable (Imbens & Woolridge, 2008)

[17] $B = \frac{(\overline{X_T} - \overline{X_C})}{\sigma_T}$, where $\overline{X_T}$ and $\overline{X_C}$ is the average of the treated and control group`s covariates, respectively. σ_T is the standard deviation of the treated group.

[18] $R = \frac{\sigma_T^2}{\sigma_C^2}$, where σ_T^2 and σ_C^2 is the variance of the treated and control group, respectively.

[19] Given the size of the Norwegian economy, we do not identify more than one "neighbor".

assets as the preferred variable to proxy as firm size. While market cap, for instance, reflects the ownership of equity only, total assets reflects the firm's total resources (Chongyu & Li, 2014). We inflate total assets to 2013 purchasing power to control for across-year comparisons[20]. Before we match on size, public firms are substantially larger than private firms, as we report in the first row in Table 1. Mean (median) total assets of public firms are 1 431 (729) million, compared to 83.9 (15.0) million for private firms. Among others, Dudley (2008) show that investment varies considerably from year to year for most firms, i.e. investments are "lumpy". In the rest of our study, we will focus on means rather than medians, a well-known choice among researchers of corporate investment (Thomas, 2002). To create a sample of firms in the same size range, we exclude all private firms smaller than the smallest public firm within each industry.

As firms grow larger, higher investments are required to maintain their size-relative investment ratios. This implies that we cannot compare public and private firms that differ substantially in size, as big investment opportunities usually occur more rarely. With inspiration from both Asker, Farre-Mensa and Ljungqvist (2014) and Gao, Hsu and Li (2014), we account for this non-linear relationship between size and investment by requiring the following condition to hold[21]:

$$(1) \quad \frac{Total\ Assets_{Public}}{Total\ Assets_{Private}} < 3 \quad or \quad \frac{Total\ Assets_{Public}}{Total\ Assets_{Private}} > \frac{1}{3}$$

We also match on *industry*. Both Jorgenson (1971) and Andras and Srinivasan (2003), find that corporate investment vary significantly across industries. Balakrishnan and Fox (2006) relates this to differences in industry capital intensity. By creating an industry loop in our matching procedure, we ensure that all matched public and private firms always are in the same industry. That is, we run the PSM model separately for each industry, implying an exact industry matching. We then match on size (and other firms characteristics) based on the estimated propensity scores within each industry. To satisfy the propensity score balancing assumption, we only keep those industries with B; standardized difference of less than 25%, and R; variation ratio between 0.5 and 2[22]. We report the dropped industries for this, and the following matching

[20] We use the inflation rates provided by Statistics Norway (SSB)
[21] Later, in the discussion of the reliability of our result, we show our results sensitivity to varying size conditions.
[22] We exclude industries not satisfying these conditions manually.

samples, in Table 18. For a visual and more detailed description of our matching procedure, see Figure 3.

2.4.3 Firm Characteristics Post Matching

After we match on industry and size, we see from the bottom graph in Figure 4 that the size distribution for public and private firms are almost identical. As shown in Table 1, mean total asset for public and private firms are 1,431 million and 1,439 million, respectively. However, matching on industry and size yields significant differences in other firm characteristics. Table 1 show that private firms are younger, have higher ROA and ROE, more debt, more retained earnings and less cash. These differences are as expected, and consistent with prior literature comparing public and private firms[23]. More surprisingly, we see that public firms have higher cost of debt, inconsistent with the findings of Pagano, Panetta and Zingales (1998). Public firms also face better investment opportunities when measured in sales growth, but not by Tobin's approximate Q. We will investigate this more in detail in our analysis.

2.4.4 Other Matching Characteristics

To be able to uncover potential short-term pressures among public firms, we need to identify pairs of public and private firms comparable on dimensions likely to affect investment (Asker, Farre-Mensa, & Ljungqvist, 2014). This implies that matching on more characteristics than industry and size are necessary. However, our aim is not to neutralize all observable differences between public and private firms. As pointed out by Heckman, LaLonde and Smith (1999), matching on too many characteristics unrelated to the outcome variable, results in samples that are unrepresentative of their respective populations. We thus limit the matching characteristics to those that theoretically should affect investment behavior.

We follow Michaely and Roberts (2012), Asker, Farre-Mensa and Ljungqvist (2014) and Gao, Hsu and Li (2014) in terms of additional matching characteristics. According to Mueller (1972), life cycle differences are closely related to both organizational growth and development. To control for lifecycle differences, we include *RE/TA* and firm *age* among our matching characteristics (DeAngelo, DeAngelo, & Stulz, 2006). In their study of how real estate shocks affects corporate investment, Chaney, Sraer and Thesmar (2012) argue that both profitability and debt-asset ratio are important determinants of a firm's investment level. We thus match on both *ROA* and *leverage*. To control for within industry differences, we also include *asset ratio*

[23] See for example Brav (2009), Gao, Hsu and Li (2014) and Asker. Farre-Mensa and Ljungqvist (2014).

as a measure of a firm's capital intensity (Balakrishnan & Fox, 2006). We also include *cost of debt* to control for investment costs. Finally, we also match on *cash holdings*, as Denis and Sibilkov (2009) show that greater cash holdings are associated with higher levels of investment, especially for financial constrained firms. For a detailed description of these, an all other defined variables, see the variable definition and construction in the Appendix.

If two or several characteristics are highly correlated, this could bias our results as we estimate the propensity scores using a probit model (Rosenbaum & Rubin, 1985). We address this potential multicollinearity problem by creating a correlation matrix, shown in Figure 5 Panel A. As expected, we see a high correlation between ROA and RE/TA. However, as we show in Panel B, our VIF test rejects the possibility of multicollinearity biasing our results[24].

3 Empirical Analysis

We have designed our empirical analysis to test the hypothesis regarding both investment levels, and sensitivity to changes in investment opportunities of public and private firms. We will also try to assess causes for the differences we find, in addition to test the robustness of our results. Later, in Section 4, we will discuss which agency costs that potentially could explain our findings[25].

3.1 Differences in Investment Levels

Table 2 presents our first findings. As shown in row 1, our full pre-matched sample indicate that private firms on average invest 2,3% more each year than public firms. However, the difference is not significant. After we match on industry and size, we see from row 2 that private firms each year increased their gross tangible fixed assets by 8.4% on average, compared to an increase of 2.6% for public firms, indicating a gap of 5.8%. We see similar results when we include depreciation in our investment measure. Row 4 show that private firms on average invest 4.3% more when we measure investment as the annual increase in net tangible fixed assets. These findings are not due to how investment is measured, as private firms out-invest public firms in all of our investment measures. In fact, the gap only widens when we include investment in intangibles, shown by row 3 and 5. These findings are all significant at the 1% level, indicated by the three asterisks.

[24] VIF is short for *variance inflation factor*, and is a commonly used Stata module to test for multicollinearity. A variable whose VIF is greater than 10 is considered questionable (Bruin, 2006).
[25] Remember that we use private firms as a counterfactual for how public firms would invest absent agency costs, under the assumption that any difference in investment behavior are due to public firm agency problems.

A substantial body of research claim that industries and firms go through life-cycle stages characterized by significant differences in restructuring and investment activity (Gort & Klepper, 1982) (Jovanovic, 1982) (Klepper, 1996). We control for these different life cycle stages among public and private firms by including age among our matching characteristics (DeAngelo, DeAngelo, & Stulz, 2006). Shown by row 6 and 8, we find that private firms continue to outinvest public firms in terms of both gross and net tangible fixed assets. In fact, this widens the gap to 6.7% and 5.6%, respectively. Including investment in intangible fixed assets yields similar results, as shown in row 7 and 9.

We see firms of equal size and in the same industry and lifecycle stage as good investment peers. First, as many of these firms are competitors, they should have the same need for expansion and growth to remain competitive in terms of both keeping, and collecting customers. Secondly, as they are of the same age, and thus in the same lifecycle stage, they should also have the same need for renewal of existing property, plants and equipment. Thus, in our industry, size and age matched sample, we should expect to see similar investment behavior across paired public and private firms. Instead, we find that private firms outinvest public firms in all of our investment measures. Shown by row 10 and 11, we find the same results both before and after the financial crisis. Not only do private firms invest more, Table 1 show that private firms also have higher return on their investments, with higher ROA (and ROE) than public firms. As noted by Li (2004), systematical overinvesting should have negative implications for a firm's profitability. This effectively disregard the possibility that our findings so far are due to private firm overinvestment. However, as mentioned in Section 2.4.4, we see significant differences in other firm characteristics thought to affect investment. We will eliminate these dissimilarities in firm characteristics shortly, but it is important to notice that they reflect differences between public and private firms that are a direct consequence of their listing status, and thus drives our findings so far: private firms invest more than their public counterparts when matched on industry, size and age.

3.1.1 Sampling and Matching Characteristics Choices

It is possible that our findings so far are due to sampling choices. For instance, our findings in Table 2 could be due to a systematical comparison of the most profitable private, and the least profitable public firms. As mentioned earlier, our methodology relies in using private firms as

a counterfactual for how public firms would invest absent the potential agency costs. Ideally, we should match on as many characteristics thought to affect investment as possible.

As shown in Table 3, increasing the number of matching characteristics does not alter our findings, with the least reliable results being significant at the 10% level. Row 2 through 5 present our findings when we match on industry, real size, leverage, cash holdings, cost of debt and ROA[26]. As shown in row 2 and 4, private firms invest 3.9% and 2.9% more each year on average, in terms of gross and net tangible fixed assets, respectively. These results are not due to how we measure investment, with private firms investing significantly more when we include investment in intangibles, shown in row 3 and 5. In the next sample, we change cost of debt with asset ratio, to control for capital intensity differences within industries. We also include retained earnings to control for different lifecycle stages. As shown in row 6 through 9, this does not close the cap either. Row 10 through 13 show the results of our most detailed matching sample. Matching on industry, real size, leverage, cash holdings, asset ratio, ROA, retained earnings and cost of debt has virtually no effect on our results. If anything, the significance has increased. Private firms increased gross tangible fixed assets by 4.9% of total assets on average, compared to 1.4% for public firms. Neither these results are due to how we measure investment. Changing the investment measure to net increase in tangible fixed assets leads to almost the exact same result. The same is true when we include investment in intangibles. We thus extend the findings of Asker, Farre-Mensa and Ljungqvist (2014) in showing that our findings are robust to additional alternate matching characteristics.

In our next matching approach, we follow Michaely and Roberts (2012), matching on industry, size, leverage, cash holdings, sales growth and ROA. This alters our results. As shown in row 2 and 4 in Table 4, private firms outinvest public in terms of both gross and net investment. However, we cannot reject the null that the gross or net increase in tangible fixed assets are equal. We find similar results in terms of investment in both gross and net tangible + intangible fixed assets, shown in row 3 and 5 respectively. These results are conflicting with our findings so far. However, as mentioned in Section 2.3, sales growth is a well-known measure for investment opportunities. Does this indicate that our findings presented in Table 2 and Table 3 are due to better investment opportunities among private firms? As we show in the next section, this is not the case.

[26] For detailed description of these and all other variables, see our variable definition and construction in the Appendix.

3.1.2 Unconditional Investment Levels

It is possible that private firms invest more than their public counterparts because they experience better investment opportunities. We have two measures of investment opportunities. As we use market cap of public firms to create an "approximate industry Q" for private firms, we see sales growth as the superior measure. To control for potential differences in investment opportunities we follow Asker, Farre-Mensa and Ljungqvist (2014) by estimating the following regression, holding sales growth and profitability constant[27];

$$(2)\quad Investment = \alpha + \beta_1(bors\_aks) + \beta_2(sales\_growth) + \beta_3(ROA) + Year_i + Industry_i + \varepsilon$$

where *investment* is one of the different investment measures we present in Section 2.2, *bors_aks* is our dummy indicating public or private listing status and *ROA* is return on assets[28]. β_1 show the difference in public and private firms investment levels, after we control for investment opportunities by holding sales growth and profitability constant. As we have repeated observations on both public and private firms, we expect observations to be independent across firms, but not necessarily within firms. Therefore, we cluster standard errors at the firm level, ensuring heteroscedasticity-robust standards errors. In addition, by including industry and year dummies, we control for industry fixed effects and year trends, respectively.

The results from estimating equation (2) are shown in Table 5. Holding investment opportunities and profitability constant do not alter our findings, and disproves the conflicting results we saw in Table 4. In fact, we find that private firms invest significantly more than public in our full sample, shown by column 1. Column 2 through 5 show our findings in the size and industry matched sample. We find that private firms increased their gross and net tangible fixed assets by 5.8% and 3.8% more than their public counterparts. Including investment in intangibles has almost no effect on our results. Adding age to control for lifecycle differences does not alter our findings either, as shown by Table 6. Private firms continue to outinvest public firms, even after we control for differences in investment opportunities. The same is true after the financial crisis, reported in column 7.

[27] We estimate the regression using Ordinary Least Squares (OLS), assuming that $E(u_i \mid x) = 0$, $cov(u_i, u_j \mid x) = 0$, $var(u_i \mid x) = \sigma^2$ and no perfect multicollinearity (Wooldridge, 2010).

[28] Among others, Hoshi, Kashyap and Scharfstein (1991) show that investment opportunities is not a sufficient statistic for determining investment. ROA, however, are positively correlated with investment (Chaney, Sraer, & Thesmar, 2010). We follow these findings, and the findings of Asker, Farre-Mensa and Ljungqvist (2014), and include ROA in our regression.

To assess whether these findings are due to sampling choices, we estimate equation (2) using a more detailed matching sample. The results from this estimation are shown in Table 7. Our industry, size, leverage, cash holdings, cost of debt and ROA matched sample leads to almost the exact same results. If anything, the gap has increased, as shown in Panel B. Column 1 and 3 in Panel A show that private firms increased their gross and net tangible fixed asset by 5.7% and 3.8% more than public firms. Including investment in intangible fixed assets do not alter our findings either, as reported in column 2 and 4. For further robustness, we include retained earnings and asset ratio to control for lifecycle differences and capital intensity, respectively. Our findings from this estimation are presented in column 5 through 8. As shown in Panel B, including RE/TA and assets ratio virtually change nothing.

Table 2 through Table 7 gives some valuable insight. Private firms invest more than their public counterparts on average, even after we control for differences in investment opportunities. Our findings are not due to how we measure investment, nor due to matching samples. Private firms outinvest public firms in terms of both tangible and intangible fixed assets, in all of our samples.

3.1.3 Matching Approaches

Our matching samples and findings so far builds on an industry loop, assuring that all matched public and private firms are in the same industry. This is important as capital intensity vary substantially across industries (Balakrishnan & Fox, 2006). To assess the robustness of our results, we also conduct two alternate matching approaches.

3.1.3.1 Year Loop

This approach is similar to the existing in terms of looping, except that we loop each year instead of each industry. That is, starting in 2001, we run the loop for all years up to 2013, ensuring that all matched observations are in the same year. We use PSM within each year to match on other firm characteristics. For a detailed description of this matching approach, see Figure 3. In this way, we capture macroeconomic cycles that potentially could affect our results[29]. Our dataset do not let us run industry and year loop simultaneously, as Stata fails to provide any results at all[30]. To still control for industry differences, we include asset ratio to measure a firm`s capital intensity. Through yearly looping, and by including asset ratio among the matching characteristics, we ensure that all firms are in the same year, while simultaneously controlling for industry differences. This solves our problem in Stata.

[29] Such as government regulations, tax policies, future market expectations and private consumption.
[30] Stata fails to provide any results at all, as our sample do not contain enough observations in each industry and year.

The findings from this matching approach are presented in Table 8, with our least significant results being at the 10% level. Row 2 through 5 show the results of matching on year, capital intensity and size. Our findings remain unaltered. Including age to control for lifecycle differences does not close the gap either, reported in row 6 through 9. Private firms invest 5.1% and 3.4% more on average in gross and net tangible assets.

3.1.3.2 No Loop

In the last alternate matching approach, we step away from looping. That is, we run PSM on the whole dataset, without any exact variable matching[31]. The drawback with no looping is that we cannot assure that all matched public and private firm observations are in the same industry or year. Thus, we solely base the quality of the paired public and private firms on the achieved balance of the firm characteristics post matching. The results are presented in Table 9. Matching on year, capital intensity, size and age confirms our previous findings. As shown by row 2 and 4, private firms invest 4.2% and 1.8% more than public firms in gross and net tangible fixed assets, respectively. Including investment in intangibles yields similar results, shown in row 3 and 5. Next we follow Michaely and Roberts (2012), matching on year, asset ratio, size, ROA, leverage, cash holdings and sales growth. As shown in row 6 through 9, this supports our previous findings further. Private firms invest more in both tangible and intangible fixed assets.

3.1.4 Investment Levels Summary

So far, we have shown that private firms invest significantly more than their public counterparts. These findings are not due to how we measure investment. We show that private firms invest more in both tangible, and tangible + intangible fixed assets, even after we control for differences in investment opportunities and lifecycle stages. Nor are our findings due to sampling choices, as our results remain robust to several matching samples. Supporting our findings further, we see similar results when applying alternate matching approaches.

Our findings are contradictory of what one would expect, as we see several reasons why public firms should invest more than private. Brav (2009) and Gao, Harford and Li (2013) show that public firms experience less financing frictions (i.e the time, effort and cost of collecting information and make a transaction) than private firms. In addition, Brav (2009) finds that private firms mostly rely on debt financing, have higher leverage ratios, and tend to avoid

[31] With the two looping approaches, we do an exact matching procedure on industry and year, respectively.

external capital markets. He further argues that these different funding characteristics are due to private equity being more expensive than public equity. Furthermore, Faccio, Marchica and Mura (2011) document that firms controlled by large diversified shareholder (i.e. public firms) undertake riskier investments than firms controlled by non-diversified large shareholders (i.e. private firms). The impact of large shareholder diversification thus affects a firms' willingness to corporate risk-taking. Finally, unlike private firms, public firms have the opportunity to pay for acquisitions with overvalued stock (Schelifer & Vishny, 2003).

Our findings so far thus support the hypothesis of short-term pressures among public firms. However, they also support other similar hypotheses regarding public vs private investment (Asker, Farre-Mensa, & Ljungqvist, 2014). For instance, public firm managers may prefer the quiet life, causing them to invest significantly less than their private peers. We will discuss these implications further in Section 4.

3.2 Differences in Investment Sensitivities

In this section, we examine how potential public firm agency costs affect their responsiveness to investment opportunities; if short-term pressures cause public firms to invest less, it should also cause public firms to be less sensitive to changes in investment opportunities, thereby testing our hypothesis. We do so by following Asker, Farre-Mensa and Ljungqvist (2014), in relying on the Q theory of investment. The Q theory defines optimal investment as the point where the marginal benefit of investing one additional unit is equal to the marginal cost of doing so (Hayashi, 1982). This implies that firms should increase their investments as their investment opportunities improve (Yoshikawa, 1980). We examine sensitivity to changes in investment opportunities by estimating the following regression;

$$(3)\quad Investment = \alpha + \beta_1(Sales\_growth) + \beta_2\{Bors\_aks_i \; x \; (Sales\_growth)\} + \beta_3(ROA) + \beta_4\{Bors\_aks_i \; x \; (ROA)\} + Year_i + FirmFEs + \varepsilon$$

where β_1 show the sensitivity to changes in investment opportunities of private firms, β_2 show the difference in investment sensitivity between private and public firms, while β_1 plus β_2 show public firms sensitivity to changes in investment opportunities. According to the Q theory, both β_1 and the sum of β_1 and β_2 should have a positive impact on investment. We include year dummies to control for year trends. We also include firm fixed effects, by using the FE module in Stata. This allows us to exploit within firm variation. As in equation (2), we cluster standard errors at the firm level, thus obtaining heteroscedasticity-robust standard errors.

3.2.1 Regression Results

The results from estimating equation (3) are reported in Table 10. In our industry and size matched sample, we find that private firms investment decisions are more sensitive to changes in sales growth, shown in column (1). The estimated private firm coefficient is 1.7%, compared to the 1.7% – 0.6% = 1.1% coefficient for public firms. However, the difference is not significant. Estimating the regression in the years before and after the financial crisis yields no significance either. Thus, in our industry and size matched sample, we cannot distinguish between public and private firms investment sensitivities.

One possible explanation to the findings above is that, in terms of sensitivity to changes in investment opportunities, we are comparing public and private firms that differ too much on dimensions affecting investment behavior. As discussed earlier, both leverage, cash holdings and ROA are all important matching characteristics when comparing corporate investment (Michaely & Roberts, 2012). Though our findings regarding investment levels proved to be robust to sampling choices, this may not be the case with investment sensitivity. Table 11 show the results of estimating equation (3) using our industry, size, leverage, cash holdings, cost of debt and ROA matched sample. This is useful for two reasons. First, it allows us to compare public and private firms more similar on dimensions thought to affect investment behavior. Secondly, it allows us to compare public and private firms with very similar performance (Asker, Farre-Mensa, & Ljungqvist, 2014). We find that private firms' investment decisions are significantly more sensitive to changes in sales growth, as reported in column (1). The estimated coefficient for private firms is 4.4%, compared to the 4.4% – 3.0% = 1.4% coefficient for public firms. As shown in column (2), we find the exact same result before the financial crisis, with estimated coefficients of 4.4% and 1.4% for public and private firms, respectively. By comparing public and private firms more similar in both investment behavioral dimensions and performance, we find that public firms are significantly less responsive to changes in investment opportunities than their private counterparts.

However, our findings may be driven by model measurements errors. As pointed out by Asker, Farre-Mensa and Ljungqvist (2014), our model to measure investment sensitivity could potentially be better suited for private firms, thus affecting the estimated coefficients. To control for this, they suggest estimating equation (3) for matched public firms only, and compare the coefficients with similar studies. Column 3 show that the coefficient for matched public firms is 1.5%. As we find no studies of investment sensitivities of Norwegian public firms, we cannot

compare our findings with others. However, as we show similar findings as both Shin and Stulz (1998), Gao, Hsu and Li (2014), and Asker Farre-Mensa and Ljungqvist (2014) did on U.S. public firms, we have faith in our model`s measurement of investment sensitivity. Another concern expressed by Asker, Farre-Mensa and Ljungqvist (2014), is that our matched public firms may be firms with low investment sensitivities, thus being unrepresentative of the total public firm population. However, by following their approach of estimating equation (3) on our total public firm sample, we find that the coefficient is 1.1%, which is marginally different from the one estimated in column (1). We report the results from this estimation in column (4). This proves that our matched sample are representative of public firms in general, thus not driving our results.

3.2.2 Controlling for Observable Differences

As shown in the previous section, we achieved no significance in our industry and size matched sample. However, by matching on industry, size, leverage, cash holdings, cost of debt and ROA, we find that private firms are significantly more sensitive to changes in investment opportunities than public firms. These findings are not consistent with our analysis of investment levels, which proved to be robust to sampling choices. We will investigate our findings robustness to sampling choices further in the following sections. In addition, we will address the concern that lifecycle differences and macroeconomic cycles potentially could drive our results.

3.2.2.1 Lifecycle Differences, Sampling Choices and Macroeconomic Cycles

During our analysis of public and private firms' investment levels, we emphasized the importance of lifecycle differences. A comparison of public and private firms in different lifecycle stages could potentially affect our results in this analysis as well. As argued by Gao, Hsu and Li (2014), firms in early lifecycle stages are often more adaptable to new technologies, which in turn makes them more sensitive to changes in investment opportunities. Consistent with our analysis of investment levels, we use retained earnings and age to control for lifecycle differences. The results of estimating equation (3) are reported in Table 12.

We start by documenting that our industry and size matched sample yields no significance when we include retained earnings, as shown by column (1). However, by using age to proxy for a firm's lifecycle stage, we find that the coefficient of 2.9% for private firms is significant at the 5% level. This is interesting, even though the public coefficient, and the corresponding difference, of 2.9% – 1.7% = 1.2% is non-significant. Nevertheless, we document a large

significant investment sensitivity of private firms, and a low non-significant investment sensitivity of public firms, both adjusted for lifecycle differences.

In column (3), we control the results of our industry, size, leverage, cash holdings, cost of debt and ROA matched sample for potential lifecycle differences, by including retained earnings as one of the matching characteristics. To examine how sensitive our results are to sampling choices, we also include asset ratio, which simultaneously control for within industry differences in capital intensity. We find that the estimated coefficient for private firms are 5.2%, compared to 5.2% – 3.7% = 1.5% for public firms, both significant at the 1% level. Private firms are still more sensitive to changes in investment opportunities, even after we control for lifecycle differences and sampling choice.

As equation (3) includes year dummies to control for yearly trends, we control for potential macroeconomic factors affecting our results. However, matched public and private firms are not necessarily observations in the same year. This is because the samples used to examine investment sensitivities so far are based on our industry loop, which match exact on industry only. As discussed in Section 3.1.3.1, macroeconomic factors are important determinants in explaining investment behavior. To show that our results are robust to public and private firms in different macroeconomic cycles, we also estimate equation (3) using our capital intensity and size matched sample, with exact yearly matching using a year loop[32]. As mentioned in previous sections, this approach ensures that all matched public and private firms are observations in the same year, while the capital intensity variable control for the main industry differences thought to affect investment behavior. We also include age to control for differences in lifecycle stages. In addition, as we are using an entirely different sample, we assess our results sensitivity to sampling choice. We show the results from this estimation in column (5). This approach yields even bigger differences. We find that the estimated sensitivity coefficient for private firms are 6.3%, compared to the 6.3% – 5.6% = 0.7% for public firms, both significant at the 1% level. Column (5) show that even after we control for lifecycle differences, macroeconomic cycles and sampling choice, public firms are still significantly less sensitive to changes in investment opportunities than their private counterparts.

[32] See Figure 3 for a detailed description of the industry and year loop matching procedure.

3.2.2.2 Measure of Investments

Next, we consider if our findings of differences in investment sensitivities are driven by outcome variable being investment in gross tangible fixed assets. As discussed during the analysis of investment levels, firms invest in both tangible and intangible fixed assets. We control for this by estimating equation (3) using gross investment in tangible + intangible fixed assets as outcome variable. Column (4) in Table 12 show that this does not affect our findings in the industry, size, leverage, cash holdings, asset ratio, ROA, retained earnings and cost of debt matched sample. In fact, the difference in investment sensitivity has increased, with the estimated coefficients for public and private firms being 5.4% and 1.7%, respectively. Using our exact year, capital intensity, size, and age matched sample does not alter our results either, as shown in column (6). Consistent with our analysis of investment levels, the differences between public and private firms sensitivity to changes is investment opportunities are not due to how we measure investment.

3.3 Reliability of our Findings

Our findings so far show that public firms invest significantly less than their private counterparts. In addition, public firms invest in a way that tend to be less sensitive to changes in investment opportunities. In this section, we discuss the reliability of our findings, by assessing the robustness to alternate Winsorizing levels and size conditions.

3.3.1 Sensitivity to Winsorizing Levels

Our analyses are based on a dataset Winsorized at the 99% level. To assess the robustness of our results, we increase the level from 99% to 99.8%, implying that all observation higher than 99.9^{th} percentile and lower than 0.1^{st} percentile are modified to either an upper or lower limit. In other words, only 0.2% of the most extreme values will be adjusted.

As expected, Table 14 presents higher standard deviations of the differences in means between public and comparable private firms. This is due to less matched public and private firms, as more observations violate the balancing assumption used in the PSM model[33]. However, Table 15 and Table 16 show that private firms still invest significantly more than their public counterparts. In addition, we see from Table 17 that private firms are still more sensitivity to changes in investment opportunities. However, we find significant results in our sample

[33] We list all dropped industries and years that do not satisfy the balancing assumption in Table 18 Panel B and Table 19 Panel B, respectively.

including lifecycle effects only, as shown in column (5). Furthermore, the sample in column (3) and (4) contains substantially less observations. Thus, our findings regarding differences in investment sensitivities only partly proves robust to a tighter Winsorizing level.

3.3.2 Sensitivity to Size Condition

As discussed in Section 2.4.2, we imposed a size condition in our matching procedure to control for the implied non-linear relationship between size and investment. A possible implication with our findings so far, is that we systematically could be comparing smaller private firms, with bigger public firms. Panel A and Panel B in Figure 6 show the robustness of our findings to varying size conditions. Our results so far are based on the [33%,300%] requirement. As we tighten the size-condition, the difference in investment levels between public and private firms are increasing. Except from the small drop at the [50%,200%] condition, the same is true for our findings of investment sensitivities. We thus show that our findings regarding both investment levels and investment sensitivity are robust to tighter size conditions, and discard the possibility of our findings being due to a systematical comparison of smaller private firms with bigger public firms.

4. Investment Behavior, Agency Costs and Short-termism

The findings in Section 3 supports our hypothesis regarding the investment behavior of public and private firms; public firms invest less than their private counterparts, and in a way that tend to be less sensitive to changes in investment opportunities. In the following sections, we will discuss possible causes explaining these results, under the assumption that any differences in investment behavior between public and private firms are due to public firm agency problems. We immediately discard the possibility of empire building or overconfident public managers driving our results. If this were the case, public firms should invest more, and in a way that is more responsive to changes in investment opportunities. This is the opposite of our findings in Section 3.

4.1 Herding among Public Managers

Herding managers have incentive to copy the choices of others, regardless of the historical or expected payoffs (Scharfstein & Stein, 1990). Our results could thus be driven by a "herding-like behavior" among public firm managers, copying each other's defensive investment decision. As noted by Stein (2003), one way of assessing such behavior is to examine the age of the CEO or the firm itself. Several empirical studies show that younger CEO`s and firms

have more to gain from herding than older, and thus are more likely to engage in such behavior[34]. Our dataset do not include the age of the CEO, but we do have access to firm age. Figure 7 show the age distribution among the public firms in our industry, size, leverage, cash holding, cost of debt and ROA matched sample, in bins of approximately 15 years[35]. The distribution is highly skewed to the left, with the majority of observations being firms younger than 30 years. According to Stein (2003), if young firms actually do herd, they should copy the investment decisions of more mature and experienced firms. We should thus expect to find similar investment levels among the public firms younger than 10 years, and older than 20 years. Figure 8 show the kernel density distribution of gross investment in tangible fixed assets for public firms older than 20, and younger than 10 years, respectively. We see no clear signs of younger firms copying the investment decisions of older firms, and thus no evidence of a herding-like behavior driving our results, as younger public firms invest more than older.

4.2 Quiet Life Preferences among Public Managers

The quiet life theory states that public firm managers may be prone to inertia when it comes to making difficult decisions (Bertrand & Mullainathan, 2003). As studies show that such preferences could lead to underinvestment in situations regarding entering a new business line, or due to public managers being lazy, this could potentially drive our results[36]. According to Gao, Harford and Li (2013), managers with a preference for the quiet life have an incentive to pile cash as a buffer to avoid making difficult decisions. If the theory of quiet life preferences were driving our results, we should expect to see a systematical relationship of high cash and low investments levels among public firms, and low cash and high investment levels among private firms. However, as most of our different samples include cash holdings as a matching characteristic, we are comparing public and private firms with equal cash levels. Still, we find that public firms invest significantly less than private. We thus find no clear indications of our findings being due to underinvestment among public firm managers that enjoy the quiet life, as we neutralize the potential effect of such preferences by controlling for different cash levels. In addition, previous studies show that public managers enjoying the quiet life usually occur in monopolistic markets[37]. As the Norwegian market are highly monitored by The Competition Authority[38], this supports our prediction further.

[34] See for example Chevalier and Ellison (1998), Baker (2000) and Hong, Kubik and Solomon (2000).
[35] We find similar results using other matching samples.
[36] See Stein (2003), and Aggarwal and Samwick (2006).
[37] See for example Hicks (1935), Rohades and Rutz (1982) and Bertrand and Mullainathan (2003)
[38] The Competition Authority`s main task is to enforce the Competition Act, which main purpose is to stimulate competition.

4.3 Short-termism among Public firms

Finally, as stated in our initial hypothesis, our results could be due to short-term pressures among public firm managers. According to Palley (1997) and Laverty (2004), firms may engage in short-term behavior if the manager's future career is tied to current earnings. A way to test this implication is to examine the degree of managerial turnover among our matched public firms. Figure 9 show the number of replaced public firm CEO`s each year[39]. We find that 21% of public firms replace their CEO each year on average. To put it differently, each year one in five public firm CEO`s lose or change their job on average. We view these findings as an indication of rapid managerial turnover among public CEO`s, thus supporting our hypothesis of a short-term distortion of public firms investment behavior. In addition, our findings are consistent with the theories of both Stein (1988) and Mullins (1991), that asymmetrical information causes the market to attach too much weight to the current stock price, resulting in public firm managers maximizing current earnings by underinvesting. Our findings thus suggests that short-term pressures distorts the investment decisions of public firms, causing them to invest less, and in a way that is less responsive to changes in investment opportunities. These findings are also consistent with the study of Asker, Farre-Mensa and Ljungqvist (2014) on U.S. firms.

A possible implication, however, is that if systematical underinvestment among public firms actually is the case, it should raise concerns among shareholders. Models of short-termism usually assume that public managers seek short-term gains to the exclusion of long-term achievement, as such behavior provides higher personal utility[40]. This gives incentive to boost current earnings by discretionally cut expenditures through underinvestment. While shareholders can observe the actual investment, they cannot observe the extent of their manager`s underinvestment, due to asymmetrical information of investment opportunities. However, they observe and understand the manager's incentives, and thus account for this underinvestment. Yet, public managers continue to underinvest. Asker, Farre-Mensa and Ljungqvist (2014) explain this with the prisoners` dilemma; in equilibrium, shareholders assume that the manager will underinvest, and the manager will actually do so. We find this as a good explanation for how short-termism can distort public firm managers' investment decisions over time.

[39] The findings are from our industry and size matched sample. However, we find similar results in all of our matching samples.
[40] See Narayanan (1985) and Asker, Farre-Mensa and Ljungqvist (2014)

4.4 Private Firm Overinvesting

Although our findings are supportive with the predictions of short-termist pressures among public firms, they could also be due to private firm overinvesting, as private firms do not receive any feedback of such by the stock market. According to Li (2004), systematical overinvestment should have negative implications for a firm's profitability. In most of our samples, we have matched public and private firms with equal profitability, measured by ROA. By comparing firms with the same profitability, we lessen any overinvestment tendencies among private firms, as such firms are excluded from our samples. However, our findings in the industry, size and age matched samples do not control for profitability. Could the results in these samples be due to systematic overinvestment by private firms? Table 13 suggest that this is not the case. We find that private firms are significantly more profitable than public in our industry, size and age matched sample. We thus find no evidence of private firm overinvesting driving our results.

4.5 Limitations, Comments and Suggestions for further Studies

As noted by Asker, Farre-Mensa and Ljungqvist (2014), a key assumption behind the theory of short-term pressures among public firms, is that private firms actually experience zero or few agency problems. We have assumed this during our study. Even though a substantial body of literature is supportive of this assumption[41], we cannot provide evidence for such a context. This is due to the fact that our dataset provides no or limited information of ownership structure. Thus, we have to rely on previous literature. The implication of potential agency problems among private firms is that it permits other possible explanations to our findings, such as private firm managers being overconfident or empire builders. This is thus one of our suggestions to further studies of this subject. However, we find that the mean percentage ownership interest of the biggest shareholder (i.e. the owner with the highest number of shares) is 0.7955 and 0.3928 for private and public firms, respectively. Although these findings cannot rule out the existence of agency costs among private firms, it indicate that private firms should experience *less* agency costs than public firms.

Although the discussions in Section 4.1 and Section 4.2 suggest that the agency theories of herding and quiet life do not explain our findings, we cannot completely rule out such a possibility. However, we base our conclusion on several identified indications more similar with the notion of short-termism.

[41] See for example Berle and Means (1932), Jensen and Meckling (1976) and Asker, Farre-Mensa and Ljungqvist (2014).

Another possible limitation with our findings is endogeneity of a firms listing status. As expressed by Asker, Farre-Mensa and Ljungqvist (2014), our findings could potential reflect unobserved differences between the types of firm that tend to go public or stay private, and not as a result of their actual listing status. Our findings could also be due to private firms developing slower than public firms, although we control for lifecycle stages by matching on age and retained earnings. Private firms would then stay longer in the preliminary stages, characterized by heavier capital investment needs (Balakrishnan & Fox, 2006). Given the data we have, we cannot further control for these possible implications, and they both create limitations in our findings.

The next limitation relates to financial constraints. During our analysis of investment sensitivity, we achieved insignificant results when using Tobin`s Q as an alternate measure of investment opportunities. Thus, we base our conclusion on sales growth being the correct measure of investment opportunities. As noted by Asker, Farre-Mensa and Ljungqvist (2014), this is a potential concern as growth in revenue may enable higher increase in investment levels of firms that are financially constrained. If private firms are more financial constrained than public, this could drive our findings of investment sensitivity. Although Farre-Mensa and Ljungqvist (2013) show that this is not the case of U.S. private firms, we cannot rule out this possibility in Norway given our data.

The last limitation we want to address relates to the Norwegian economy as a whole. Compared the study by Asker, Farre-Mensa and Ljungqvist (2014) of the U.S., the Norwegian economy is substantially smaller. An implication with this is that we are less likely to identify public and private firms identical on our matching characteristics. This is supported by Table 18 and Table 19, where we report all the industries and years not satisfying the balancing condition. As presented in Section 2.4.1, the balancing condition measures the quality of the propensity score matching. Although we base all our findings on samples satisfying this condition, we still face the possibility of comparing public and private firms that, up to a certain extent, still could differ on our matching characteristics.

Finally, our analysis include public firms listed on Oslo Børs (OSEBX) and Oslo Axess (OAAX). Firms listed on the OAAX are smaller firms and usually less traded than the firms

listed at the OSEBX [42]. In addition, a listing at the OAAX requires less shareholders. According to the reviewed agency cost theory, such features suggest that firms listed at the OAAX should experience less agency problems, and thus less short-term pressures than OSEBX firms. This implies that by analyzing OSEBX and private firms only, we should expect to find even bigger investment behavior differences. However, as our dataset do not distinguish OSEBX and OAAX listed firms, we cannot examine this. Note that this is not a limitation of our study, but a suggestion to further research regarding this subject.

5. Conclusion

This thesis examines whether short-termism distorts the investment behavior of Norwegian publicly listed firms, by following the recent study of Asker, Farre-Mensa and Ljungqvist (2014). Under the assumption that private firms experience zero or few agency problems, we use private firms as a counterfactual for how public firms would invest absent such agency costs. We do so by applying an exact and propensity score matching procedure using Stata 14, allowing us to identify and compare public and private firms equal on characteristics theoretically deterministic for corporate investment.

We find that public firms invest significantly less than their private counterparts. In addition, they invest in a way that tend to be less sensitive to changes in investment opportunities. Our findings are consistent with prior studies of this subject, and support the hypothesis of short-term pressures distorting the investment decisions of public firms.

Our thesis contributes to the financial literature in several ways. First, we see no similar studies contrasting the investment behavior of Norwegian public and private firms. Secondly, by using private firms as a counterfactual for how public firm would invest given the absence of agency costs, we identify short-termism as a potential driver for public firm investment. This is supported by indications of a high presence of managerial turnover. Our thesis can thus be seen as one of the first linking short-termism to Norwegian corporate investment, and highlight a potential trade-off related to the going-public decision in Norway.

[42] By accessing the Facts and Figures for November 2015 (as well as any other month) at the Oslo Børs webpages, we find that the average daily number of trades / number of issuers, generally are much higher at OSEBX than at OAAX.

Bibliography

Aggarwal, R. K., & Samwick, A. A. (2006). Empire-builders and shirkers: Investment, firm performance, and managerial incentives. *Journal of Corporate Finance 12(3),* 489-515.

Andras, T. L., & Srinivasan, S. (2003). Advertising Intensity and R&D Intensity: Differences across Industries and Their Impact on Firm's Performance. *International Journal of Business and Economics 2(2),* 167 - 176.

Asker, J., Farre-Mensa, J., & Ljungqvist, A. (2014). Corporate Investment and Stock Market Listing: A Puzzle*? Review of Financial Studies,* hhu077.

Auletta, K. (1986). *Greed and Glory on Wall Street: The Fall of the House of Lehman.* New York: Random House Incorporated.

Austin, P. (2011). An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies. *Multivariate Behaviroal Research 46(3),* 399 - 424.

Baker, M. (2000). Career concerns and staged investment: evidence from the venture capital industry. *Cambridge: Unpublished working paper, Harvard University* .

Balakrishnan, S., & Fox, I. (2006). Asset specificity, firm heterogeneity and capital structure. *Strategic Management Journal 14(1),* 3-16.

Baumol, W. J. (1959). *Business Behavior, Value, and Growth (Vol. 1967).* New York: Macmillan.

Berle, A., & Means, G. C. (1991). *The modern corporation and private property.* Piscataway: Transaction Publishers.

Bertrand, M., & Mullainathan, S. (2003). Enjoying the quiet life? Corporate governance and managerial preferences. *Journal of Political Economy 111(5),* 1043-1075.

Bhide, A. (1993). The hidden costs of stock market liquidity. *Journal of financial economics 34(1),* 31-51.

Bhojraj, S., Hribar, P., Picconi, M., & McInnis, J. (2009). Making sense of cents: An examination of firms that marginally miss or beat analyst forecasts. *The Journal of Finance 64(5),* 2361-2388.

Boyne, G. (2002). Public and private management: what's the difference? *Journal of management studies 39,* 97-122.

Brandon, R., & Wang , S. (2012). Market Belief Risk and the Cross-Section of Stock Returns. *Swiss Finance Institute Research Paper ,* 12-37.

Brav, O. (2009). Access to capital, capital structure, and the funding of the firm. *The Journal of Finance 64(1),* 263-308.

Brønnøysundregistrene. (2015, September 01). *Brønnøysundregistrene*. Retrieved from The BRC - Information in English: https://www.brreg.no/the-bronnoysund-register-centre/

Bruin, J. (2006). *Institute for Digital Research and Education*. Retrieved from Stata Web Books: Regression with Stata: Chapter 2 - Regression Diagnostics : http://www.ats.ucla.edu/stat/stata/webbooks/reg/chapter2/statareg2.htm

Bruni, F., Fair, D. E., & O'Brien, R. (2012). *Risk management in volatile financial markets.* Berlin: Springer Science & Business Media.

Chaney, T., Sraer, D., & Thesmar, D. (2010). The collateral channel: How real estate shocks affect corporate investment. *No. w16060. National Bureau of Economic Research*.

Chevalier, J., & Ellison, G. (1998). Career Concerns of Mutual Fund Managers. *No. w6394 National Bureau of Economic Research.*

Chongyu, D., & Li, Z. (2014). Measuring Firm Size in Empirical Corporate Finance. *SSRN Electronic Journal, ssrn 2345506.*

Chung, K., & Pruitt, S. (1994). A simple approximation of Tobin's q. *Financial management*, 70-74.

DeAngelo, H., DeAngelo, L., & Stulz, R. M. (2006). Dividend policy and the earned/contributed capital mix: a test of the life-cycle theory. *Journal of Financial economics 81(2)*, 227-254.

Denis, D. J., & Sibilkov, V. (2009). Financial constraints, investment, and the value of cash holdings. *Review of Financial Studies* , hpp031.

Dudley, E. (2008). *Essay on Capital Structure and Investment.* Ann Arbor: ProQuest.

Edmans, A., Fang, V., & Lewellen, K. (2014). *Equity Vesting and Managerial Myopia.* (DP10145) Centre for Economic Policy Research.

Faccio, M., Marchica, M.-T., & Mura, R. (2011). Large shareholder diversification and corporate risk-taking. *Review of Financial Studies*, hhr065.

Fama, E. F., & French, K. R. (1992). The cross-section of expected stock returns. *The Journal of Finance 47(2)*, 427-465.

Farre-Mensa, J., & Ljungqvist, A. (2013). Do measures of financial constraints measure financial constraints? *No. w19551 National Bureau of Economic Research.*

Gala, V., & Julio, B. (2012). Convergence in corporate investments. *SSRN Electronic Journal, ssrn 1787350.*

Gao, H., Harford, J., & Li, K. (2013). Determinants of corporate cash policy: Insights from private firms. *Journal of Financial Economics 109(3)*, 623-639.

Gao, H., Hsu, P., & Li, K. (2014). Managerial Short-Termism and Corporate Innovation Strategies. *SSRN Electronic Journal, ssrn 2407075*.

Gervais, S., Odean, T., & Heaton, J. B. (2003). Overconfidence, investment policy, and executive stock options. *Rodney L. White Center for Financial Research Working Paper* , 15-02.

Gort, M., & Klepper, S. (1982). Time paths in the diffusion of product innovations. *Economic Journal 92*, 630-653.

Hadi, A., & Simonoff, J. (1993). Procedures for the Identification of Multiple Outliers in Linear Models. *Journal of the American Statistical Association 88(424)*, 1264-1272.

Hayashi , F. (1982). Tobin's marginal q and average q: A neoclassical interpretation. *Econometrica: Journal of the Econometric Society* , 213-224.

Heaton, J. B. (2002). Managerial optimism and corporate finance. *Financial management*, 33-45.

Heckman, J. J., LaLonde, R., & Smith, J. A. (1999). The economics and econometrics of active labor market programs. I O. Ashenfelter, & D. Card, *Handbook of Labor Economics Vol. 3* (ss. 1865-2097). Amsterdam: Elsevier.

Hicks, J. R. (1935). Annual survey of economic theory: the theory of monopoly. *Econometrica: Journal of the Econometric Society*, 1-20.

Hong, H., Kubik, J. D., & Solomon, A. (2000). Security Analysts' Career Concerns and Herding of Earnings Forecasts. *The Rand Journal of Economics*, 121-144.

Hoshi , T., Kashyap, A., & Scharfstein, D. (1991). Corporate structure, liquidity, and investment: Evidence from Japanese industrial groups. *The Quarterly Journal of Economics*, 33-60.

Imbens, G. M., & Woolridge , J. M. (2008). Recent developments in the econometrics of program evaluation. *No. w14251 National Bureau of Economic Research*.

Jensen, M. C. (1986). Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers. *Corporate Finance, and Takeovers. American Economic Review 76(2)*.

Jensen, M. C. (1993). The Modern Industrial Revolution, Exit, and the Failure of Internal. *The Journal of Finance 48(3)*, 831-880.

Jensen, M. C. (1997). Eclipse of the public corporation. *Harvard Business Review (Sept.-Oct. 1989), revised* , 61-74.

Jensen, M. C., & Meckling, W. H. (1976). Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of financial economics 3(4)*, 305-360.

Jorgenson, D. (1971). Econometric studies of investment behavior: A survey. *Journal of Economic Literature 9(4)*, 1111-1147.

Jose, M., Nichols, L., & Stevens, J. (1986). Contributions of diversification, promotion, and R&D to the value of multiproduct firms: A Tobin's q approach. *Financial Management*, 33-42.

Jovanovic, B. (1982). Selection and the evolution of industry. *Econometrica 50*, 649–670.

Klepper, S. (1996). Entry, exit, growth, and innovation over the product life cycle. *American Economic Review* , 562-583.

Kuttner, R. (1986). The Truth about Corporate Riders. *New Republic 194*, 14-19.

Ladika, T., & Sautner, Z. (2014). Managerial Short-Termism and Investment: Evidence from Accelerated Option Vesting. *SSRN Electronic Journal, ssrn 2286789*.

Laverty, K. J. (2004). Managerial myopia or systemic short-termism? The importance of managerial systems in valuing the long term. *Management Decision 42(8)* , 949-962.

Lehn, K., & Poulsen, A. (1989). Free cash flow and stockholder gains in going private transactions. *The Journal of Finance 44(3)*, 771-787.

Leone, A., Minutti-Meza, M., & Wasley, C. (2014). Influential Observations and Inference in Accounting Research. *Simon Business School Working Paper No. FR 14-06* .

Leuven, E., & Sianesi, B. (2006). *Research Papers in Economics.* Retrieved from PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing: http://repec.org/bocode/p/psmatch2.html

Li, D. (2004). The implications of capital investment for future profitability and stock returns: an over-investment perspective. *California: (Doctoral dissertation, University of California, Berkeley).*

Malkiel, B., Furstenberg, G., & Watson, H. (1979). Expectations, Tobin's q, and industry investment. *The Journal of Finance 34(2)*, 549-561.

Michaely, R., & Roberts, M. (2012). Corporate dividend policies: Lessons from private firms. *Review of Financial Studies, 25(3)*, 711-746.

Mueller, D. (1972). A Life Cycle Theory of the Firm. *The Journal of Industrial Economics 20(3)*, 199-219.

Mullins, D. W. (1991). Foreword in: . I M. T. Jacobs, *Short-term America.* Boston, MA: Harvard Business School Press.

Narayanan, M. P. (1985). Managerial incentives for short-term results. *Journal of Finance 40(5)*, 1469–1484.

Pagano, M., Panetta, F., & Zingales, L. (1998). Why Do Companies Go Public? An Empirical Analysis. *The Journal of Finance 53(1)*, 27-64.

Palley, T. (1997). Managerial turnover and the theory of short-termism. *Journal of Economic Behavior and Organization 32(4)*, 547 - 557.

Rhoades , S. A., & Rutz, R. D. (1982). Market power and firm risk: a test of the 'quiet life' hypothesis. *Journal of Monetary Economics* , 73-85.

Rosenbaum, P. R., & Rubin, D. B. (1985). Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. *The American Statistician 39(1)*, 33-38.

Rosenbaum, P., & Rubin, D. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika 70(1)*, 41-55.

Rozeff, M. (1982). Growth, beta and agency costs as determinants of dividend payout ratios. *Journal of financial Research 5(3)*, 249-259.

Rubin, D. (2001). Using Propensity Scores to Help Design Observational Studies: Application to the Tobacco Litigation. *Health Services and Outcomes Research Methodology 2.3(4)*, 169–188.

Saunders, A., & Steffen , S. (2011). The costs of being private: Evidence from the loan market. *Review of Financial Studies 24(12)* , 4091-4122.

Scharfstein, D. S., & Stein, J. C. (1990). Herd Behavior and Investment. *The American Economic Review* , 465-479.

Schelifer , A., & Vishny, R. (2003). Stock market driven acquisitions. *Journal of Financial Economics 70(3)*, 295–311.

Sheen, A. (2011). *Do public and private firms behave differently? An examination of investment in the chemical industry.* Boston: Working Paper, Harvard Business School.

Shin, H., & Stulz, R. (1998). Are internal capital markets efficient? *Quarterly Journal of Economics*, 531-552.

Smith, J., & Todd, P. (2005). Does matching overcome LaLonde's critique of nonexperimental estimators? *Journal of econometrics 125(1)*, 305-353.

Stein, J. C. (1989). Efficient capital markets, inefficient firms, in a model of myopic corporate behavior. *The Quarterly Journal of Economics*, 655–669.

Stein, J. C. (2003). Agency, information and corporate investment. *Handbook of the Economics of Finance 1*, 111 - 165.

Thomas, J. (2002). Is lumpy investment relevant for the business cycle? *Journal of political Economy 110(3)*, 508-534.

Wooldridge, J. M. (2010). *Econometric analysis of cross section and panel data.* Cambridge: MIT Press.

Wurgler, J. (2000). Financial markets and the allocation of capital. *Journal of financial economics 58(1)*, 187-214.

Yoshikawa, H. (1980). On the "q" Theory of Investment. *The American Economic Review*, 739-743.

Zingales, L. (1995). Insider ownership and the decision to go public. *The Review of Economic Studies 62(3)*, 425-448.

Appendix

Variable Definitions

Variable	*Definition*
Indicators	
Bors_aks	An indicator variable equal to 1 if the company are listed on Oslo Stock Exchange for the whole or part of the year, and zero otherwise.
Bransje	An industry breakdown, based on the NACE-system.
Aar	An indicator for each financial year.
Investment Opportunities	
Sales growth	The annual change in revenue, normalized by beginning-of-year revenue.
Approximate Q	Proxy of Tobin`s Q. Estimated as the market value to the book value of total assets. Market value for private firms are estimated using the average market value for public firms in each industry and each year.
Investment Measures	
Gross	Defined as the annual change in gross tangible fixed assets, normalized by beginning-of-year total assets. Accounting for depreciation.
Gross + intangible	Defined as the annual change in gross tangible + intangible fixed assets, normalized by beginning-of-year total assets. Accounting for depreciation.
Net	Defined as the annual change in net tangible fixed assets, normalized by beginning-of-year total assets. Not accounting for depreciation.
Net + intangible	Defined as the annual change in net tangible + intangible fixed assets, normalized by beginning-of-year total assets. Not accounting for depreciation.
Firm Characteristics	
Age	Number of years since the firm was incorporated.
Size	Defined as the sum of fixed and current assets. All values are reported in 1000 NOK, nominal value.
Real size	Defined as total assets inflated to 2013 purchasing power, using the inflation rate provided by Statistics Norway. All values are reported in 1000 NOK.
ROA	Defined as the return on assets. Estimated by net income normalized by total assets.
Asset ratio	Defined as revenue normalized by total assets, measuring capital intensity.
Leverage	Defined as debt normalized by total assets.
RE / TA	Defined as retained earnings normalized by total assets.
Cost of debt	Defined as interest paid normalized by interest bearing debt.
Cash holdings	Defined as cash normalized by total assets.
ROE	Defined as the return on equity. Estimated using the DuPont identity.

Variable Construction

Variable	*Definition* [*variable names from SNF database are reported in brackets*]

Investment Opportunities

Sales growth

$$\frac{\text{Revenue}_{t}\,[\text{salgsinn}_{t}] - \text{Revenue}_{t-1}\,[\text{salgsinn}_{t-1}]}{\text{Revenue}_{t-1}\,[\text{salgsinn}_{t-1}]}$$

Approximate Q

$$\frac{\text{Market Cap + Net Debt}}{\text{Total Assets}} \qquad \frac{[\text{market\_cap\_proxy + kgjeld + lgjeld – cash}]}{[\text{sumeiend}]}$$

Investment Measures

Gross

$$\frac{\text{Tangible Fixed Assets}_{t} + \text{Depreciation}_{t} – \text{Tangible Fixed Assets}_{t-1}}{\text{Total Assets}_{t-1}}$$

$$\frac{[\text{avskr}_{t} + \text{eiend}_{t} + \text{maskanl}_{t} + \text{skiprigfl}_{t} + \text{drlosore} – \text{eiend}_{t-1} - \text{maskanl}_{t-1} - \text{skiprigfl}_{t-1} - \text{drlosore}_{t-1}]}{[\text{sumeiend}_{t-1}]}$$

Gross + intangibles

$$\frac{\text{Change in Gross Tangible Fixed Assets + Change in Gross Intangible Fixed Assets}}{\text{Total Assets}_{t-1}}$$

$$\frac{[\text{sumeiend}_{t} + \text{avskr} - \text{sumeiend}_{t-1} – (\text{oml}_{t} – \text{oml}_{t-1}) – (\text{finanlm}_{t} – \text{finanlm}_{t-1})\,]}{[\text{sumeiend}_{t-1}]}$$

Net

$$\frac{\text{Tangible Fixed Assets}_{t} – \text{Tangible Fixed Assets}_{t-1}}{\text{Total Assets}_{t-1}}$$

$$\frac{[\text{eiend}_{t} + \text{maskanl}_{t} + \text{skiprigfl}_{t} + \text{drlosore} – \text{eiend}_{t-1} - \text{maskanl}_{t-1} - \text{skiprigfl}_{t-1} - \text{drlosore}_{t-1}]}{[\text{sumeiend}_{t-1}]}$$

Net + intangibles

$$\frac{\text{Change in Net Tangible Fixed Assets + Change in Net Intangible Fixed Assets}}{\text{Total Assets}_{t-1}}$$

$$\frac{[\text{sumeiend}_{t} - \text{sumeiend}_{t-1} – (\text{oml}_{t} – \text{oml}_{t-1}) – (\text{finanlm}_{t} – \text{finanlm}_{t-1})\,]}{\text{sumeiend}_{t-1}}$$

Firm Characteristics

Age

Year [aar] – Year of incorporation [stiftaar]

Size

Total Assets[sumeiend]

Real size

Total Assets [sumeiend] * (1+inflation $_{t,2013}$)

ROA

$$\frac{\text{Net income [aarsrs]}}{\text{Total Assets [sumeiend]}}$$

Asset ratio

$$\frac{\text{Revenue [salgsinn]}}{\text{Total Assets [sumeiend]}}$$

Leverage

$$\frac{\text{Long Term Debt [lgjeld] + Short Term Debt [kgjeld]}}{\text{Total Assets [sumeiend]}}$$

RE / TA

$$\frac{\text{Net Income [aarsrs] – Dividends [utb + konsbid]}}{\text{Total Assets [sumeiend]}}$$

Cost of debt

$$\frac{\text{Interest Paid [rentekost]}}{\text{Interest Bearing Debt [rkgjeld\_max + rlgjeld]}}$$

Cash holdings

$$\frac{\text{Cash [cash]}}{\text{Total Assets [sumeiend]}}$$

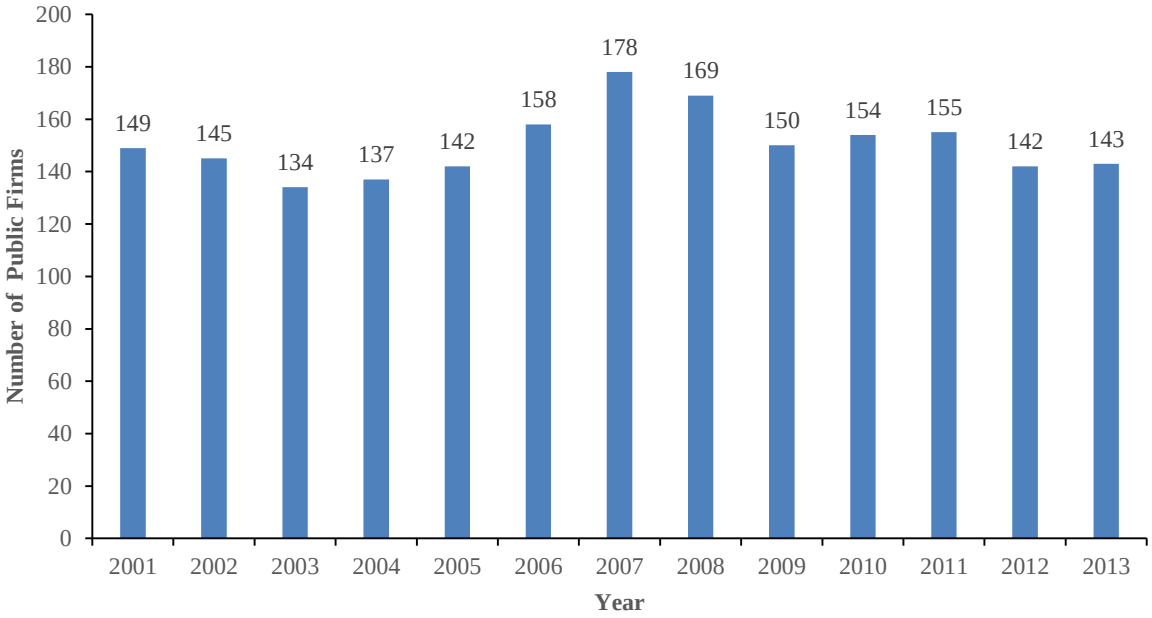
ROE

$$\frac{\text{Net Income [aarsrs]}}{\text{Sales [salgsinn]}} * \frac{\text{Sales [salgsinn]}}{\text{Total Assets [sumeiend]}} * \frac{\text{Total Assets [sumeiend]}}{\text{Equity [ek]}}$$

Figure 1. Distribution of Public and Private Firms per Year

Panel A and Panel B presents the number of public and private firm observations each year in our full sample, respectively. The differences is substantial, with a total of 1 956 public firm year observations and 520 112 private firm year observations.

Panel A: Public Firms



Panel B: Private Firms

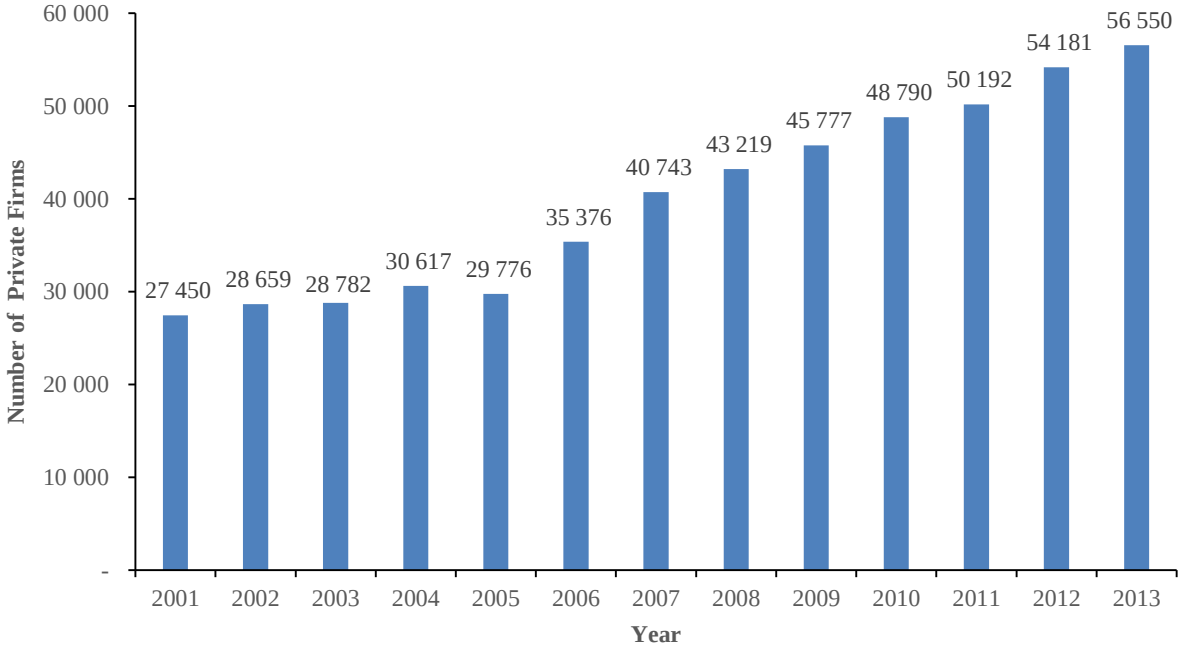
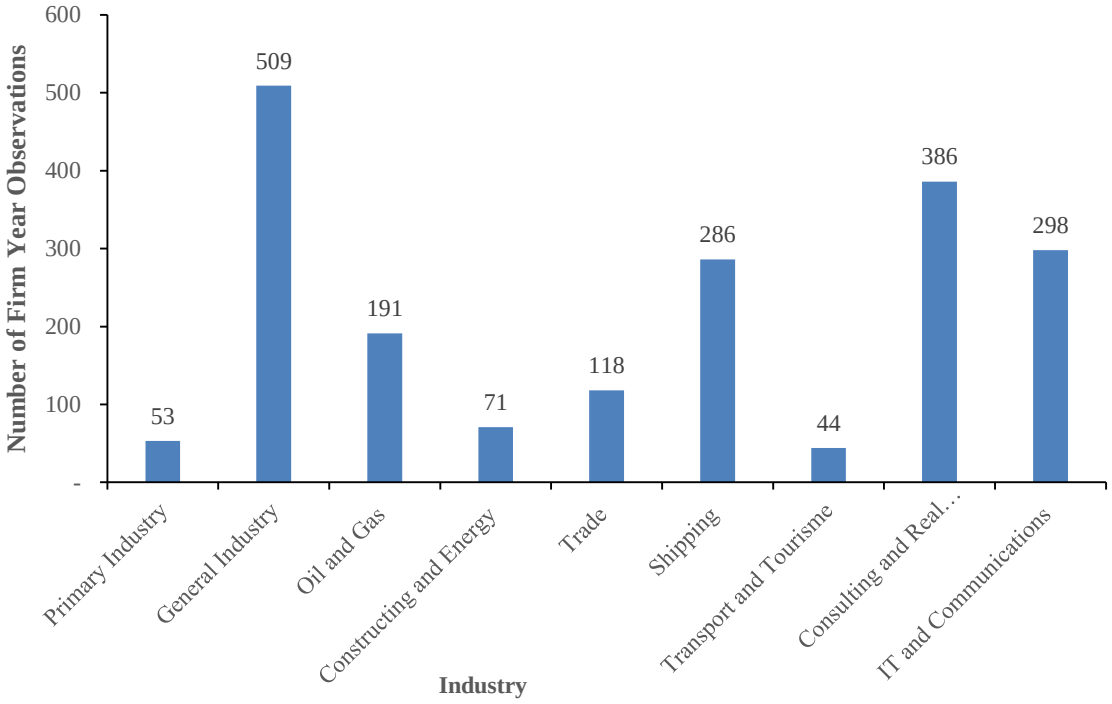


Figure 2. Distribution of Public and Private Firms per Industry

Panel A and Panel B show the distribution of public and private firm year observations in each industry in the period between 2001 and 2013. For further details and discussions regarding the industry variable, see Section 2.1.

Panel A: Public Firms



Panel B: Private Firms

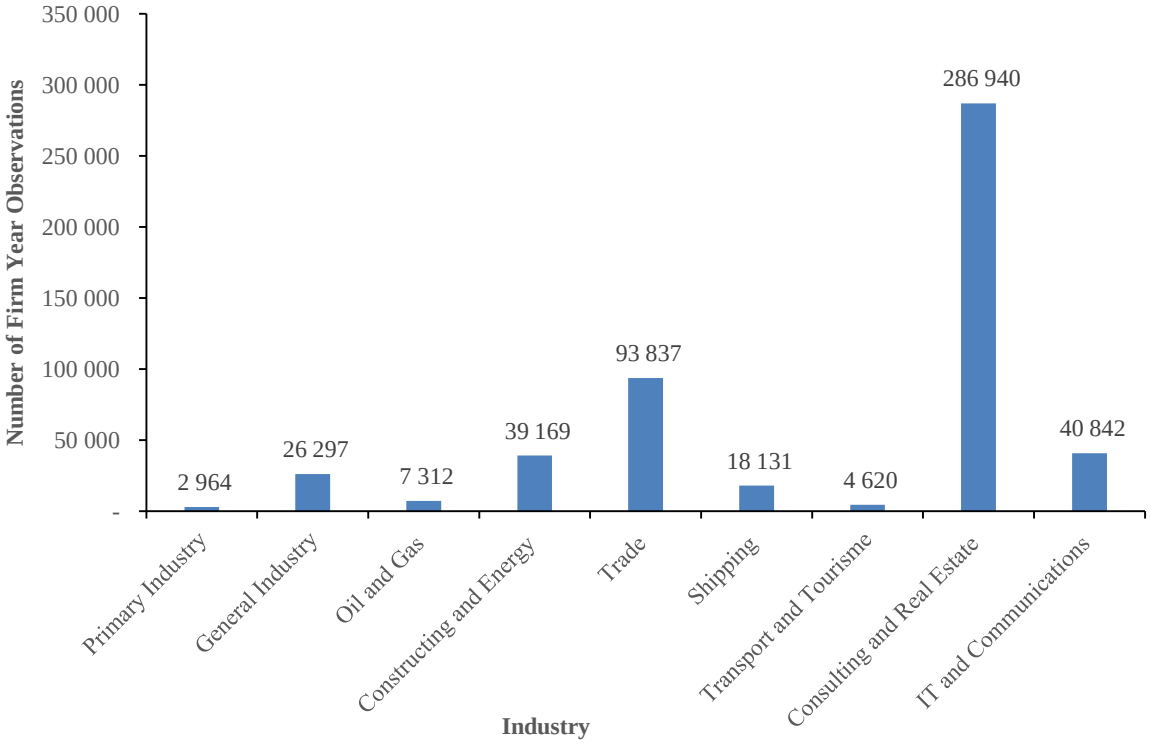


Figure 3. Matching Procedure

The purpose of this figure is to give a visual description of our matching procedure. Our industry (year) loop ensures that all matched public and private firms are in the same industry (year), as shown in stage (1). Within each industry (year), we run PSM on the other matching characteristics, identifying public and private firms in each industry (year) similar on those characteristics. This is stage (2). We then manually exclude all industries (years) not satisfying the propensity score balancing assumption. We report all excluded industries (years) for the different samples in Table 18 (Table 19). Stage (3) leads to our temporary sample. Next, in stage (4), we run our temporary sample through the size condition, ensuring that matched public and private firms are of approximately the same size. Stage (4) leads to our final matching samples, which is the samples used in all analyses.

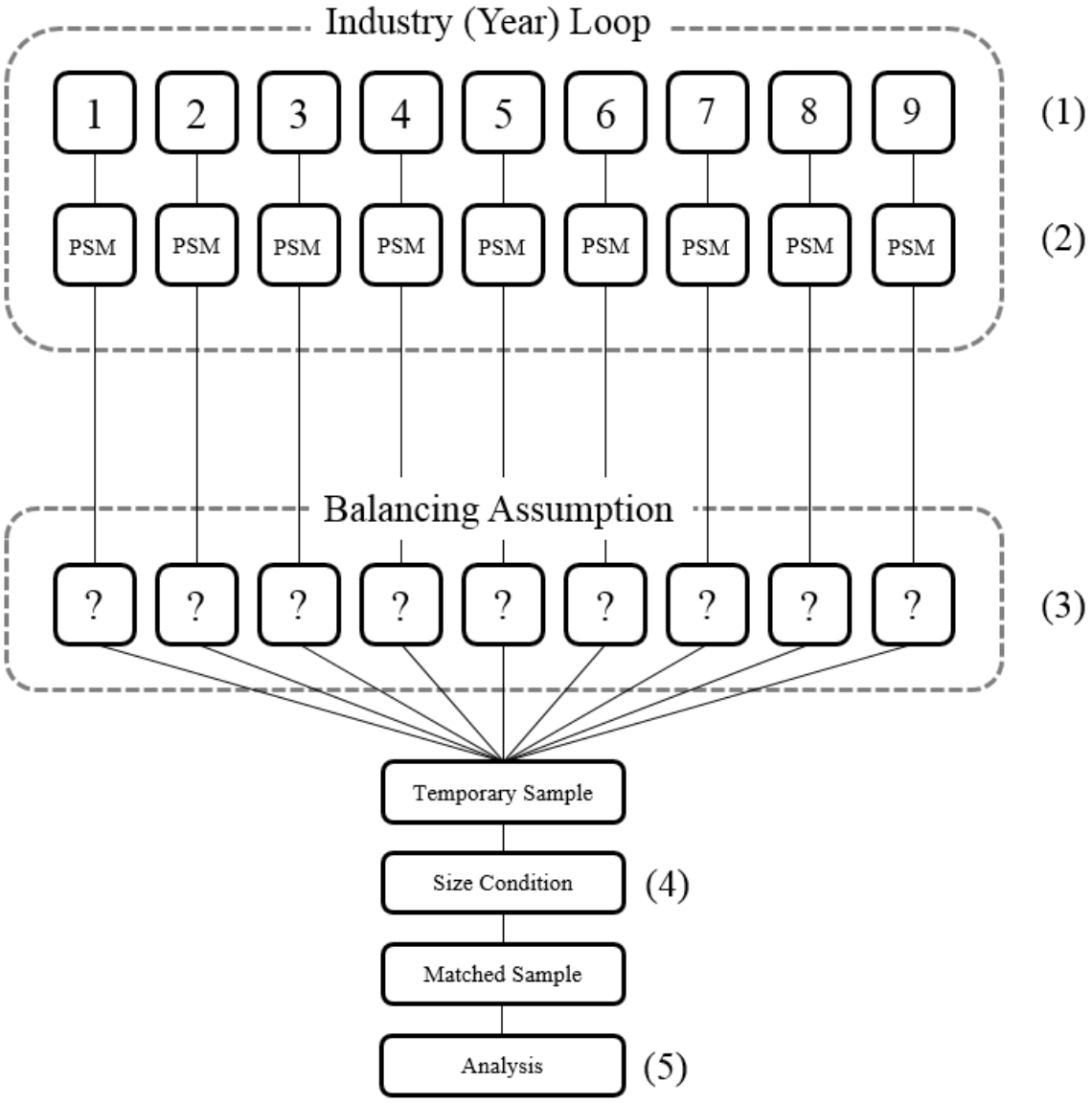
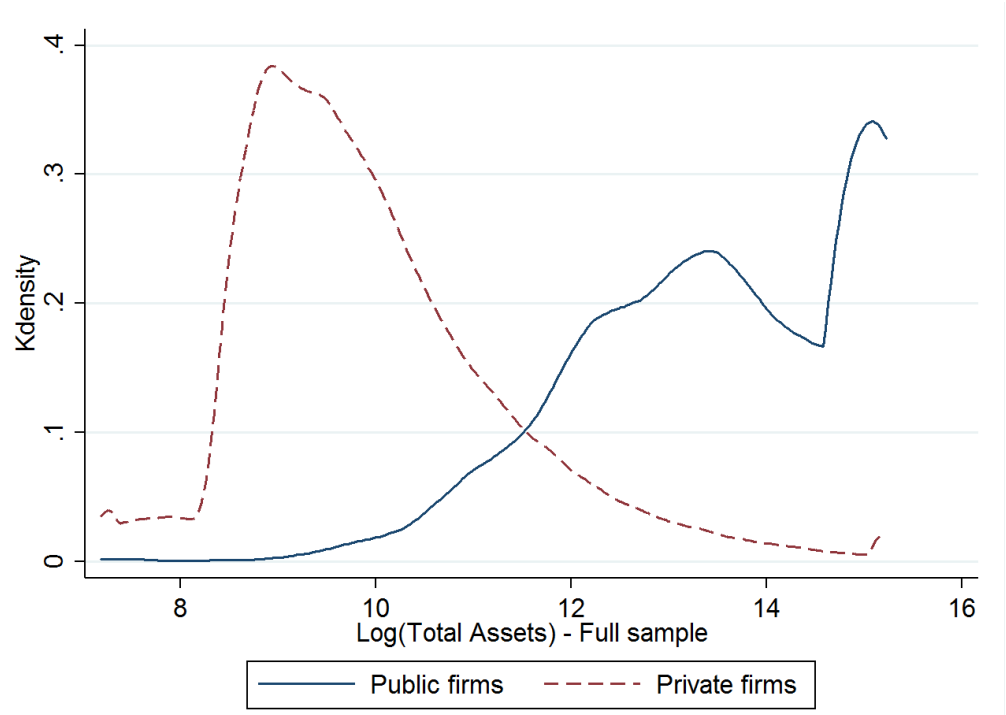


Figure 4. Size Distribution of Public and Private Firms

The top and bottom graph reports the Kernel density size distribution of public and private firms in our full and industry-size matched sample, respectively. Before we match on industry and size, we see that public firms are much larger than private. The bottom graph shows that, after we match on industry and size, the size distributions are nearly identically, implying a high matching quality. For further details of this, and all other matching samples, see Section 2.1 and Section 2.4. The "odd" shapes are due to a Winsorizing of the variables at the 99% level.



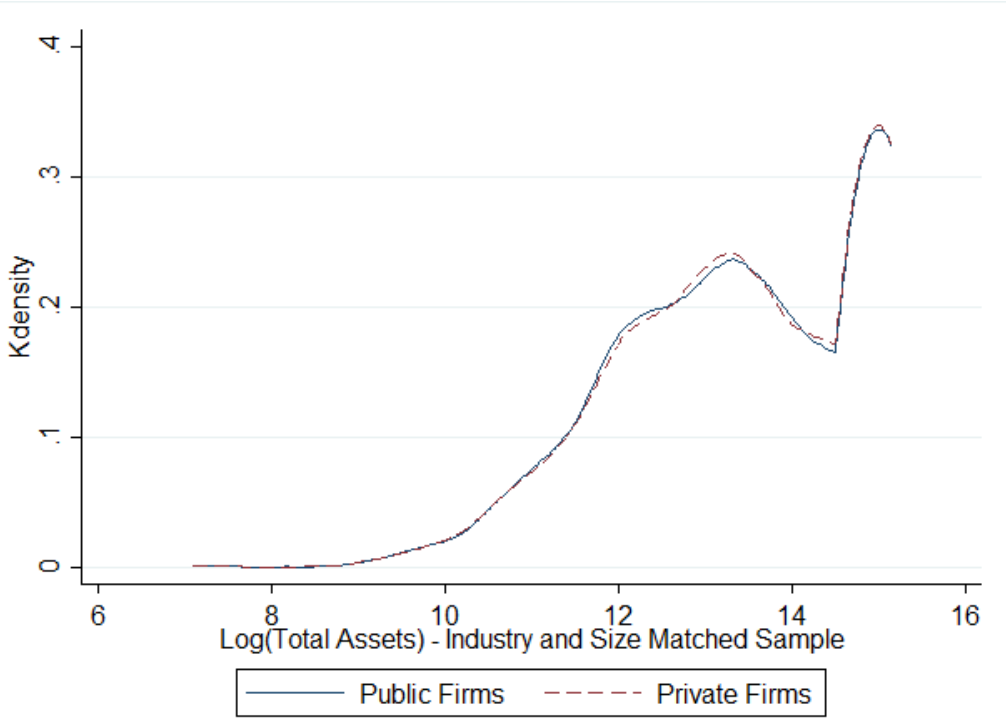


Figure 5. Correlation Matrix and Multicollinearity Test

Panel A presents a correlation matrix for the different matching characteristics included in our analysis. We find a high correlation between ROA and RE/TA, indicated by the highlighted cell. Panel B reports the results from the multicollinearity test. As all VIF values are less than 10, we do not address the potential problems with multicollinearity further.

Panel A

	Size	Asset ratio	Leverage	Cash holdings	RE/TA	ROA	Cost of debt
Size	1.00						
Asset ratio	-0.06	1.00					
Leverage	-0.10	0.08	1.00				
Cash holdings	-0.06	0.20	-0.16	1.00			
RE/TA	0.01	0.04	-0.30	0.09	1.00		
ROA	0.00	0.09	-0.30	0.19	0.83	1.00	
Cost of debt	-0.02	0.12	-0.05	0.07	0.01	0.04	1.00

Panel B

Variable	VIF	1/VIF
ROA	3.43	0.292
RE/TA	3.35	0.298
Leverage	1.16	0.860
Cash holdings	1.11	0.898
Asset ration	1.08	0.929
Cost of debt	1.02	0.979
Size	1.02	0.983

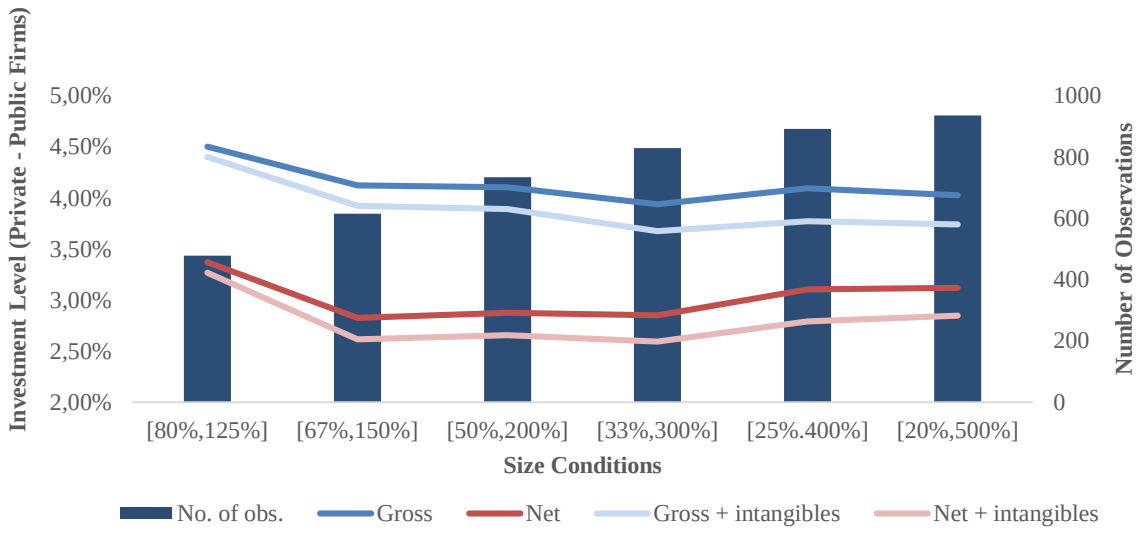
* Multicollinearity if VIF > 10

Mean VIF 1.74

Figure 6. Sensitivity to Size Condition

This figure show the sensitivity of our findings to different size conditions. For a description and discussion of the size condition, see Section 2.4.2. In both panels, we use our industry, size, leverage, cash holdings, cost of debt and ROA matched sample. Panel A reports the differences between public and private firms investment levels. We find that private firms invest more regardless of size condition choice. Panel B reports the differences in sensitivity to changes in investment opportunities between public and private firms. We find that private firms are more responsive to investment opportunities for all size conditions. We use sales growth to proxy for investment opportunities. Our findings in both panels are significant at the 5 % level. Note that in these graphs, we have changed our reporting of difference in investment from public – private, to private – public.

Panel A: Investment Level Differences



Panel B: Investment Sensitivity Differences

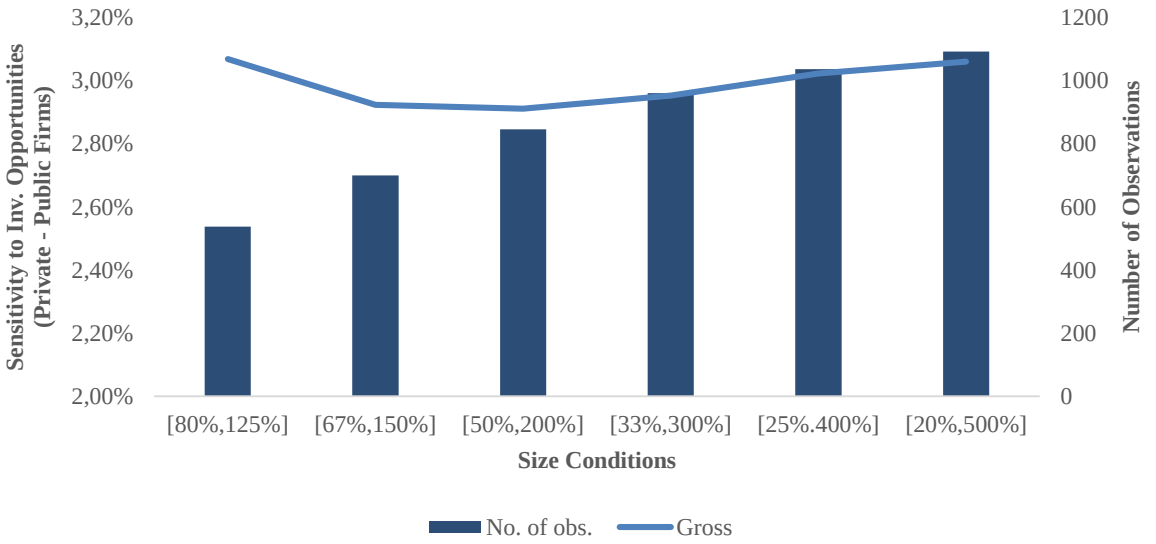


Figure 7. Age Distribution of Matched Public Firms

This figure show the age distribution of public firms in our industry, size, leverage, cash, cost of debt and ROA matched sample. Each bin is set to approximately 15 years. The distribution is highly skewed, with most of the public firms being younger than 30 years.

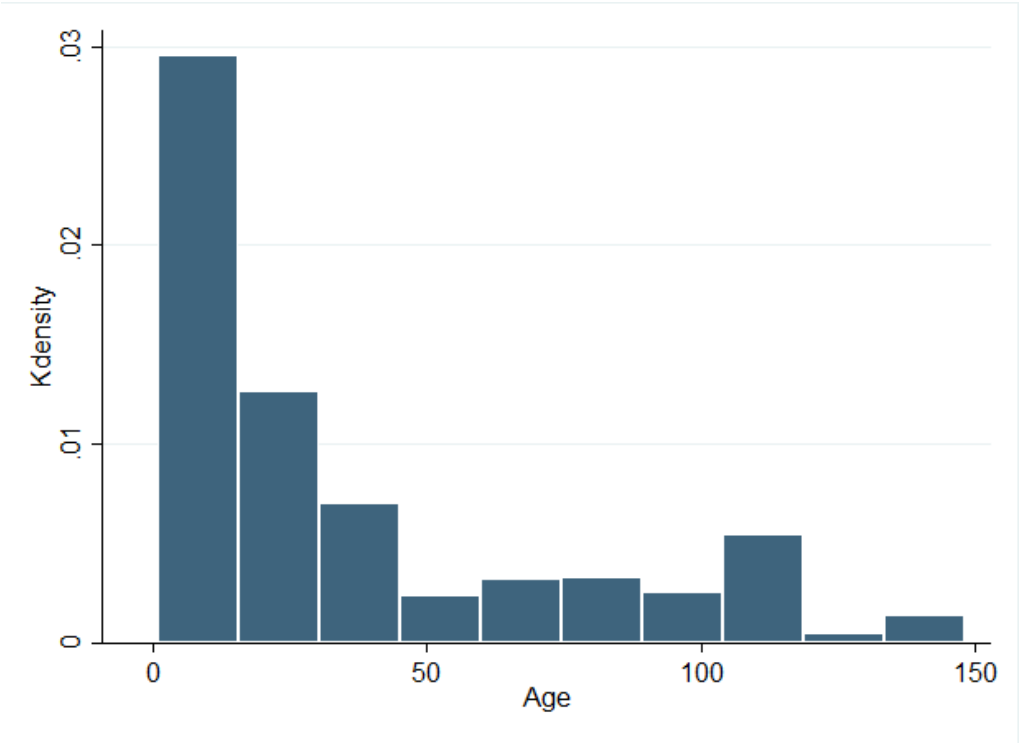


Figure 8. Distribution of Gross Investment Levels

This figure show the gross investment level distribution of public firms in our industry, size, leverage, cash, cost of debt and ROA matched sample, for firms older than 20, and younger than 10 years, respectively.

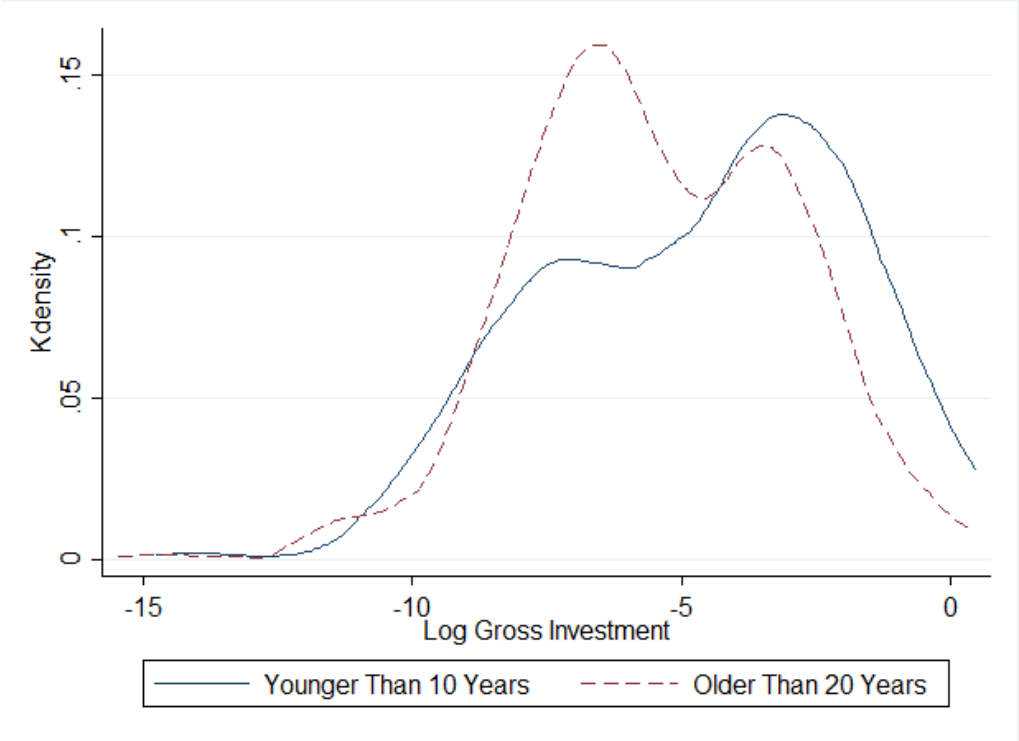


Figure 9. Number of Replaced CEOs

This figure show the number of replaced public CEOs each year in our industry and size matched sample. We find similar results using other samples. Approximately 21% of the public matched firms replace their CEO each year on average.

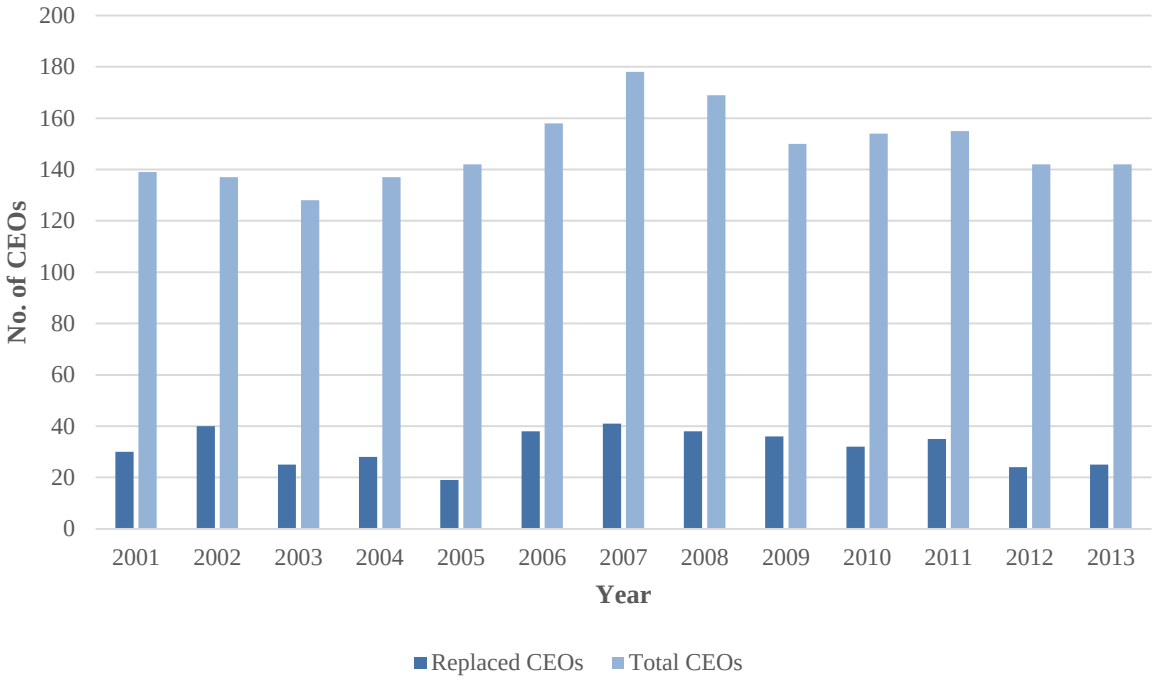


Table 1. Summary Statistics

This table show summary statistics of Norwegian public and private firms for the period 2001 to 2013. Our full sample consist of 87 443 private firms and 311 public firms, with 520 112 and 1 956 firm-year observations, respectively. The matched sample is obtained by using exact industry loop matching and propensity score size matching. See further description under Section 2.4. The industry-size matched sample consist of 1 955 public firm-year observations (311 public firms) and 1 955 comparable private firm-year observations (1 229 private firms). For a detailed description of these, and all other variables, see our variable definition and construction in the Appendix. All values are reported in NOK 1000 of 2013 purchasing power. All variables are Winsorized at the 0.5th and 99.5th percentile (except approximate Q and age), to lessen the impact of spurious outliers on our results. Test statistics of mean (median) differences in firm size, investment opportunities and firm characteristics are obtained by using t-tests (Wilcoxon-tests). The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations.

		Full Sample			Matched Sample		
		Public Firms	Private Firms	Diff.	Public Firms	Private Firms	Diff.
Firm Size							
Total assets	mean	1 430 582	83 883	1 346 699 ***	1 431 283	1 439 558	-8 275 ***
	median	728 951	14 951	714 000 ***			
	st. dev.	1 425 295	332 799		1 425 323	1 424 982	
Investment Opps.							
Sales growth	mean	0.880	0.336	0.544 ***	0.883	0.302	0.581 ***
	median	0.020	0.028	-0.008			
	st. dev.	4.663	2.669		4.715	2.168	
Approximate Q	mean	25.426	30.957	-5.532 ***	25.427	26.799	-1.372 **
	median	18.838	26.928	-8.089 ***			
	st. dev.	23.795	21.209		23.801	26.876	
Firm Characteristics							
ROA	mean	-0.047	0.050	-0.097 ***	-0.047	0.052	-0.099 ***
	median	0.010	0.034	-0.024			
	st. dev.	0.255	0.161		0.255	0.136	
Asset ratio	mean	0.241	0.905	-0.664 ***	0.241	0.585	-0.345 ***
	median	0.011	0.089	-0.078 ***			
	st. dev.	0.465	1.412		0.465	0.981	
Leverage	mean	0.444	0.666	-0.222 ***	0.444	0.591	-0.147 ***
	median	0.431	0.730	-0.299 ***			
	st. dev.	0.280	0.321		0.280	0.304	
RE/TA	mean	-0.069	0.012	-0.080 ***	-0.069	0.037	-0.106 ***
	median	-0.003	0.011	-0.014 ***			
	st. dev.	0.249	0.156		0.249	0.142	
Cost of debt	mean	0.076	0.062	0.014 ***	0.075	0.042	0.033 ***
	median	0.038	0.041	-0.002			
	st. dev.	0.210	0.158		0.206	0.167	
Cash holdings	mean	0.130	0.149	-0.019 ***	0.130	0.074	0.056 ***
	median	0.056	0.054	0.002 *			
	st. dev.	0.188	0.207		0.188	0.143	
Age	mean	28.038	15.092	12.945 ***	28.047	18.611	9.436 ***
	median	15.000	11.000	4.000 ***			
	st. dev.	32.571	15.538		32.577	19.255	
ROE	mean	-0.096	0.334	-0.431 ***	-0.091	0.283	-0.374 ***
	median	0.027	0.188	-0.162 ***			
	st. dev.	1.243	1.357		1.152	1.133	
No. of observations*		1 956	520 112		1 955	1 955	
No. of firms		311	87 443		311	1 229	

* Sales growth, cost of debt and ROE contains less observations due to missing values.

Table 2. Conditional Investment Levels – Industry Loop

This table reports the investment levels of matched public and private firms, based on our exact industry loop matching and propensity score matching. We describe the matching procedure in Section 2.4.We only keep industries that satisfies the propensity score balancing assumptions, with standardized difference of less than 25% and variation ratio between 0.5 and 2. For a further description of this assumption, see Section 2.4.1. We list all dropped industries in Table 18, Panel A. In row 2 to 5, we match on industry and size, while row 6 to 9 include firm age to control for lifecycle differences. Row 10 and 11 show the difference in investment level before and after the global financial crisis, respectively. Size is set to 2013 purchasing power, to control for across year comparisons. A detailed description of all variables are reported in the variable definition and construction in the Appendix. Both firm characteristics (except age) and investment measures are Winsorized at the 0.5th and 99.5th percentile to lessen the impact of spurious outliers on our results. We use paired t-tests to assess differences in investment levels between matched public and private firms. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations.

Row	Sample	Investment Measure	Public Firms				Private Firms				Public - Private Firms	
			Mean	Std. Dev	Obs.	Firms	Mean	Std. Dev	Obs.	Firms	Means	
1	Full sample:	Gross	**0.041**	0.474	1 956	311	**0.064**	3.113	520 112	87 443	-0.023	
	Sample matched on:	Industry, size										
2		Gross	**0.026**	0.171	1 955	311	**0.084**	0.258	1 955	1 229	-0.057	***
3		Gross + intangibles	**0.039**	0.235	1 955	311	**0.102**	0.287	1 955	1 229	-0.063	***
4		Net	**0.005**	0.156	1 955	311	**0.047**	0.242	1 955	1 229	-0.043	***
5		Net + intangibles	**0.018**	0.224	1 955	311	**0.066**	0.278	1 955	1 229	-0.048	***
	Sample matched on:	Industry, size, ln age										
6		Gross	**0.026**	0.193	1 102	212	**0.093**	0.288	1 102	609	-0.067	***
7		Gross + intangibles	**0.039**	0.246	1 102	212	**0.105**	0.315	1 102	609	-0.066	***
8		Net	**0.009**	0.183	1 102	212	**0.065**	0.277	1 102	609	-0.056	***
9		Net + intangibles	**0.022**	0.235	1 102	212	**0.077**	0.508	1 102	609	-0.055	***
	Sample matched on:	Industry, size, ln age (time span: 2001-2007)										
10		Gross	**0.033**	0.194	380	104	**0.084**	0.259	380	252	-0.050	***
	Sample matched on:	Industry, size, ln age (time span: 2008-2013)										
11		Gross	**0.010**	0.139	568	153	**0.088**	0.297	568	377	-0.078	***

Table 3. Conditional Investment Levels: Detailed Matching – Industry Loop

This table reports investment levels of matched public and private firms. Compared to Table 2, we include several other firm characteristics in the matching procedure. We describe the matching procedure in Section 2.4.We only keep industries that satisfies the propensity score balancing assumptions, with standardized difference of less than 25% and variation ratio between 0.5 and 2. For a further description of this assumption, see Section 2.4.1. We list all dropped industries in Table 18, Panel A. In row 2 to 5, we match on industry, size, leverage, cash holdings, cost of debt and ROA, while row 6 to 9 include asset ratio and RE/TA to control for within industry differences in capital intensity and lifecycle differences, respectively. Finally, row 10 to 13 combines all matching characteristics used in the previous rows. Size is set to 2013 purchasing power, to control for across year comparisons. A detailed description of all variables are reported in the variable definition and construction in the Appendix. Both firm characteristics and investment measures are Winsorized at the 0.5th and 99.5th percentile to lessen the impact of spurious outliers on our results. We use paired t-tests to assess differences in investment levels between matched public and private firms. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations.

Row	Sample	Investment Measure	Public Firms Mean	Public Firms Std. Dev	Public Firms No.of Obs.	Public Firms No.of Firms	Private Firms Mean	Private Firms Std. Dev	Private Firms No.of Obs.	Private Firms No.of Firms	Public - Private Firms Difference in Means
1	Full sample:	Gross	**0.041**	0.474	1 956	311	**0.064**	3.113	520 112	87 443	-0.023
	Sample matched on:	Industry, size, leverage, cash holdings, cost of debt, ROA									
2		Gross	**0.012**	0.169	829	211	**0.052**	0.211	829	506	-0.039 ***
3		Gross + intangibles	**0.020**	0.208	829	211	**0.057**	0.234	829	506	-0.037 ***
4		Net	**-0.001**	0.160	829	211	**0.028**	0.196	829	506	-0.029 ***
5		Net + intangibles	**0.007**	0.197	829	211	**0.033**	0.217	829	506	-0.026 **
	Sample matched on:	Industry, size, leverage, cash holdings, asset ratio, ROA, RE/TA									
6		Gross	**0.026**	0.175	675	191	**0.054**	0.216	675	430	-0.027 ***
7		Gross + intangibles	**0.037**	0.239	675	191	**0.063**	0.251	675	430	-0.025 *
8		Net	**0.008**	0.163	675	191	**0.034**	0.207	675	430	-0.026 ***
9		Net + intangibles	**0.020**	0.230	675	191	**0.043**	0.240	675	430	-0.023 *
	Sample matched on:	Industry, size, leverage, cash holdings, asset ratio, ROA, RE/TA, cost of debt									
10		Gross	**0.014**	0.133	596	144	**0.049**	0.222	596	331	-0.035 ***
11		Gross + intangibles	**0.021**	0.164	596	144	**0.053**	0.232	596	331	-0.031 ***
12		Net	**0.002**	0.125	596	144	**0.032**	0.213	596	331	-0.030 ***
13		Net + intangibles	**0.010**	0.156	596	144	**0.036**	0.221	596	331	-0.026 **

Table 4. Conditional Investment Levels: Michaely and Roberts (2012) – Industry Loop

This table reports the investment levels of matched public and private firms, based on the matching characteristics suggested by Michaely and Roberts (2012). We describe the matching procedure in Section 2.4. We only keep industries that satisfies the propensity score balancing assumptions, with standardized difference of less than 25% and variation ratio between 0.5 and 2. We list all dropped industries in Table 18, Panel A. Due to several missing sales growth observations, this sample consists of 876 firm-year observations. Row 2 to 5 show the results when we match on industry, size, leverage, cash holdings, sales growth and ROA. Size is set to 2013 purchasing power, to control for across year comparisons. A detailed description of all variables are reported in the variable definition and construction in the Appendix. Both firm characteristics and investment measures are Winsorized at the 0.5th and 99.5th percentile to lessen the impact of spurious outliers on our results. We use paired t-tests to assess differences in investment levels between matched public and private firms. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations.

Row	Sample	Investment Measure	Public Firms				Private Firms				Public - Private Firms
			Mean	Std. Dev	Obs.	Firms	Mean	Std. Dev	Obs.	Firms	Means
1	Full sample:	Gross	**0.041**	0.474	1 956	311	**0.064**	3.113	520 112	87 443	-0.023
	Sample matched on:	Industry, size, leverage, cash holdings, sales growth and ROA									
2		Gross	**0.030**	0.194	438	142	**0.049**	0.178	438	262	-0.019
3		Gross + intangibles	**0.032**	0.234	438	142	**0.051**	0.200	438	262	-0.020
4		Net	**0.005**	0.178	438	142	**0.016**	0.164	438	262	-0.011
5		Net + intangibles	**0.007**	0.225	438	142	**0.018**	0.185	438	262	-0.011

Table 5. Unconditional Investment Levels

This table reports the results from estimating equation (2) in Section 3.1.2. The sample is identical with the one we present in Table 2, matching on industry and size. The *public* coefficient show the difference between public and private firms investment levels, holding investment opportunities (sales growth) and profitability (return on assets) constant. We control for year trends and industry fixed effects by implementing dummies in our ordinary least square (OLS) regression. These are not reported. We list heteroscedasticity-robust standard errors underneath the related coefficient. Standard-errors are clustered at the firm level. Both firm characteristics and investment measures are Winsorized at the 0.5th and 99.5th percentile to lessen the impact of spurious outliers on our results. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations.

Sample:	Full	Industry, Size			
Dependent Variable:	Gross	Gross	Gross + Intangible	Net	Net + Intangible
	(1)	(2)	(3)	(4)	(5)
Public	-0.029 ***	-0.058 ***	-0.053 ***	-0.038 ***	-0.034 **
	0.005	*0.010*	*0.011*	*0.009*	*0.010*
Inv. Opps.	0.004 ***	0.011 ***	0.016 ***	0.010 ***	0.015
	0.000	*0.002*	*0.002*	*0.002*	*0.002*
ROA	-0.043 ***	-0.034	-0.015	0.008	0.027
	0.002	*0.023*	*0.027*	*0.020*	*0.026*
R^2	1.2%	7.6%	8.5%	5.8%	7.6%
R^2 adj.	1.2%	6.6%	7.5%	4.7%	6.5%
No. Obs	314 284	2 280	2 280	2 280	2 280
No firms	62 750	1 044	1 044	1 044	1 044

Table 6. Unconditional Investment Levels – Controlling for Lifecycle Differences

This table reports the results from estimating equation (2) in Section 3.1.2. The sample is identical with the one we present in Table 2, matching on industry, size and age. Age is included to control for lifecycle differences. The *public* coefficient show the difference between public and private firms investment levels, holding investment opportunities (sales growth) and profitability (return on assets) constant. We control for year trends and industry fixed effects by implementing dummies in our ordinary least square (OLS) regression. These are not reported. We list heteroscedasticity-robust standard errors underneath the related coefficient. Standard-errors are clustered at the firm level. Both firm characteristics and investment measures are Winsorized at the 0.5th and 99.5th percentile to lessen the impact of spurious outliers on our results. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations.

Sample:	Full	Industry, Size, ln Age				Industry, Size, ln Age, 2001-2007	Industry, Size, ln Age, 2008-2013
Dependent Variable:	Gross	Gross	Gross + Intangible	Net	Net + Intangible	Gross	Gross
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Public	-0.029 ***	-0.054 ***	-0.045 **	-0.034 **	-0.025 *	-0.032	-0.051 ***
	0.005	*0.012*	*0.014*	*0.011*	*0.012*	*0.017*	*0.015*
Inv. Opps.	0.004 ***	0.014 ***	0.018 ***	0.013 ***	0.017 ***	0.013	0.016 ***
	0.000	*0.004*	*0.004*	*0.003*	*0.004*	*0.009*	*0.004*
ROA	-0.043 ***	0.005	0.015	0.024	0.032	-0.072	0.045
	0.002	*0.025*	*0.037*	*0.021*	*0.033*	*0.078*	*0.033*
R^2	1.2%	9.7%	11.2%	8.7%	10.4%	9.4%	15.2%
R^2 adj.	1.2%	8.1%	9.7%	7.0%	8.8%	6.4%	13.1%
No. Obs	314 284	1 258	1 258	1 258	1 258	508	628
No firms	62 750	527	527	527	527	275	337

Table 7 Panel A. Unconditional Investment Levels – Detailed Sample

Panel A reports the results from estimating equation (2) in Section 3.1.2. The samples is identical with those we present in Table 3. In column (1) to (4), we match on industry, size, leverage, cash holding, cost of debt and ROA. In column (6) to (9) we include asset ratio and RE/TA to control for within industry differences in capital intensity and lifecycle differences, respectively. The *public* coefficient show the difference between public and private firms investment levels, holding investment opportunities (sales growth) and profitability (return on assets) constant. We control for year trends and industry fixed effects by implementing dummies in our ordinary least square (OLS) regression. These are not reported. We list heteroscedasticity-robust standard errors underneath the related coefficient. Standard-errors are clustered at the firm level. Both firm characteristics and investment measures are Winsorized at the 0.5th and 99.5th percentile to lessen the impact of spurious outliers on our results. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations. Panel B show the estimated coefficients of public investment levels across our different samples.

	Matched on:							
Sample:	Industry, Size, Leverage Cash Holdings, Cost of Debt, ROA				Industry, Size, Leverage, Cash Holdings, Cost of Debt, ROA, RE/TA, Asset Ratio			
Dependent Variable:	Gross	Gross + Intangibles	Net	Net + Intangibles	Gross	Gross + Intangibles	Net	Net + Intangibles
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Public	-0.057 ***	-0.063 ***	-0.038 **	-0.043 **	-0.058 ***	-0.056 ***	-0.040 **	-0.038 **
	0.014	*0.016*	*0.013*	*0.015*	*0.014*	*0.015*	*0.013*	*0.014*
Inv. Opps.	0.013 ***	0.017 ***	0.012 **	0.015 ***	0.017 ***	0.019 ***	0.015 ***	0.018 ***
	0.004	*0.004*	*0.004*	*0.004*	*0.004*	*0.005*	*0.004*	*0.004*
ROA	0.050	0.070	0.045	0.064	-0.042	-0.056	0.003	-0.010
	0.050	*0.063*	*0.046*	*0.058*	*0.047*	*0.060*	*0.043*	*0.054*
R^2	12.0%	13.7%	10.4%	12.4%	17.9%	19.4%	15.8%	17.3%
R^2 adj.	9.8%	11.6%	8.2%	10.3%	15.1%	16.7%	12.9%	14.5%
No. Obs	961	961	961	961	647	647	647	647
No firms	444	444	444	444	291	291	291	291
Panel B:								
Sample	Industry, size, leverage, cash holdings, cost of debt, ROA				Industry, size, leverage, cash holdings, cost of debt, ROA, RE/TA, asset ratio			
Public	-0.057 ***	-0.063 *	-0.038 **	-0.043 **	-0.058 ***	-0.056 ***	-0.040 **	-0.038 **
Sample	Industry, size, ln age				Industry, size, leverage, cash holdings, cost of debt, ROA			
Public	-0.054 ***	-0.045 **	-0.034 **	-0.025 *	-0.057 ***	-0.063 *	-0.038 **	-0.043 **
Difference	-0.003	-0.018	-0.003	-0.019	0.000	0.008	-0.003	0.005

Table 8. Conditional Investment Levels – Year Loop

This table reports the investment levels of matched public and private firms, based on our exact year loop matching and propensity score matching. We describe the matching procedure in Section 3.1.3.1.We only keep years that satisfies the propensity score balancing assumptions, with standardized difference of less than 25% and variation ratio between 0.5 and 2. For a further description of this assumption, see Section 2.4.1. We list all dropped years in Table 19, Panel A. In row 2 and 3, we match on year, asset ratio and size, while row 4 and 5 include firm age to control for lifecycle differences. A detailed description of all variables are reported in the variable definition and construction in the Appendix. Both firm characteristics (except age) and investment measures are Winsorized at the 0.5th and 99.5th percentile to lessen the impact of spurious outliers on our results. We use paired t-tests to assess differences in investment levels between matched public and private firms. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations.

			Public Firms				Private Firms				Public - Private Firms
Row	Sample	Investment Measure	Mean	Std. Dev	No. of Obs.	No. of Firms	Mean	Std. dev	No. of Obs.	No. of Firms	Difference in Means
1	Full sample:	Gross	**0.041**	0.474	1 956	311	**0.064**	3.113	520 112	87 443	-0.023
	Sample matched on:					Year, asset ratio, size					
2		Gross	**0.027**	0.109	777	230	**0.069**	0.233	777	608	-0.042 ***
3		Gross + intangibles	**0.040**	0.162	777	230	**0.078**	0.260	777	608	-0.039 ***
4		Net	**0.006**	0.094	777	230	**0.037**	0.221	777	608	-0.031 ***
5		Net + intangibles	**0.019**	0.155	777	230	**0.047**	0.249	777	608	-0.028 ***
						Year, asset ratio, size, ln age					
6		Gross	**0.036**	0.136	288	164	**0.087**	0.235	288	240	-0.051 ***
7		Gross + intangibles	**0.039**	0.172	288	164	**0.089**	0.264	288	240	-0.050 ***
8		Net	**0.014**	0.117	288	164	**0.048**	0.222	288	240	-0.034 **
9		Net + intangibles	**0.019**	0.167	288	164	**0.052**	0.255	288	240	-0.032 *

Table 9. Conditional Investment Levels – No loop

This table reports the investment levels of matched public and private firms, based propensity score matching without any exact loop matching. We describe the matching procedure in Section 3.1.3.2.The propensity score balancing assumptions is fulfilled, with standardized difference of less than 25% and variation ratio between 0.5 and 2. For a further description of this assumption, see Section 2.4.1. In row 2 through 5, we match on year, asset ratio, size and age. In row 6 to 9 we match on year, asset ratio, size, ROA, leverage, cash holdings and sales growth. Size is set to 2013 purchasing power, to control for across year comparisons A detailed description of all variables are reported in the variable definition and construction in the Appendix. Both firm characteristics (except age) and investment measures are Winsorized at the 0.5th and 99.5th percentile to lessen the impact of spurious outliers on our results. We use paired t-tests to assess differences in investment levels between matched public and private firms. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations.

			Public Firms				Private Firms				Public - Private Firms
Row	Sample	Investment Measure	Mean	Std. Dev	No.of Obs.	No.of Firms	Mean	Std. Dev	No.of Obs.	No.of Firms	Difference in Means
1	Full sample:	Gross	**0.041**	0.474	1 956	311	**0.064**	3.113	520 112	87 443	-0.023
	Sample matched on:		Year, asset ratio, size, ln age								
2		Gross	**0.041**	0.189	1 255	252	**0.083**	0.248	1 255	906	-0.042 ***
3		Gross + intangibles	**0.060**	0.261	1 255	252	**0.089**	0.266	1 255	906	-0.029 ***
4		Net	**0.012**	0.171	1 255	252	**0.031**	0.203	1 255	906	-0.018 ***
5		Net + intangibles	**0.013**	0.175	1 255	252	**0.049**	0.239	1 255	906	-0.036 **
	Sample matched on:		Year, asset ratio, size, ROA, leverage, cash holdings, sales growth								
6		Gross	**0.034**	0.201	524	174	**0.073**	0.221	524	349	-0.038 ***
7		Gross + intangibles	**0.044**	0.245	524	174	**0.087**	0.258	524	349	-0.043 ***
8		Net	**0.012**	0.189	524	174	**0.037**	0.209	524	349	-0.025 **
9		Net + intangibles	**0.022**	0.234	524	174	**0.051**	0.246	524	349	-0.029 **

Table 10. Sensitivity to Investment Opportunities

This table presents the results from estimating equation (3) shown in Section 3.2. The estimated coefficient *investment opportunities* show private firms sensitivity to investment opportunities, while *investment opportunities + public* show public firms sensitivity to investment opportunities. The sample is identical with the one we present in Table 2, matching on industry and size. We examine public and private firms investment sensitivities by exploiting within-firm variation. We have two measures of investment opportunities, sales growth and approximate Q (See Section 2.3). The depended variable is gross investment. We include year dummies to control for year trends. These are not reported. We also include firm fixed effects, by using the fixed effects module in Stata. We list heteroscedasticity-robust standard errors underneath the related coefficient. Standard-errors are clustered at the firm level. Both firm characteristics and investment measures are Winsorized at the 0.5th and 99.5th percentile to lessen the impact of spurious outliers on our results. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations. The t-test is two-sided, while the F-test is one-sided.

Dependent Variable:	Gross Investment				
Measure of Investment Opps.:	Sales Growth				Appr. Q
Sample:	Industry, Size	Industry, Size	Matched Public Firms	All public Firms	Industry, Size
	(1)	(2)	(3)	(4)	(5)
Investment opportunities	0.017		0.011 ***	0.011 ***	0.0002
	0.018		*0.003*	*0.003*	*0.0004*
x public	-0.006				-0.0002
	0.018				*0.0004*
Inv. Opps (2001-2007)		0.008			
		0.013			
x public		0.001			
		0.013			
Inv. Opps (2008-2013)		0.152			
		0.088			
x public		-0.011			
		0.122			
ROA	0.062	0.007	-0.001	0.002	0.037
	0.102	*0.118*	*0.031*	*0.031*	*0.063*
ROA x public	-0.066	-0.177			-0.037
	0.106	*0.079*			*0.067*
R^2 (within)					
No. obs	2 280	2 280	1 313	1 314	3 435
No firms	1 044	1 044	252	252	1 521
F-test: all coeff. = 0	2.09 ***	2.15 ***	2.46 ***	2.47 ***	1.21

Table 11. Sensitivity to Investment Opportunities – Detailed

As Table 10, this table presents the results from estimating equation (3) shown in Section 3.2. The estimated coefficient *investment opportunities* show private firms sensitivity to investment opportunities, while *investment opportunities + public* show public firms sensitivity to investment opportunities. The sample is identical with the one we present in Table 3, matching on industry, size, leverage, cash holdings, cost of debt and ROA. We examine public and private firms investment sensitivities, by exploiting within-firm variation. We have two measures of investment opportunities, sales growth and approximate Q (See Section 2.3). The depended variable is gross investment. We include year dummies to control for year trends. These are not reported. We also include firm fixed effects, by using the fixed effects module in Stata. We list heteroscedasticity-robust standard errors underneath the related coefficient. Standard-errors are clustered at the firm level. Both firm characteristics and investment measures are Winsorized at the 0.5th and 99.5th percentile to lessen the impact of spurious outliers on our results. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations. The t-test is two-sided, while the F-test is one-sided.

Dependent Variable:	Gross Investment				
Measure of Investment Opps:	Sales Growth				Appr. Q
Sample:	Industry, Size, Leverage, Cash Holdings, Cost of Debt, ROA		Matched Public Firms	All public Firms	Industry, Size, Leverage, Cash Holdings, Cost of Debt, ROA
	(1)	(2)	(3)	(4)	(5)
Investment opportunities	0.044 ***		0.015 ***	0.011 ***	-0.001
	0.001		*0.004*	*0.003*	*0.002*
x public	-0.030 ***				0.001
	0.005				*0.001*
Inv. Opps (2001-2007)		0.044 ***			
		0.001			
x public		-0.030 ***			
		0.005			
Inv. Opps (2008-2013)		0.044			
		0.039			
x public		-0.029			
		0.040			
ROA	-0.067	-0.067	0.065	0.002	0.090
	0.066	*0.067*	*0.143*	*0.031*	*0.108*
ROA x public	0.120	0.123			-0.106
	0.150	*0.149*			*0.140*
R^2 (within)	17.60 %	17.60 %	15.10 %	9.13 %	2.96 %
No. obs	961	961	554	1 314	1 560
No firms	444	444	167	252	700
F-test: all coeff. = 0	184.20 ***	301.20 ***	2.43 ***	2.47 ***	1.44

Table 12. Lifecycle Differences, Sampling and Macroeconomic Effects

This table presents the results from estimating equation (3) shown in Section 3.2, when we control for lifecycle differences. The estimated coefficient *investment opportunities* show private firms sensitivity to investment opportunities, while *investment opportunities + public* show public firms sensitivity to investment opportunities. Column (1) and (2) contain our industry and size matched sample, controlling for lifecycle differences by RE/TA and age, respectively. In column (3) and (4), we do exact industry loop matching and propensity score matching. Size is set to 2013 purchasing power, to control for between year comparisons. In column (5) and (6), we do exact year loop matching and propensity score matching. We examine public and private firms investment sensitivities by exploiting within-firm variation. We have two measures of investment opportunities, sales growth and approximate Q (See Section 2.3). The depended variable is gross investment. We include year dummies to control for year trends. These are not reported. We also include firm fixed effects, by using the fixed effects module in Stata. We list heteroscedasticity-robust standard errors underneath the related coefficient. Standard-errors are clustered at the firm level. Both firm characteristics (except age) and investment measures are Winsorized at the 0.5th and 99.5th percentile to lessen the impact of spurious outliers on our results. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations. The t-test is two-sided, while the F-test is one-sided.

	Exact Industry Matching:				Exact Year Matching:	
Sample:	Size, Industry, RE/TA	Size, Industry, ln Age	Industry, Size, Leverage, Cash Holdings, Assets Ratio, ROA, RE/TA, Cost of Debt		Size, ln(Age) Capital Intensity	
Dependent Variable:	Gross	Gross	Gross	Gross + Intangibles	Gross	Gross + Intangibles
	(1)	(2)	(3)	(4)	(5)	(6)
Investment opportunities	0.006	0.029 **	0.052 ***	0.054 ***	0.063 ***	0.067 ***
	0.006	*0.010*	*0.007*	*0.007*	*0.010*	*0.011*
… x public	0.009	-0.017	-0.037 ***	-0.037 ***	-0.056 ***	-0.054 ***
	0.007	*0.011*	*0.008*	*0.009*	*0.011*	*0.012*
ROA	-0.030	-0.193	-0.069	-0.048	-0.347 **	-0.166
	0.372	*0.181*	*0.363*	*0.384*	*0.131*	*0.159*
… x public	*0.091*	*0.289*	*0.007*	*-0.031*	*0.458* **	*0.308*
	0.379	*0.188*	*0.370*	*0.391*	*0.151*	*0.176*
R^2 (within)	11.7%	13.9%	34.1%	34.2%	21.1%	21.1%
No. Obs	1 083	1 258	647	647	933	933
No firms	483	527	291	291	536	536
F-test: all coeff. =0	2.42 ***	2.31 ***	17.22 ***	12.11 ***	6.75 ***	6.35 ***

Table 13. Differences in Profitability

This table reports the differences in profitability of matched public and private firms. Row 2 contains our exact industry loop matching and propensity score size matching. Row 3 include age, while row 4 and 5 examines profitability before and after the global financial crisis. See Section 2.4 for a description of our matching procedure. We use return on assets to proxy for profitability. All firm characteristics (except age) are Winsorized at the 0.5th and 99.5th percentile to lessen the impact of spurious outliers on our results. We use paired t-tests to assess differences in profitability between matched public and private firms. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations.

	Measure for Profitability:	Return on Assets (ROA)						
		Public Firms			Private Firms			Public - Private Firms
Row	Sample	Profit-ability	No.of Obs.	No.of Firms	Profit-ability	No.of Obs.	No.of Firms	Diff. in Profitability
1	Full sample:	-0.047	1 956	311	0.050	520 112	87 443	-0.097 ***
	Sample matched on:							
2	Industry, size	-0.047	1 955	311	0.052	1 955	1 299	-0.099 ***
3	Industry, size, ln age	-0.036	1 102	212	0.047	1 102	609	-0.083 ***
4	Industry, size, ln age (2001-2007)	0.003	380	104	0.046	380	252	-0.043 ***
5	Industry, size, ln age (2008-2013)	-0.086	689	161	0.039	689	492	-0.125 ***

Table 14. Summary Statistics - Winsorizing Robustness

As in Table 1, this table presents summary statistics of matched public and private firms, by using exact industry loop matching and propensity score size matching. Size is set to 2013 purchasing power, to control for across-year comparisons. However, all variables (except age and approximate Q) are now Winsorized at the 0.1st and 99.9th percentile. The results from our findings in Table 1 are listed in the right column. Test statistics of mean differences in firm size, investment opportunities and firm characteristics are obtained by using t-test. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations.

	Matched Sample			
Winsorizing Level:	99.8%			99.0%
Firm Size	Public	Private	Difference	Difference
Total assets	2 469 967	2 426 662	43 305 ***	-8 275 ***
std. dev.	3 867 514	3 702 109		
Investment Opportunities				
Sales growth	1.896	1.188	0.708	0.581 ***
std. dev.	16.076	18.001		
Approximate Q	25.465	27.341	-1.876 ***	-1.372 ***
std. dev.	23.838	27.457		
Firm Characteristics				
ROA	-0.072	0.047	-0.118 ***	-0.099 ***
std. dev.	0.372	0.153		
Asset ratio	0.241	0.602	-0.361 ***	-0.345 ***
std. dev.	0.465	1.018		
Leverage	0.450	0.581	-0.131 ***	-0.147 ***
std. dev.	0.337	0.294		
RE/TA	-0.092	0.022	-0.114 ***	-0.106 ***
std. dev.	0.365	0.161		
Cost of debt	0.146	0.147	-0.000	0.033 ***
std. dev.	1.030	1.218		
Cash holdings	0.131	0.080	0.051 ***	0.056 ***
std. dev.	0.189	0.145		
Age	28.090	20.364	7.726 ***	9.436 ***
std. dev.	32.637	24.035		
ROE	-0.107	0.150	-0.257 ***	-0.374 ***
std. dev.	1.431	2.410		
No. of observations*	1 956	520 112		1 955
No of firms*	311	87 443		

* Sales growth, cost of debt and ROE contains less observations due to missing values.

Table 15. Conditional Investment Level – Winsorizing Robustness

As in Table 2, 3 and 4, this table reports the differences in investment levels between public and private firms, but with all variables (except age) Winsorized at the 0.1st and 99.9th percentile. The result from Table 2, 3 and 4 (based on old Windsorizing level) are listed in the two right columns. We only keep industries consistent with the propensity score balancing assumption, with standardized difference of less than 25% and variation ratio between 0.5 and 2. All dropped industries are reported in Table 18, Panel B. We use paired t-tests to assess differences in investment levels between matched public and private firms. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations. For further details, see descriptions in Table 2, 3 and 4.

		Winsorizing level							
		99.8 %						99.0 %	
		Public Firms		Private Firms		Public Firms - Private Firms		Public Firms - Private Firms	
Row	Investment Measure	Means	No. of Obs.	Means	No. of Obs.	Difference in Means	Total no. of Obs.	Difference in Means	Total no. of Obs.
	Sample Matched on:	Industry and size							
1	Gross	0.031	1947	0.120	1947	-0.088 ***	3894	-0.057 ***	3910
2	Gross + intangible	0.047	1947	0.139	1947	-0.092 ***	3894	-0.063 ***	3910
3	Net	0.009	1947	0.087	1947	-0.078 ***	3894	-0.043 ***	3910
4	Net + intangible	0.026	1947	0.108	1947	-0.082 ***	3894	-0.048 ***	3910
	Sample Matched on:	Industry, size and ln age							
5	Gross	0.025	484	0.134	484	-0.109 ***	968	-0.067 ***	2204
6	Gross + intangible	0.039	484	0.156	484	-0.116 ***	968	-0.066 ***	2204
7	Net	0.005	484	0.093	484	-0.087 ***	968	-0.056 ***	2204
8	Net + intangible	0.020	484	0.115	484	-0.095 ***	968	-0.055 ***	2204
	Sample Matched on:	Industry, size, leverage, cash holdings, cost of debt and ROA							
9	Gross	0.035	109	0.262	109	-0.227 **	218	-0.039 ***	1658
	Sample Matched on:	Industry, size, leverage, cash holdings, sales growth, ROA							
10	Gross	-0.018	91	0.136	51	-0.154 *	142	-0.019	876

Table 16. Unconditional Investment Levels – Winsorizing Robustness

As in Table 5 and 6, this table reports the differences in investment levels between public and private firms, but with all variables (except age) Winsorized at the 0.1st and 99.9th percentile. We only keep industries consistent with the propensity score balancing assumption, with standardized difference of less than 25% and variation ratio between 0.5 and 2. All dropped industries are reported in Table 18, Panel B. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations. For further details, see table descriptions in Table 5 and 6.

	Winsorizing Level: 99.8%					
Sample:	Industry, size		Industry, Size, ln Age		Industry, Size, Leverage, Cash Holdings, Cost of Debt, ROA	
Dependent Variable:	Gross	Net	Gross	Net	Gross	Net
	(1)	(2)	(3)	(4)	(5)	(6)
Public	-0.059 ***	-0.040 **	-0.121 ***	-0.088 **	-0.111 ***	-0.063 **
	0.013	*0.013*	*0.035*	*0.033*	*0.025*	*0.023*
Inv. Opps.	0.001 *	0.001 *	0.005 ***	0.005 ***	0.011 ***	0.011 ***
	0.001	*0.001*	*0.001*	*0.001*	*0.001*	*0.001*
ROA	-0.012	0.011	-0.058	-0.030	-0.137	-0.128
	0.018	*0.016*	*0.043*	*0.033*	*0.155*	*0.155*
R^2	3.0 %	2.3 %	9.8 %	9.0 %	86.3 %	85.9 %
R^2 adj.	2.0 %	1.3 %	7.0 %	6.2 %	84.5 %	84.0 %
No. Obs	2 406	2 406	602	602	142	142
No firms	1 114	1 114	276	276	80	80

Table 17. Sensitivity to Investment Opportunities – Winsorizing Robustness

As Table 10, 11 and 12, this table reports the sensitivity to investment opportunities between public and comparable private firms, but with all variables variables (except age) Winsorized at the 0.1st and 99.9th percentile. We drop all industries and years not consistent with the propensity score balancing assumption, with standardized difference of less than 25% and variation ratio between 0.5 and 2. All dropped industries and years are reported in Table 18 Panel B and Table 19 Panel B, respectively. The results are denoted at statistical significance levels of 1%, 5% and 10%, given superscript ***, ** and *, respectively. All observations are firm-year observations. For further details, see descriptions in Table 10, 11 and 12.

Dependent variable:	Gross Investment					
Measure on investment opps:	Sales Growth					
					Control for Lifecycle Stages	
	Industry Loop					Year Loop
Sample:	Industry, size		Industry, size, leverage, cash holdings, cost of debt, ROA		Industry, size, age	Size, capital intensity, age
	(1)	(2)	(3)	(4)	(5)	(6)
Investment opportunities	0.046		0.169		0.069 *	0.036
	0.044		*0.143*		*0.021*	*0.038*
x public	-0.044		-0.159		-0.063 *	-0.034
	0.044		*0.143*		*0.021*	*0.038*
Inv. Opps (2001-2007)		0.030		0.227		
		0.041		*0.331*		
x public		-0.029		-0.222		
		0.041		*0.331*		
Inv. Opps (2008-2013)		0.173 **		0.209		
		0.059		*0.186*		
x public		-0.170 **		-0.195		
		0.059		*0.185*		
ROA	0.063	0.032	0.517	0.432	-0.433	0.227
	0.074	*0.076*	*0.284*	*0.446*	*0.259*	*0.199*
ROA x public	-0.014	0.016	-0.522	-0.470	0.498	-0.242
	0.079	*0.080*	*0.371*	*0.467*	*0.263*	*0.207*
R^2 (within)	4.1 %	4.9 %	51.1 %	58.3 %	10.3 %	8.2 %
No. obs	2406	2406	142	142	602	507
No firms	1 114	1 114	80	80	276	340
F-test: all coeff. = 0	1.345	1.784 **	5.109 ***	10 073 ***	2 995 *	1 357

Table 18. Excluded Industries

This table presents all manually dropped industries that do not satisfy the propensity score balancing assumption, with standardized difference of less than 25% and variation ratio between 0.5 and 2. Panel A and Panel B show the dropped industries for Winsorizing levels of 99% and 99.8%, respectively. We present the different industries in Panel C.

Panel A

Dropped Industry = 1

Industry Loop	**Winsorizing level 99%**	Industry								
PSM Characteristics		1	2	3	4	5	6	7	8	9
Size, ln age					1	1		1		1
Size, ln age (2001-2007)		1					1		1	1
Size, ln age (2008-2013)					1	1		1		1
Size, RE/TA						1		1	1	1
Size, leverage, cash holding Sales growth, ROA		1		1	1	1		1		
Size, leverage, cash holdings, cost of debt, ROA		1				1		1		
Size, asset ratio, leverage cash holdings, RE/TA, ROA		1			1		1	1		
Size, asset ratio, leverage cash holdings, RE/TA, ROA, Cost of debt		1		1	1			1	1	
Total dropped in each industry =		5	0	2	5	5	2	7	3	4

Panel B

Industry Loop	**Winsorizing level 99.8%**	Industry								
PSM Characteristics		1	2	3	4	5	6	7	8	9
Size, ln age					1	1		1	1	
Size, leverage, cash holding Sales growth, ROA			1	1	1	1		1	1	1
Size, leverage, cash holdings, cost of debt, ROA		1	1		1	1	1	1	1	
Total dropped in each industry =		1	2	1	3	3	1	3	3	1

Panel C

Industry	Description
1	Primary Industry
2	General Industry
3	Oil and Gas
4	Constructing and Energy
5	Trade
6	Shipping
7	Transport and Tourism
8	Consulting and Real Estate
9	IT and Communications

Table 19. Dropped Years

This table presents all manually dropped years that do not satisfy the propensity score balancing assumption, with standardized difference of less than 25% and variation ratio between 0.5 and 2. Panel A and Panel B show the dropped years for Winsorizing levels of 99% and 99.8%, respectively.

Panel A

Dropped Year = 1		**Winsorizing level 99%**												
Year Loop														
PSM Characteristics	Year	01	02	03	04	05	06	07	08	09	10	11	12	13
Size, capital intensity		1	1	1		1		1						
Size, capital intensity, ln age				1			1		1	1	1			
Total dropped in each year =		1	1	2	0	1	1	1	1	1	1	0	0	0

Panel B

Dropped Year = 1		**Winsorizing level 99.8%**												
Year Loop														
PSM Characteristics	Year	01	02	03	04	05	06	07	08	09	10	11	12	13
Size, capital intensity			1	1	1	1	1						1	
Size, capital intensity, ln age		1	1	1		1		1					1	1
Total dropped in each year =		1	2	2	1	2	1	1	0	0	0	0	2	1