PUBLICLY LISTED OR PRIVATELY HELD

A COMPARISON OF INVESTMENT BEHAVIOR

ANDREA NORDQUIST

WILMA TILLQVIST

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Publicly Listed or Privately Held: A Comparison of Investment Behavior

Abstract:

We compare investment levels and investment sensitivities of public and private firms along the dimensions of assets, human capital and innovation. For a sample constructed to include a broad universe of Swedish firms, we find that public firms have higher investment levels and investment sensitivities than those that are private, with the differences being statistically and economically significant. For a size and industry matched sample, as well as for a group of transition firms, the differences are less evident but, when present, they are consistent in that public firms' investment levels exceed those of private firms. Based on empirical analysis, we cannot rule out empire-building as an explanation to the differences. Our findings indicate that the differences in investment behavior are economically meaningful and should be considered in the decision to be publicly listed or privately held.

Keywords:

Investment level, Investment sensitivity, Private firms, Public firms, Empire-building

Authors:

Andrea Nordquist (23840)
Wilma Tillqvist (24453)

Tutor:

Dong Yan, Assistant Professor, Department of Finance

Examiner:

Adrien d'Avernas, Assistant Professor, Department of Finance

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Stockholm School of Economics

1. Introduction

There are several consequences on firm behavior stemming from a firm's decision to stay private or go public. In a corporate finance context, it is of interest to understand the impact on investment behavior from such a decision. However, to date, the direction and magnitude of this impact is not established as there, from a theoretical perspective, are competing hypotheses while it, from an empirical perspective, is difficult to find a counterfactual. In this paper, we address these issues by comparing the investment behavior of publicly listed and privately held firms. Using this research design, we are able to compare public firm investment behavior to that of an alternative and, given fundamental differences in transparency and ownership structure between the two types of firms, we study the theoretical channels driving the differences in investment behavior.

We place our study in Sweden, motivated by good private firm data availability on Swedish incorporated firms. This choice allows us to capture a broad universe of firms, which forms the basis of our first sample group, the full sample. We next construct a propensity-score matched sample, based on the foundation laid out by Rosenbaum and Rubin (1983), to compare public and private firms with similar size and industry distributions. We complement our main analysis of the full and matched samples by identifying those firms that transition from private to public, addressing potential sample selection concerns by comparing the same firm as both a public and private entity. All three sample groups are based on a dataset composed using Serrano, PAtLink and the Swedish Tax Agency. After data cleaning, we have an unbalanced panel, namely the full sample, consisting of 2,076,598 private firm-years and 3,364 public firm-years covering the time period 1998-2019. In addition, this is used as a base to construct the matched and transition samples.

Our study of investment behavior is based on investment levels and investment sensitivities, and we measure three categories of investment; assets, human capital and innovation. For the full sample, we find that public firms both have higher investment levels and investment sensitivities than private firms. The differences are statistically and economically significant, and apply to all three investment categories. In the size and industry matched sample, as well as in the transition group, we do not find as evident differences in investment levels across all investment measures as in the full sample. However, for those investment measures where we still observe differences, it remains that public firms have higher investment levels than those of private firms.

From a theoretical perspective, these results could be consistent with either the hypothesis that a public listing enables better access to capital, and so reduces an underinvestment problem otherwise apparent among private firms, or the hypothesis that public firm managers engage more in empire-building and, therefore, overinvest. We disentangle these effects in a further step, using an empirical approach built around how public and private firms react to positive and negative sales growth, as a proxy for investment opportunities. We find that public firms in the full sample generally invest more than private firms regardless of whether investment opportunities are good or bad, which is indicative of empire-building. Given some contradictory results and the fact that public firms generally have higher investment sensitivities, we are cautious to draw too strong conclusions. Rather, we note that the empirical evidence suggests, but cannot entirely distinguish, that empire-building plays a role in driving higher investment levels among public firms.

Asker et al. (2015) study differences in investment levels and investment sensitivities between public firms and an anonymized set of private firms in the United States. We replicate much of their paper, but extend it by (1) capturing a broader universe of private firms, and (2) measuring investment along more dimensions. The first extension stems from the fact that Asker et al. (2015) have a private firm dataset mainly consisting of larger private firms, and

they focus their analysis on size matched samples. We implement the same rationale for our matched sample, but in addition we find it relevant to include small private firms in the full sample, given that they represent a large part of the private firm universe as well as the economy at large. The second extension adds value to the current literature as we, by studying more investment measures, are able to get a better view of the effects of going and being public on investment behavior. A public listing may potentially affect investment categories in different ways.

While taking the extensions and different research settings into consideration, we find it highly relevant to compare our results to those of Asker et al. (2015) given that our paper is closely related to theirs. Asker et al. (2015) find results consistent with short-termism theories predicting that capital market pressures distort firms' investment behavior. The conclusions regarding investment levels and investment sensitivities in our study thus contrast those found by Asker et al. (2015). Nevertheless, as our study cannot rule out that empire-building shapes public firms' higher investment levels, our study approaches Asker et al. (2015) on the dimension that agency problems could be an underlying mechanism sculpting public firms' investment behavior. However, they observe short-termism and we identify empire-building tendencies.

We are not aware of any multi-industry study of public and private firms' investment behavior capturing such a broad set of firms and measures as ours. Our study contributes to the literature focusing on the trade-off between going public and staying private, as we understand how a public listing affects investment decisions along several dimensions. This is relevant in Sweden, given the active Initial Public Offering (IPO) market (De La Cruz et al., 2019). Secondly, we also see that our research contributes to a better understanding of private firms, which is a growing but still limited research area, with the main boundaries being set by data limitations.

The remainder of the paper is organized as follows. In section 2, we position our study in relation to what has previously been researched and, further, we develop hypotheses for the differences in investment behavior between public and private firms. Next, in section 3, we describe our data, samples and outcome variables. We then turn to empirical analysis in section 4, and potential explanations in section 5. Section 6 concludes the paper.

2. Literature Review and Hypothesis Development

2.1 Related research

Our paper is positioned at the intersection of research focused on the effects of going public on investment behavior and that about differences between public and private firms. There are a few other studies that take action at this intersection but, due to low data coverage on privately held firms' financials, the literature is limited. Asker et al. (2015), the main inspiration for this paper, compare the investment behavior of U.S. public and private firms during 2001-2011, using a dataset consisting of anonymized private firms. The paper documents results that are in line with the prediction that short-termist pressures from the stock market distort investment decisions. More specifically, Asker et al. (2015) find that public firms have lower investment levels and investment sensitivities than private firms, and that these differences are particularly large in industries with high sensitivity of share prices to earnings news.

Other studies have worked around low data coverage by limiting their comparison of public and private firms to a particular industry in which data is more accessible. Gilje and Taillard (2016) study the U.S. natural gas industry and conclude, different from Asker et al. (2015), that private firms react less to investment opportunities than public firms. They identify public firms' better access to external capital to be an important mechanism underlying the differences. Sheen (2020), studying the U.S. chemical industry, also finds heterogeneity when

comparing public and private firms' investment behavior. They identify that private firms better time capacity increases, potentially explained by public firm extrapolation of past demand shocks and agency problems between managers and owners.

Given that prior studies have reached different conclusions, both in terms of the direction of the differences between public and private firms' investment behavior and the channel driving the results, our line of research is motivated. Due to the great scope of data on private firms in Sweden, we are able to do a multi-industry study, while still extending the Asker et al. (2015) paper. We do so by (1) incorporating a broader universe of private firms, and (2) measuring more dimensions of investment behavior to identify whether a stock market listing affects investment decisions related to assets, human capital and innovation in different ways. To the best of our knowledge, there is no other study on differences between public and private firms that has incorporated such a broad set of investment measures as ours.

In a broader context, we contribute to the growing empirical research domain comparing public and private firms along several dimensions with the aim of understanding the trade-off between going public and staying private. Compared to public firms, private firms have been found to rely more on debt financing (Brav, 2009) and have a loan cost disadvantage (Saunders and Steffen, 2011). Private firms also pay lower dividends and engage less in dividend-smoothing (Michaely and Roberts, 2012), have broader and more exploratory patents (Gao et al., 2018), participate less in merger waves (Maksimovic et al., 2013) and are less likely to pollute (Shive and Forster, 2020).

2.2 Hypothesis development

Under the assumption of a perfect capital market, all projects with positive net present value (NPV) would get access to financing. However, information asymmetry between current shareholders and new investors can create frictions compared to the perfect capital market benchmark, in the form of adverse selection (e.g., Myers and Majluf, 1984) and moral hazard (e.g., Holmstrom and Tirole, 1997), thereby imposing financial constraints on firms. Publicly listed firms are fundamentally different from private firms in that they are more transparent. This transparency reduces the information asymmetry otherwise apparent in capital markets and could lower the cost of equity (Bharath and Dittmar, 2010) and cost of debt (Campello et al., 2011; Saunders and Steffen, 2011) for public firms. This financing benefit should make them better positioned to make long-term investments, compared to private firms. Thus, the financing hypothesis (H1) predicts that public firms invest more than private firms.

> **The financing hypothesis (H1)** Public firms invest more than private firms because of better access to capital.

Public firm managers could be particularly prone to empire-building. Similar to financial constraints, empire-building is a deviation from a perfect capital market, but this time because of agency problems between firm managers and shareholders (Jensen, 1986). If managers derive private benefits from running larger firms, because of greater power and influence, they tend to overinvest in assets and number of employees, even if the investments are unprofitable. There are also other potential explanations to managers' empire-building preferences, such as overconfidence or their will to reduce risk via diversification, but the overinvestment prediction remains intact (H2) (e.g., Malmendier and Tate, 2005). The empire-building hypothesis results in the same prediction as the financing hypothesis, but the former suggests suboptimal investment behavior and the latter efficient.

> **The empire-building hypothesis (H2)** Public firms invest more than private firms because of public firm managers' empire-building preferences.

There are also theories providing foundation for the opposite prediction. Ownership and management are typically more separated in public firms compared to private firms. This separation can introduce, as well as increase, agency problems if managers' interests diverge from those of investors (Jensen and Meckling, 1976). More specifically, there are several aspects of the public market that might induce short-termism. The first set of aspects relates to managers (H3), and the second to shareholders (H4).

Short-term focused measures, such as earnings, often form the basis of the evaluation of managers and their compensation. This, combined with the fact that control mechanisms, such as hostile takeovers, often are based on output measures, could induce managers to boost short-term performance measures, even if it comes at the expense of long-term shareholder value (Narayanan, 1985; Stein, 1988). Further, managers may be reluctant to undertake investment projects as such projects reveal information about their ability (Stein, 2003).

> **The career concern hypothesis (H3)** Public firms invest less than private firms because of public firm managers' career concerns, induced by short-termist pressures.

It could also be that shareholders and analysts have a short-term focus, thereby generating quarterly earnings pressures (Narayanan, 1985). Further, as shareholders in public firms can diversify their investment portfolios and tend to own smaller equity stakes in a single firm, they are not as incentivized to monitor the manager as investors in private firms (Bhide, 1993). This free-rider problem is a further contribution to increased agency problems.

> **The short-term focused investor hypothesis (H4)** Public firms invest less than private firms because shareholders and analysts are short-term focused.

Given contrasting theoretical predictions, the choice of an empirical research design is motivated.

3. Sample and Data

Swedish legislation stipulates that all limited liability companies should make their financial statements publicly available. Consequently, the data on both public and private firms in Sweden is extensive, making it an appropriate geographical setting for our research. Related studies, focused on other geographies, are typically limited to a certain subset of private firms, while we are able to capture a broader universe. This broad universe of firms forms our full sample and, to address sample selection concerns, we further take steps to construct a matched sample. We compile our dataset using mainly three sources: Serrano, PAtLink and the Swedish Tax Agency.

3.1 Data sources

We obtain financial data and company information from Serrano, a database provided by the Swedish House of Finance National Research Data Center. Serrano gathers financial statement and bankruptcy data from the Swedish Companies Registration Office, general company data from Statistics Sweden and group data from Bisnode's group register. Serrano makes available five underlying datasets and a compiled dataset constructed out of these. In the latter, financials have been calendarized, and adjustments have been made for omissions and incomplete values. However, we encounter an issue as the compiled dataset only includes company level financials, even for firms that are part of a corporate group. For group companies, our analysis is best performed on consolidated financials. Hence, instead of using the compiled dataset, we construct our own by combining relevant variables from the underlying Serrano files. We take

steps to ensure comparability across firms and years, but recognize that this comes at the expense of losing some of the observations. We extract data for the longest time period possible in Serrano, leading to an unbalanced panel dataset from 1998 to 2019. We adjust financials to SEK millions of 2010 purchasing power using a consumer price index from Statistics Sweden.

Next, we collect data from PAtLink, a database with patent and trademark information, also available via the Swedish House of Finance. The patent file covers all patents of Swedish firms from 1990 to 2018, with data extracted from PATSTAT. From PAtLink, we obtain patent application count per firm-year and merge this variable into our database with financial and company information using company registration number as common identifier.

For our analysis, it is crucial to identify listing status per firm-year, and not just a static private and public firm status. As Serrano does not include such a variable, we instead gather this information from the Swedish Tax Agency. They have, on their website, company pages for all firms that are, or have been, listed on Nasdaq OMX Stockholm, NGM Main Regulated Equity, Nasdaq First North Sweden, Spotlight Stock Market and NGM Nordic SME. The company pages present a firm's registration number, stock market and listing date, as well as dates for potential delistings, share issues and name changes. The Swedish Tax Agency has gathered this information from the relevant marketplaces and company websites. As the information is not available in a downloadable format, we visit all company pages and manually collect company registration numbers, along with the dates of a company's listings and delistings, as well as the relevant stock exchange. In this way, our collected database reports the dates a firm changes its listing status. We define a firm as public those years it is listed on any of the stock markets covered by the Swedish Tax Agency, as these are the main markets in Sweden, and private otherwise. We treat the year a firm changes its status as an event year during which the firm is considered as neither public nor private. Our sample of public firms represents 1,229 unique public firms, before cleaning the data.

3.2 Sample construction

We impose several restrictions to construct our sample, with most of them being made to ensure valid and comparable observations. Each observation represents a firm-year, meaning that the data cleaning is performed on this level. Appendix B describes the number of observations dropped in each step. First, we exclude observations with a legal status other than limited liability company as these companies are likely to deviate in their investment behavior because of, for example, personal liability. Further, only limited liability companies can go public and such private firms are therefore a better comparison to publicly listed firms. Similarly, firms owned by the state, a county council or a municipality are dropped. We keep only observations that concern either independent firms or top parents in a corporate group reporting consolidated financial statements. Subsidiaries' and top parents' entity-level financials are thus excluded to eliminate the effect from overlapping financials, specific corporate structures and inter-company transactions on our results. To ensure comparability in our growth measures, we further take steps to exclude firm-years with shorter or longer accounting periods than the typical 12 months. Then, following standard practice, we exclude financial, insurance and real estate firms (two-digit Swedish Standard Industrial Classification (SNI) codes 64-66 and 68) and utility firms (SNI code 35-39), as these industries tend to be regulated and have to apply distinct accounting principles. We also drop observations for which the industry classification is missing.

Furthermore, we exclude inactive firm-years and firm-years under which a bankruptcy or liquidation was initiated, ongoing or completed, while keeping those before such events to avoid survivorship bias. We also restrict our sample to firm-years with audited financial statements, to avoid the impact from invalid data points. Additionally, it is required that firms follow basic accounting identities, defined as having non-negative sales and total assets. As we

are studying independent firms and corporate groups, the legal entities included in our sample should be operating. In that context, we impose a minimum required number of employees equal to one. Finally, we restrict our sample to firms with at least three years of consecutive sales and total assets greater than zero, to be able to construct lags and still have a data series. After the process of data cleaning, we have an unbalanced panel dataset with 2,076,598 private firm-year observations representing 224,276 private firms and 3,364 public firm-year observations representing 493 public firms.

As we do not set a minimum firm size requirement other than having assets and sales above zero, at least one employee, and audited financial statements, we will include many small firms in our sample. This is particularly likely in light of the fact that around 95% of all Swedish companies are small, with less than ten employees (Statistics Sweden, 2020). We recognize that this could increase the probability of outliers and high growth rates in our investment measures. Nevertheless, as our study aims to make a contribution in capturing a broad universe of firms, we instead adjust for this by winsorizing continuous variables in the full sample at a level of 2.5% at both tails, compared to for example, Asker et al. (2015) with a lower winsorizing level of 0.5%.

3.3 Matching

As can be seen in Table 1, public firms are on average around 360 times larger in terms of total assets than private firms in the full sample. The groups also differ in terms of their industry distributions, based on an analysis of SNI codes. We recognize the need to control for these differences due to that size and industry both have been shown to affect investment behavior (Gala and Julio, 2011; Jorgenson, 1971). We control for this in our regression equations, but as it could be that the differences are too large to fully account for in a linear model, we also account for them using a matching procedure. Our dataset is well-suited for matching as we have a large control group (private firms) compared to the treated group (public firms), increasing the probability of finding an appropriate private firm to match to the public firm. However, a potential concern raised by Asker et al. (2015) is that using a matching procedure leads to a comparison of the largest private firms with the smallest public firms as public firms on average are larger than private firms. To partially control for this, we perform parallel tests on the full and matched samples throughout our study.

In line with related literature (e.g., Gao et al., 2013; Michaely and Roberts, 2012; Asker et al., 2015), a one-to-one nearest neighbor matching procedure with replacement is adopted by calculating the propensity score using a probit regression. Since we use a matching procedure with replacement, bias is reduced because of better matches while at the same time reducing efficiency because of fewer unique observations (Smith and Todd, 2005).

As Table 1 demonstrates, public and private firms differ across numerous characteristics but the aim with matching is not to make the public and private groups as similar as possible, as this would bias the results, but rather to make them comparable across those dimensions expected to affect investment behavior. Therefore, for our baseline match, we follow Gao et al. (2013) and Asker et al. (2015), by creating nearest neighbors that match on size and industry. The firm-years are required to be within the exact same industry, based on three-digit SNI codes, and calendar year. For size, measured by total assets, we take further steps to reconstruct our sample with the aim of getting a finer match. This is done to reduce the impact of outliers on our matching process, while simultaneously wanting to benefit from as large a sample as possible for a more comprehensive conclusion.

Accordingly, we establish size requirements before and after matching. Specifically, a lower bound restriction is established by first identifying the smallest value of total assets (approximately SEK 0.128 million) for public firms in the full sample, and then scaling this value by 1.3 (around SEK 0.098 million). This is rounded to SEK 0.1 million and is used to

construct a condition; where private firms need to attain this level of total assets in order to be included in our matching procedure. We next winsorize at a finer level than for the full sample (now at 1% at both tails). Finally, after matching, the matched pairs are restricted to having a ratio of total assets (TA) less than 1.3 to get precise matches (i.e., $\max(TA_{public}, TA_{private}) / \min(TA_{public}, TA_{private}) < 1.3$). Asker et al. (2015) similarly use a ratio requirement for their baseline match, but they set the ratio to 2 instead of 1.3. We have to be more restrictive in order to get a good match, and therefore adopt a ratio requirement that Asker et al. (2015) include for robustness. The procedure results in 1,328 matched pairs of public and private firms-years respectively.

Figure 1 shows the size distributions of public and private firms before and after matching. We observe that post-matched public and private firms are much closer in size, indicating that the matching procedure was successful. This is further strengthened by Table 1, as the difference in total assets between public and private firms is no longer significantly different from 0 in the matched sample. Moreover, Rosenbaum and Rubin (1985) evaluate how matching on the propensity score drastically improves the standardized difference between the two studied groups, which in turn indicates a good match. This is done by showing the percent reduction in standardized differences and for our matched sample, we see one of 89.6%. In addition, to examine the robustness of our matching procedure, we match with different size and matching criteria.

3.4 Summary statistics

Table 1 shows descriptive statistics for public and private firms in the full and matched samples. By comparing the means of the two groups of firms in the full sample, we conclude that public firms are larger than private firms, both in terms of total assets and number of employees, while they in addition are older. Further, public firms are less profitable, hold less cash, and have lower debt levels as well as less retained earnings. Public firms also experience higher sales growth. These results are all significant at any reasonable rejection level. In the matched sample, public and private firms are no longer significantly different from each other along the dimension of total assets, which indicates a successful match. The signs of the differences between the two groups of firms have changed for some measures, compared to the full sample, most notably for cash holdings as the difference is no longer significant, as well as for the number of employees. It still holds true that public firms are less profitable, have lower debt levels and less retained earnings, and experience higher sales growth.

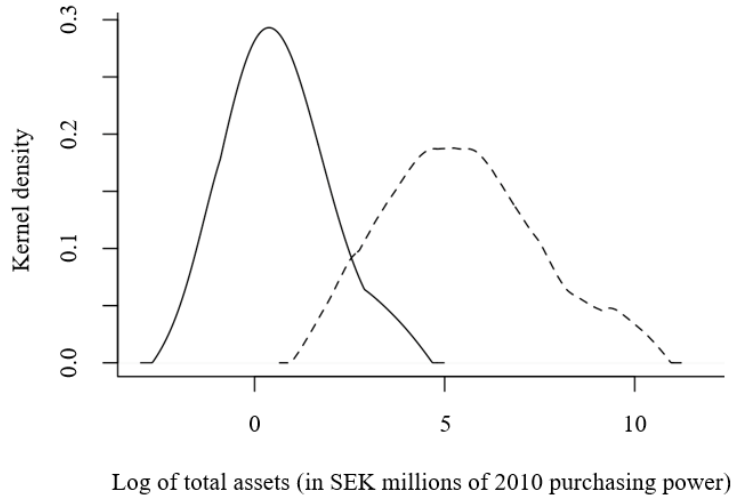
Based on a comparison of descriptive statistics for our matched sample with that of Asker et al. (2015), we find similar directions of the differences in means between public and private firms for most variables. The main differences between our findings and theirs lie in magnitudes and in that Asker et al. (2015) find a significant difference for cash holdings.

Table 1
Descriptive statistics

		Full sample			Matched sample		
		Public firms	Private firms	Differences in means or medians	Public firms	Private firms	Differences in means or medians
Firm size							
Total assets (MSEK)	Mean	1,653.5	4.6	1,648.9***	53.5	51.5	1.9
	Median	206.7	1.7	205.1***	42.6	41.9	0.7
	SD	4,308.6	8.4		41.1	37.8	
Investment opportunities							
Sales growth	Mean	0.285	0.047	0.238***	0.495	0.183	0.312***
	Median	0.088	0.011	0.077***	0.088	0.054	0.034*
	SD	0.797	0.357		1.707	0.622	
Firm characteristics							
ROA	Mean	-0.075	0.112	-0.187***	-0.251	0.098	-0.349***
	Median	0.027	0.080	-0.053***	-0.186	0.090	-0.276***
	SD	0.304	0.201		0.378	0.232	
Cash holdings	Mean	0.197	0.284	-0.087***	0.245	0.245	0.000
	Median	0.120	0.213	-0.093***	0.159	0.162	-0.003
	SD	0.203	0.261		0.236	0.238	
Book leverage	Mean	0.092	0.120	-0.028***	0.075	0.124	-0.049***
	Median	0.014	0.000	0.014***	0.000	0.017	-0.017***
	SD	0.132	0.195		0.122	0.182	
RE/TA	Mean	-0.082	0.167	-0.249***	-0.472	0.242	-0.714***
	Median	0.148	0.133	0.015***	0.014	0.222	-0.208***
	SD	0.931	0.250		1.697	0.349	
Number of employees	Mean	1,051.9	17.6	1,034.3***	42.7	695.1	-652.4***
	Median	92.0	3.0	89.0***	20.0	23.0	-3.0
	SD	3,982.8	940.0		69.5	6,057.0	
Age	Mean	20.0	15.0	5.0***	14.3	22.3	-8.0***
	Median	15.0	12.0	3.0***	13.0	16.0	-3.0***
	SD	19.8	11.8		9.3	21.4	
No. of observations		3,364	2,076,598		1,328	1,328	
No. of firms		493	224,276		293	1,003	

The table reports descriptive statistics (means, medians and standard deviations) for firm characteristics of public and private firms in the full and matched samples. *, ** and *** denote that the differences in means (medians) are significant at 10%, 5% and 1%, respectively, based on the p-value of a two-sided *t*-test (Wilcoxon rank-sum test). Each observation represents a firm-year and the time period covered by the data is 1998 to 2019. Fiscal years ending on or before May 31 are considered as ending the previous calendar year, but the financial values are not calendarized. All monetary units are reported in SEK millions of 2010 purchasing power and continuous variables, except number of employees and age, are winsorized at the 2.5% (1.0%) level at both tails for the full (matched) sample. There are unreported variations in the number of observations per firm characteristic, which can be explained by missing values. All variables are defined in Appendix A.

Panel A. Full sample



Panel B. Matched sample

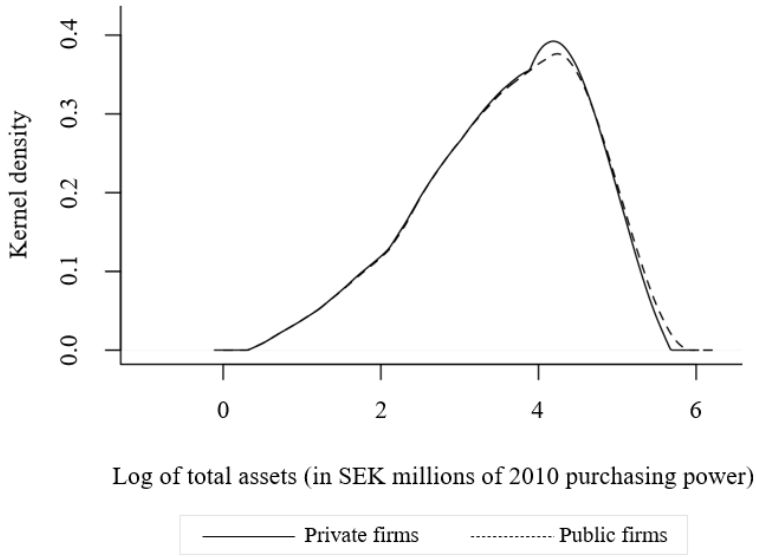


Figure 1
Pre- and post-matched size distributions for public and private firms
Panel A shows the size distribution of private (full line) and public (dashed line) firms in the full sample using Epanechnikov kernel densities with bandwidth 0.4. Size is measured as the natural logarithm of winsorized total assets measured in SEK millions of 2010 purchasing power. Each observation represents a firm-year. Panel B shows a similar distribution for private (full line) and public (dashed line) firms in the matched sample.

3.5 Outcome variables

We construct three categories of outcome variables; investment in assets, human capital and innovation. These categories have been studied together in other corporate investment studies (e.g., Bena et al., 2017), but we are not aware of any single study comparing the investment behavior of public and private firms along these three dimensions simultaneously. The extension is relevant as it, firstly, contributes to our understanding of the consequences on investment of going public. It could be that public equity is equally important, or detrimental, for all or some of the investment categories. Secondly, it enhances our understanding of the mechanism underlying the results. For example, firms under short-termist pressures could continue to invest in assets, as this is observed on the balance sheet, but stop investing in human capital and innovation, as these are hard-to-measure assets (Stein, 2003). Thus, studying only one category could distort the view of the underlying mechanism.

3.5.1 Investment in assets. Assets are at the core of corporate investment behavior and applicable to all firms. Thus, this investment category forms the basis of our research, and as it is also the focus in Asker et al. (2015), it allows for a comparison. We cover tangible, intangible and total fixed assets, as well as total assets, measured as the difference between end-of-year and beginning-of-year balance. Capital expenditures (CapEx) is another commonly used investment measure, but as all private firms are not required to include cash flow statements in their annual reports, we cannot study it as reported. Instead, we approximate CapEx by computing the annual change in tangible fixed assets, then adding the annual change in intangible fixed assets and depreciation and amortization. Ideally, we would calculate the change in tangible fixed assets and add only depreciation. However, as Serrano does not distinguish between depreciation and amortization, we include intangible fixed assets in our definition. All measures of investment in assets are divided by beginning-of-year total assets to adjust for firm size.

3.5.2 Investment in human capital. Given that firms might underinvest in hard-to-measure assets to boost current earnings (Stein, 2003), we acknowledge that it would have been ideal to study measures that are not reported in the financial statements, such as employee training. However, as such data is not available for our sample, we study investment in human capital by measuring the annual change in (logged) number of employees, personnel expenses to sales, and personnel expenses per employee. Decreases in these measures could indicate that firms stop recruiting or delocalize their production, which could boost short-term profits at the expense of long-term performance (Bena et al., 2017).

3.5.3 Investment in innovation. Innovation input is measured by research and development (R&D) expenditures, but as this income statement item only is available for firms with financial statements classified by the nature of expense, we get a relatively low number of observations for our R&D measure. We complement R&D by studying patent count, a measure of innovation output. Patent measures do not perfectly measure innovation activity, but are widely accepted (Lerner et al., 2011). While being aware of the disadvantage of patent count, as it does not capture differences between breakthrough innovation and incremental discoveries (Griliches, 1990), we argue that it still reflects relevant aspects of investment. Patent count is measured as per application year and is assumed to be zero for firm-years for which no patent data is available via PAtLink, in line with other papers (Bena et al., 2017). In our regressions, we measure patent count by the natural logarithm of one plus patent count.

3.5.4 Investment opportunities. In addition to investment level, we study investment sensitivity. Of the two commonly used proxies for investment opportunities – sales growth and Tobin's *q* – the former is most suitable for our study as Tobin's *q* requires market capitalization, a measure not available for private firms. We thus proxy investment opportunities using sales growth, which is in line with related literature (e.g., Michaely and Roberts, 2012; Asker et al., 2015).

4. Differences in Investment Behavior Between Public and Private Firms

4.1 Investment levels

4.1.1 Hypothesis testing: differences in investment levels. Table 2 presents investment levels of public and private firms, and the result from a comparison of their means and medians. In the full sample, public firms invest more than private firms in all three investment categories and for all investment measures within those categories. For example, public firms' total fixed asset base increases by 8.2% of total assets a year on average, compared to 0.7% for private firms. This difference of 7.5 percentage points is statistically significant at below the 1% level and economically meaningful as the difference comprises a large part of total assets. For the other asset investment measures, public firms continue to outinvest private firms, although with fluctuating magnitude as the differences in means range between 1.2 percentage points (tangible fixed assets) and 11.3 percentage points (total assets). Public firms' investment levels in human capital and innovation also exceed those of private firms.

Turning to the size and industry matched sample, the signs of the differences in means and medians between public and private firms remain for most of the investment measures. Based on mean values and a 1% significance level, public firms invest more than private firms in intangible fixed assets, total fixed assets, CapEx, personnel expenses and R&D. These results contrast those of Asker et al. (2015), as their corresponding analysis shows higher investment levels among private firms. Nevertheless, descriptive statistics in Michaely and Roberts (2012) show that U.K. public firms invest more in fixed assets, and Gao et al. (2018) report that U.S. public firms have higher levels of CapEx and R&D but lower property, plant and equipment (PP&E). We thus recognize that other studies have found similar differences between public and private firms, without controlling for differences between the two groups, on similar dimensions as us.

As average values can be largely affected by outliers, continuous variables are winsorized at 2.5% at both tails in the full sample and at 1% at both tails in the matched sample. Unreported analysis shows that our results are robust to different winsorizing levels. One alternative approach to reduce the impact of outliers would have been to mostly analyze medians instead of averages. However, in accordance with most work on corporate investment, we rely on averages because of lumpiness in investment (Thomas, 2002).

Table 2
Investment levels

		Full sample			Matched sample		
		Public firms	Private firms	Differences in means or medians	Public firms	Private firms	Differences in means or medians
Investment in assets							
Tangible fixed assets	Mean	0.013	0.001	0.012***	0.011	0.017	-0.006
	Median	0.000	-0.007	0.007***	-0.001	-0.002	0.001
	SD	0.066	0.104		0.092	0.114	
Intangible fixed assets	Mean	0.055	-0.001	0.056***	0.061	-0.002	0.063***
	Median	0.000	0.000	0.000***	0.000	0.000	0.000
	SD	0.210	0.006		0.339	0.024	
Total fixed assets	Mean	0.082	0.007	0.075***	0.081	0.043	0.038***
	Median	0.009	-0.008	0.017***	-0.001	-0.002	0.001*
	SD	0.283	0.135		0.409	0.179	
Total assets	Mean	0.174	0.061	0.113***	0.158	0.153	0.005
	Median	0.045	0.010	0.035***	-0.008	0.055	-0.063***
	SD	0.538	0.320		0.702	0.416	
CapEx	Mean	0.122	0.053	0.059***	0.146	0.065	0.081***
	Median	0.036	0.004	0.032***	0.039	0.012	0.027***
	SD	0.275	0.126		0.417	0.167	
Investment in human capital							
Change in number of	Mean	44.8	0.5	44.3***	1.0	-27.3	28.2
employees	Median	2.0	0.0	2.0***	0.0	0.0	0.0*
	SD	371.1	107.3		27.1	721.1	
Personnel expenses to sales	Mean	1.006	0.368	0.638***	1.773	0.419	1.354***
	Median	0.454	0.341	0.113***	0.549	0.332	0.217***
	SD	2.054	0.219		4.378	0.351	
Personnel expenses per	Mean	0.650	0.354	0.296***	0.667	0.562	0.105***
employee	Median	0.629	0.351	0.278***	0.651	0.533	0.118***
	SD	0.236	0.183		0.246	0.216	
Investment in innovation							
R&D	Mean	0.287	0.002	0.285***	1.724	0.066	1.658***
	Median	0.016	0.000	0.016***	0.423	0.000	0.423***
	SD	0.772	0.008		4.222	0.089	
Patent	Mean	2.7	0.0	2.6***	0.8	0.6	0.2
	Median	0.0	0.0	0.0***	0.0	0.0	0.0***
	SD	17.0	10.1		3.5	5.3	
No. of observations		3,364	2,076,598		1,328	1,328	
No. of firms		493	224,276		293	1,003	

The table reports descriptive statistics (means, medians and standard deviations) for firm characteristics of public and private firms in the full and matched samples. *, ** and *** denote that the differences in means (medians) are significant at 10%, 5% and 1%, respectively, based on the p-value of a two-sided *t*-test (Wilcoxon rank-sum test). Each observation represents a firm-year and the time period covered by the data is 1998 to 2019. Fiscal years ending on or before May 31 are considered as ending the previous calendar year, but the financial values are not calendarized. All monetary units are reported in SEK millions of 2010 purchasing power and continuous variables, except change in number of employees and patent count, are winsorized at the 2.5% (1.0%) level at both tails for the full (matched) sample. There are unreported variations in the number of observations per firm characteristic, which can be explained by missing values. All variables are defined in Appendix A.

4.1.2 Investment level regressions for the full sample. The preceding comparison based on average investment levels suggests that public firms invest more than private firms. However, this analysis does not account for the fact that public and private firms could have different investment opportunities. Thus, we next build a regression model that includes sales growth as a measure of investment opportunities. The model further includes profitability, measured by return on assets (ROA). Following Asker et al. (2015) and standard investment literature, it takes the following form:

$$investment_{it} = \alpha * PUBLIC_{it} + \beta * sales\ growth_{it} + \delta * ROA_{it} + \varphi_j + \eta_t + \varepsilon_{it} \qquad (1)$$

i, *j* and *t* denote firms, industries and years, respectively. *Investment* concerns one of the investment measures defined in Appendix A. *PUBLIC* is a dummy variable that assumes the value 1 (0) if the firm-year belongs to a public (private) firm. The variables *sales growth* and *ROA* are calculated according to the definitions in Appendix A. Further, the regression model includes industry fixed effects, φ_j, and year fixed effects, η_t, to control for industry- and year-specific heterogeneity. The regression model does not include firm fixed effects since it overlaps with the main variable of interest, the public dummy. As firm fixed effects absorb all that is constant about a firm, and the sample of firms that change their status from public to private, or vice versa, is relatively small, the firm fixed effects would also include the public dummy variable.

Table 3 presents ordinary least squares (OLS) regression results.[1] For investment in assets, the public dummy has a positive and statistically significant coefficient estimate regardless of how we measure investment. The positive sign of the coefficients means that public firms invest more in assets than private firms, in line with the full sample results found in Table 2. The differences range between 1.1 percentage points for tangible fixed assets to 18.7 percentage points for total assets. These results are economically indicative. For our human capital measures, we see a reinforcing pattern as public firms invest somewhat more in employee count (1.3 percentage points), while investment in personnel expenses to sales and average personnel cost per employee are substantially higher in comparison to private firms (54.7 and 22.8 percentage points, respectively). Thus, public firms seem to invest more not only in physical capital, but also in human capital. Further, the regression results illustrate that public firms invest more in innovation input (R&D) and innovation output (patent count).

[1] Ideally, standard errors would be heteroscedasticity-consistent and clustered at the firm level. However, for our standard regressions with industry fixed effects based on three-digit SNI codes, our statistical software lacks the capacity to perform such regressions because of the large-scale dataset. To address this potential concern, we run the same regressions, but rather with industry fixed effects based on two-digit SNI codes, for the full sample in order to incorporate heteroscedasticity-consistent standard errors (unreported analysis). Although we do observe some differences in standard errors and *t*-statistics, the direction and significance level of the coefficient estimates are not affected by this. Thus, this issue does not impact the conclusions.

Table 3
OLS estimates for differences in investment levels between public and private firms (equation (1), full sample)

	Investment in assets					Investment in human capital			Investment in innovation	
	Tangible fixed assets	Intangible fixed assets	Total fixed assets	Total assets	CapEx	Change in number of employees	Personnel expenses to sales	Personnel expenses per employee	R&D	Patent
PUBLIC	0.011***	0.058***	0.079***	0.187***	0.075***	0.013***	0.547***	0.228***	0.229***	0.251***
	(6.1)	(306.4)	(33.0)	(41.8)	(34.7)	(2.9)	(126.0)	(61.5)	(55.7)	(165.0)
Sales growth	0.035***	0.000***	0.039***	0.278***	0.053***	0.261***	-0.041***	0.047***	0.009***	0.005***
	(154.5)	(3.6)	(132.7)	(508.1)	(202.1)	(469.5)	(-91.8)	(123.8)	(4.1)	(26.7)
ROA	0.046***	0.001***	0.087***	0.723***	0.031***	-0.036***	-0.160***	0.072***	-0.115***	-0.010***
	(112.9)	(24.3)	(166.1)	(731.2)	(65.4)	(-36.2)	(-200.2)	(105.9)	(-28.0)	(-31.2)
Observations	1,832,646	1,832,642	1,832,650	1,832,650	1,832,650	1,832,650	1,795,095	1,795,095	37,571	1,832,650
R^2	3.4%	5.9%	4.2%	39.7%	10.0%	11.7%	24.1%	12.3%	24.6%	4.2%
Adjusted R^2	3.4%	5.9%	4.2%	39.7%	10.0%	11.7%	24.1%	12.3%	24.1%	4.2%
F statistic	250.8***	443.7***	310.9***	4,628.9***	782.0***	929.5***	2,179.1***	968.7***	55.5***	308.6***

The table reports OLS coefficients from estimating equation (1) for the full sample. *, **, and *** denote that a coefficient is significant at the 10%, 5% and 1% level, respectively. Each observation represents a firm-year and the time period covered by the data is 1998 to 2019. Fiscal years ending on or before May 31 are considered as ending the previous calendar year, but the financial values are not calendarized. Continuous variables, except the change in logged number of employees and logged patent count, are winsorized at the 2.5% level at both tails. Variations in the number of observations can be explained by missing values. *t*-statistics are reported in parentheses below each coefficient. Dependent and independent variables are defined in Appendix A.

As reported in parentheses under the coefficients in Table 3, the *t*-statistics are high. While this indicates that the results are statistically significant at any reasonable rejection level, we remark that the values are unusually high. In unreported analysis, we estimate equation (1) for the public and private groups separately. From this, we conclude that the high *t*-statistics are driven by the large sample of private firms, meaning that we get very significant results for this group. To further address the subject at hand, we specify investment regression model (2), in which we control for more variables that are commonly used in corporate investment literature. More specifically, we control for size (*log assets*) and change in cash holdings (*change cash*). As Table 1 shows, the public and private firms in the full sample are statistically different along these dimensions. In other aspects, model notation follows that of equation (1).

$$investment_{it} = \alpha * PUBLIC_{it} + \beta * sales\ growth_{it} + \delta * ROA_{it} + \phi * log\ assets_{it} + \omega * change\ cash_{it} + \varphi_j + \eta_t + \varepsilon_{it} \quad (2)$$

The new regression results, presented in Table 4, show that our conclusions for intangible fixed assets, total fixed assets, total assets and CapEx are not altered when controlling for more variables. For these investment measures, the public dummy coefficient remains positive and significant below the 1% level, with public firms' investment level exceeding that of private firms by between 2.9 percentage points (total fixed assets) and 5.9 percentage points (intangible fixed assets). However, for change in tangible fixed assets, the sign of the public dummy is flipped compared to equation (1), showing that tangible fixed assets, as a percentage of total assets, grow 2.7 percentage points less per year for public firms compared to private firms. One potential explanation for the flipped sign is that public firms tend to be larger than private firms (Table 1) and, on average, larger firms invest more in tangible fixed assets. Similarly, this could explain the flipped sign of the public dummy coefficient of the change in (logged) number of employees, as larger firms tend to have more employees, motivated by the fact that employee count sometimes is used as a measure of firm size. With this flipped sign, public firms invest less in acquiring new employees (employee count) but more in their existing employees (personnel expenses) compared to private firms. The coefficients of the public dummy for the innovation measures remain similar, both in terms of sign and magnitude.

Table 4
OLS estimates for differences in investment levels between public and private firms (equation (2), full sample)

	Investment in assets					Investment in human capital			Investment in innovation	
	Tangible fixed assets	Intangible fixed assets	Total fixed assets	Total assets	CapEx	Change in number of employees	Personnel expenses to sales	Personnel expenses per employee	R&D	Patent
PUBLIC	-0.027***	0.059***	0.029***	0.054***	0.043***	-0.041***	0.615***	0.018***	0.243***	0.234***
	(-14.5)	(308.7)	(12.6)	(12.6)	(19.8)	(-8.9)	(141.6)	(5.4)	(53.7)	(152.7)
Sales growth	0.039***	0.000***	0.048***	0.240***	0.057***	0.259***	-0.037***	0.034***	0.007***	0.004***
	(172.4)	(8.7)	(168.8)	(455.2)	(214.3)	(460.7)	(-82.9)	(97.0)	(3.4)	(20.0)
ROA	0.071***	0.002***	0.144***	0.540***	0.054***	-0.039***	-0.151***	0.036***	-0.125***	-0.015***
	(163.0)	(33.1)	(258.7)	(525.0)	(103.6)	(-35.9)	(-172.9)	(52.7)	(-28.4)	(-39.6)
Log assets	0.011***	-0.000***	0.015***	0.027***	0.009***	0.014***	-0.019***	0.057***	-0.004***	0.004***
	(168.0)	(-35.3)	(182.5)	(181.6)	(121.3)	(86.8)	(-146.3)	(570.5)	(-7.9)	(78.4)
Change cash	-0.084***	-0.001***	-0.173***	0.426***	-0.074***	-0.016***	0.008***	-0.007***	0.045***	0.003***
	(-188.5)	(-18.9)	(-302.8)	(403.6)	(-139.6)	(-14.6)	(8.8)	(-9.5)	(10.1)	(8.4)
Observations	1,832,646	1,832,642	1,832,650	1,832,650	1,832,650	1,832,650	1,795,095	1,795,095	37,571	1,832,650
R^2	6.7%	6.0%	10.4%	45.5%	11.7%	12.1%	25.0%	25.8%	24.9%	4.5%
Adjusted R^2	6.7%	6.0%	10.4%	45.5%	11.7%	12.1%	25.0%	25.8%	24.4%	4.5%
F statistic	501.0***	446.8***	807.0***	5,825.4***	921.2***	955.9***	2,270.2***	2,373.6***	56.0***	330.9***

The table reports OLS coefficients from estimating equation (2) for the full sample. *, **, and *** denote that a coefficient is significant at the 10%, 5% and 1% level, respectively. Compared to Table 3, Table 4 includes *log assets* and *change cash* as additional variables. Each observation represents a firm-year and the time period covered by the data is 1998 to 2019. Fiscal years ending on or before May 31 are considered as ending the previous calendar year, but the financial values are not calendarized. Continuous variables are winsorized at the 2.5% level at both tails, except change in logged number of employees and logged patent count. Variations in the number of observations can be explained by missing values. *t*-statistics are reported in parentheses below each coefficient. Dependent and independent variables are defined in Appendix A.

4.1.3 Investment level regression for the matched sample. We note that it is possible that public and private firms are different on observed and unobserved dimensions, even though we control for some variables in our regression equations in the full sample. By matching, we partially address this potential issue. Further, in section 4.1.2, we concluded that the high *t*-statistics presented in Table 3 are driven by the large sample of private firms. As the sample size of private firms is notably reduced in the matched sample, the matched sample will help us understand if the previous results that public firms invest more than private firms are likely to be robust. Table 5 reports the regression results from estimating equation (1) in the baseline size and industry matched sample.

For six out of ten investment measures, the public dummy coefficient loses its statistical significance in the matched sample compared to the full sample. While the public dummy coefficients for tangible fixed assets, total assets and change in the number of employees are now negative, we cannot reject that they could be zero (or positive) and, hence, we do not find evidence that public firms invest less than private firms in these asset classes. For the coefficients that remain significant, we still observe that public firms have higher investment levels than private firms. More specifically, public firms invest in intangible fixed assets, as a percentage of total assets, by 3.8 percentage points more than private firms, and they invest significantly more in their current employees as measured by personnel expenses to sales and per employee, as well as in patents. These results are robust to matching using different size restrictions as well as on more variables (Appendix C).

4.2 Investment sensitivities

Investment sensitivity concerns how a firm reacts to changes in investment opportunities. Analyzing how public and private firms compare in this regard complements the view given by investment level in our study of investment behavior. The following regression model forms the basis of the investment sensitivity analysis, in line with Asker et al. (2015) and the *q* theory literature:

$$investment_{it} = \alpha * sales\ growth_{it} + \beta * PUBLIC_{it} * sales\ growth_{it} + \delta * ROA_{it} + \phi * PUBLIC_{it} * ROA_{it} + \varphi_j + \eta_t + \varepsilon_{it} \quad (3)^2$$

Consistent with regression equations (1) and (2), we measure investment opportunities by sales growth, and we now interact the public dummy variable with sales growth (*PUBLIC * sales growth*) to study if public and private firms react differently to investment opportunities. Further, the public dummy interacts with profitability (*PUBLIC * ROA*). Variables are further defined in Appendix A.

[2] Asker et al. (2015) include firm fixed effects instead of industry fixed effects in their investment sensitivity regression equation, as this is possible when the public dummy interacts with other variables. However, as our software package is not able to perform such regressions for our large dataset, we keep industry fixed effects as in equation (1) and (2). This should be considered when comparing our results with those of Asker et al. (2015).

Table 5
OLS estimates for differences in investment levels between public and private firms (equation (1), matched sample)

	Investment in assets					Investment in human capital			Investment in innovation	
	Tangible fixed assets	Intangible fixed assets	Total fixed assets	Total assets	CapEx	Change in number of employees	Personnel expenses to sales	Personnel expenses per employee	R&D	Patent
PUBLIC	-0.005	0.038***	0.014	-0.011	0.015	-0.025	0.455***	0.082***	0.769	0.048**
	(-1.1)	(3.5)	(1.0)	(-0.5)	(1.1)	(-1.4)	(3.4)	(7.8)	(1.5)	(2.1)
Sales growth	0.010***	0.047***	0.066***	0.128***	0.070***	0.105***	-0.061	0.000	0.071	0.001
	(6.1)	(12.5)	(13.5)	(14.4)	(14.3)	(17.5)	(-1.3)	(0.1)	(0.4)	(0.2)
ROA	0.011*	-0.031**	-0.012	0.063*	-0.129***	-0.001	-2.425***	-0.058***	-1.963***	-0.163***
	(1.7)	(-2.0)	(-0.6)	(1.7)	(-6.3)	(0.0)	(-12.4)	(-3.8)	(-2.8)	(-5.0)
Observations	2,504	2,504	2,504	2,504	2,504	2,504	2,208	2,208	296	2,504
R^2	10.3%	12.2%	11.7%	13.0%	15.8%	16.1%	21.1%	21.7%	24.3%	22.5%
Adjusted R^2	6.5%	8.4%	8.0%	9.3%	12.2%	12.5%	17.3%	17.9%	7.3%	19.2%
F statistic	2.7***	3.3***	3.1***	3.5***	4.4***	4.5***	5.5***	5.7***	1.4**	6.8***

The table reports OLS coefficients from estimating equation (1) for the baseline matched sample. *, **, and *** denote that a coefficient is significant at the 10%, 5% and 1% level, respectively. Each observation represents a firm-year and the time period covered by the data is 1998 to 2019. Fiscal years ending on or before May 31 are considered as ending the previous calendar year, but the financial values are not calendarized. Continuous variables are winsorized at the 1.0% level at both tails, except change in logged number of employees and logged patent count. Variations in the number of observations can be explained by missing values. *t*-statistics are reported in parentheses below each coefficient. Dependent and independent variables are defined in Appendix A.

For all investment measures in the full sample (Table 6A), the direction of the coefficient estimates of the *PUBLIC * sales growth* variable, β, mirror that of the public dummy for equation (2). This means that public firms not only invest more in intangible fixed assets, total fixed assets, total assets, CapEx, personnel expenses to sales and per employee, and innovation, but they are also more sensitive towards investment opportunities for these measures. Similarly, public firms both invest less in and are less sensitive to investment opportunities for tangible fixed assets and change in (logged) number of employees, compared to private firms. Though, the difference in investment sensitivity is quite small for tangible fixed assets, being 1.2 percentage points lower for public firms.

In the matched sample (Table 6B), public firms react differently than private firms towards investment opportunities in assets. More specifically, public firms show higher investment sensitivity for intangible fixed assets, total fixed assets and CapEx, and lower investment sensitivity for total assets. Lower investment sensitivity among public firms is also seen for patent count. For the other investment measures, we generally cannot reject the null hypothesis that there is no difference between public and private firms' investment sensitivities.[3]

4.3 Interpretation of results from the full and matched samples

In the full sample, representing a broad universe of firms, public firms show higher investment levels and investment sensitivities for eight out of ten investment measures.[4] The differences between public and private firms are larger in magnitude for the eight measures for which public firms invest more, compared to the two measures for which private firms have higher investment levels. We see no systematic difference between the three investment categories. Rather, the finding that public firms invest more and are more sensitive to changes in investment opportunities apply to all categories; assets, human capital and innovation. Hence, while Asker et al. (2015) find that short-termist pressures distort the investment behavior of public and private firms, we instead find evidence in line with the financing or empire-building hypothesis. Our results are thus more in line with Gilje and Taillard (2016) on this dimension, as they find that public firms are more sensitive to investment opportunities. Their results are driven by public firms' better access to capital, and they reject that it would be related to an overinvestment problem. To disentangle whether public firms' higher investment levels are due to better access to financing alleviating an underinvestment problem, or public firm managers' overinvestment tendencies, we analyze these two channels in section 5.

Turning to the size and industry matched sample, the results are generally less statistically significant. However, for the public dummy coefficients that remain significant, it still holds that public firms invest more than private firms. More specifically, public firms invest more in intangible fixed assets, personnel expenses to sales, personnel expenses per employee and patents. Human capital thus seems to be an important investment category for public firms in the matched sample. Results are more varying for investment sensitivities. The differences between the full and matched sample could stem from that the matched sample constitutes a certain group of firms, namely the smallest public firms and the largest private firms. These firms' investment behavior could deviate from that of the broader firm universe. Given that the matched sample gives a somewhat different view, we also construct a sample of transition firms for robustness.

[3] For investment in (logged) number of employees, there is a significant difference at the 10% level but we consider this to be a high rejection level, especially in light of the fact that the other investment measures for human capital are insignificant.

[4] These conclusions are based on equation (2) for investment level and equation (3) for investment sensitivity.

Table 6
OLS estimates for differences in investment sensitivities between public and private firms (equation (3))

Panel A. Full sample

	Investment in assets					Investment in human capital			Investment in innovation	
	Tangible fixed assets	Intangible fixed assets	Total fixed assets	Total assets	CapEx	Change in number of employees	Personnel expenses to sales	Personnel expenses per employee	R&D	Patent
Sales growth	0.035***	-0.001***	0.038***	0.277***	0.053***	0.262***	-0.043***	0.047***	-0.005***	0.005***
	(154.3)	(-26.2)	(129.2)	(504.3)	(198.5)	(468.3)	(-98.2)	(123.7)	(-2.7)	(25.6)
*PUBLIC * Sales growth*	-0.012***	0.087***	0.097***	0.030***	0.079***	-0.047***	0.124***	0.025***	0.080***	0.074***
	(-5.5)	(393.2)	(34.5)	(5.6)	(31.0)	(-8.8)	(26.3)	(6.2)	(14.4)	(41.1)
ROA	0.046***	0.001***	0.088***	0.725***	0.032***	-0.038***	-0.152***	0.072***	-0.012***	-0.011***
	(112.5)	(29.1)	(166.5)	(731.9)	(66.2)	(-37.4)	(-191.0)	(105.2)	(-3.1)	(-31.2)
*PUBLIC * ROA*	-0.036***	0.015***	-0.053***	-0.747***	-0.081***	0.097***	-2.614***	-0.350***	-1.489***	-0.346***
	(-6.1)	(24.3)	(-7.0)	(-52.2)	(-11.8)	(6.6)	(-197.3)	(-30.7)	(-114.4)	(-70.8)
Observations	1,832,646	1,832,642	1,832,650	1,832,650	1,832,650	1,832,650	1,795,095	1,795,095	37,571	1,832,650
R^2	3.4%	8.9%	4.3%	39.8%	10.0%	11.7%	25.2%	12.2%	39.7%	3.2%
Adjusted R^2	3.4%	8.9%	4.2%	39.8%	10.0%	11.7%	25.2%	12.2%	39.4%	3.2%
F statistic	249.9***	686.0***	310.9***	4,619.0***	779.4***	926.6***	2,311.6***	953.5***	112.0***	232.2***

(continued)

Table 6
Continued

Panel B. Matched sample

	Investment in assets					Investment in human capital			Investment in innovation	
	Tangible fixed assets	Intangible fixed assets	Total fixed assets	Total assets	CapEx	Change in number of employees	Personnel expenses to sales	Personnel expenses per employee	R&D	Patent
Sales growth	0.015***	-0.002	0.025*	0.174***	0.028**	0.131***	-0.129	0.018	-0.080	0.047**
	(3.3)	(-0.2)	(1.8)	(7.0)	(2.0)	(7.7)	(-1.0)	(1.7)	(-0.2)	(2.2)
*PUBLIC * Sales growth*	-0.006	0.056***	0.046***	-0.058**	0.046***	-0.031*	0.059	-0.019	0.218	-0.051**
	(-1.3)	(4.9)	(3.1)	(-2.2)	(3.2)	(-1.7)	(0.4)	(-1.6)	(0.5)	(-2.2)
ROA	0.043***	-0.021	0.083**	0.493***	-0.074**	0.024	-0.874**	-0.070**	0.383	-0.214***
	(3.5)	(-0.8)	(2.3)	(7.5)	(-2.0)	(0.5)	(-2.5)	(-2.5)	(0.3)	(-3.7)
*PUBLIC * ROA*	-0.041***	-0.036	-0.134***	-0.607***	-0.078*	-0.018	-2.647***	-0.074**	-3.674***	0.007
	(-2.8)	(-1.0)	(-3.0)	(-7.6)	(-1.8)	(-0.3)	(-6.2)	(-2.1)	(-2.7)	(0.1)
Observations	2,504	2,504	2,504	2,504	2,504	2,504	2,208	2,208	296	2,504
R^2	10.6%	12.7%	12.4%	15.2%	16.3%	16.1%	22.1%	19.7%	26.1%	22.5%
Adjusted R^2	6.8%	8.9%	8.6%	11.5%	12.7%	12.5%	18.3%	15.8%	9.2%	19.2%
F statistic	2.8***	3.4***	3.3***	4.2***	4.5***	4.5***	5.8***	5.0***	1.5**	6.8***

Panel A reports the OLS coefficients from estimating equation (3) for the full sample. Panel B provides the same output report, but for the matched sample. *, **, and *** denote that a coefficient is significant at the 10%, 5% and 1% level, respectively. Each observation represents a firm-year and the time period covered by the data is 1998 to 2019. Fiscal years ending on or before May 31 are considered as ending the previous calendar year, but the financial values are not calendarized. Continuous variables are winsorized at 2.5% at both tails in the full sample and at 1.0% in the matched sample, except change in logged number of employees and logged patent count. Variations in the number of observations can be explained by missing values. *t*-statistics are reported in parentheses below each coefficient. Dependent and independent variables are defined in Appendix A.

4.4 Transition sample

The transition sample includes those firms that transition from private to public during our studied time period. By comparing the same firm as both a public and private entity, we mitigate sample selection concerns. Nevertheless, the sample is associated with some other methodology concerns as the time surrounding an IPO is unique, and firms commonly go public to fund new investments (Brau and Fawcett, 2006). Nevertheless, the transition group complements our analysis of the full and matched samples, especially considering less significant results in the latter.

We identify transition firms by limiting the full sample to those firms that change their listing status from private to public via an IPO. Next, we require that the firms have at least three years of data both prior to, and following, the IPO. This leaves us with a sample of 1,187 firm-years, belonging to 100 unique firms. We modify investment level equation (1) to include firm fixed effects instead of industry fixed effects.[5] The OLS regression results are presented in Appendix D. To a large extent, we find similar patterns as those observed in the full and matched samples. At a significance level of 5% or below, firms invest more in intangible fixed assets, total fixed assets, personnel expenses to sales and per employee, and R&D, when they are public compared to when they are private. For all investment measures that are significant, the transition firms invest more when they are public, in line with the findings concluded from the main analysis.

5. Potential Explanations

The results in section 4 suggest that public firms invest more than private firms. This result is in line with either the financing hypothesis or the empire-building hypothesis, as presented in section 2.2. The financing hypothesis indicates that public firms' investment behavior is efficient, while the empire-building hypothesis indicates the opposite. Hence, it is of interest and importance to understand the underlying mechanism. In this section, we use an empirical approach, built around positive and negative investment opportunities, that allows us to examine the empire-building hypothesis and the financing hypothesis simultaneously. The analysis focuses on the full sample, as this is where public firms' higher investment levels are particularly evident, which makes it the most appropriate sample for an extended analysis.

5.1 Theory and testable implications

Under the financing hypothesis, public firms are expected to have better access to financing (Bharath and Dittmar, 2010; Campello et al., 2011; Saunders and Steffen, 2011), compared to financially constrained private firms. This allows public firms to take better advantage of good investment opportunities. Under the empire-building hypothesis, public firm managers are expected to overinvest (Jensen, 1986), regardless of whether investment opportunities are good or bad. Thus, both hypotheses generate testable implications in the context of investment opportunities. We aim to find evidence of the channel driving the results, or rule out one of the explanations, by studying how public and private firms react to positive and negative investment opportunities. As an extension of our investment level equation (1), we build the following regression model:

$$investment_{it} = \alpha_0 + \beta_1 * I(SG^+)_{it} * PUBLIC_{it} + \beta_2 * I(SG^-)_{it} * PUBLIC_{it} + \delta * sales\ growth_{it} + \phi * ROA_{it} + \varphi_j + \eta_t + \varepsilon_{it} \quad (4)$$

[5] The following investment level regression equation is estimated for the transition group:
$investment_{it} = \alpha * PUBLIC_{it} + \beta * sales\ growth_{it} + \delta * ROA_{it} + \mu_i + \eta_t + \varepsilon_{it}$,
where μ_i represents firm fixed effects. Other variables are defined according to equation (1) in section 4.1.2.

Notation follows that of equation (1). *I(SG+)* is a dummy variable categorized based on sales growth which assumes the value 1 (0) if sales growth is positive (negative). Contrastingly, the *I(SG-)* dummy takes the value 1 (0) if sales growth is negative (positive). *I(SG+)* and *I(SG-)* each interact with the public dummy as separate entities. Good investment opportunities are captured by positive sales growth and bad investment opportunities are captured by negative sales growth. Variables are further defined in Appendix A.

The testable implications focus on β_1 and β_2 as these are the coefficient estimates showing how public firms invest differently from private firms. If the financing hypothesis dominates, we would expect public firms to invest more when investment opportunities are good as financially constrained private firms cannot invest to the same extent. β_1 would thus be positive as the coefficient adds to the average investment level, the intercept, when *I(SG+)* assumes the value 1, and a negative sign would reject the hypothesis. When investment opportunities are bad, it would be sound firm behavior to disinvest. This would lead to a conclusion that financially unconstrained public firms disinvest more than financially constrained private firms. However, due to stickiness in downturns as physical and human capital is difficult to rebuild once sold, it could be that unconstrained public firms are better positioned to keep their capital in downturns, while constrained private firms have to sell it. In such a scenario, public firms would be expected to disinvest less than private firms, meaning that β_2 is positive while the average investment level is negative. Hence, the financing hypothesis does not generate a clear prediction of how public and private firms react differently to negative investment opportunities. However, while public firms might disinvest less in downturns, we would not expect them to invest more. β_2 should thus be interpreted in the context of α_0.

The financing hypothesis $\beta_1 > 0$ and $\alpha_0 + \beta_2 < 0$

Managers with empire-building preferences are expected to invest regardless of whether investment opportunities are good or bad. Under this hypothesis, private firms are not financially constrained and, therefore, both public and private firms could either invest equally as much when investment opportunities are good, or one could invest more than the other. β_1 can thus be either positive or negative. However, the prediction is clear for β_2 as public firm managers are expected to invest even in the case of negative investment opportunities. Thus, in the scenario when sales growth is negative, and *I(SG-)* dummy takes the value 1, β_2 should be positive.

The empire-building hypothesis $\beta_2 > 0$ and $\alpha_0 + \beta_2 > 0$

5.2 Empirical test and interpretation

Table 7 reports that β_1, the coefficient estimate of *I(SG+) * PUBLIC*, is positive for all investment measures. This shows that public firms' investment levels are higher when investment opportunities are good. As this is required under the financing hypothesis, but also could be the case under empire-building, we cannot rule out one of the hypotheses based on β_1 alone. Turning to β_2, the coefficient estimate of *I(SG-) * PUBLIC*, we see that it is positive for all but one investment measure. As this either could signify that public firms invest more (supportive of empire-building) or disinvest less (supportive of better access to financing) than private firms in downturns, we interpret β_2 in the context of α_0. Such an analysis reveals that the average investment level for public firms is positive for all asset investment measures when sales growth is negative: 0.030 (0.015 + 0.015) for tangible fixed assets, 0.004 (-0.001 + 0.005) for intangible fixed assets, 0.040 (0.022 + 0.018) for total fixed assets, 0.220 (0.033 + 0.187) for total assets, and 0.130 (0.103 + 0.027) for CapEx. These results are supportive of the

Table 7
OLS estimates for investment levels under positive and negative investment opportunities (equation (4), full sample)

	Investment in assets					Investment in human capital			Investment in innovation	
	Tangible fixed assets	Intangible fixed assets	Total fixed assets	Total assets	CapEx	Change in number of employees	Personnel expenses to sales	Personnel expenses per employee	R&D	Patent
Intercept	0.015***	-0.001***	0.022***	0.033***	0.103***	-0.004*	0.250***	0.232***	0.006	0.004***
	(14.4)	(-6.4)	(16.4)	(12.9)	(85.1)	(-1.8)	(123.1)	(133.4)	(0.5)	(4.7)
*I(SG+) * PUBLIC*	0.009***	0.086***	0.109***	0.187***	0.100***	0.041***	0.385***	0.205***	0.160***	0.260***
	(4.1)	(372.6)	(37.7)	(34.2)	(37.9)	(7.4)	(72.7)	(45.4)	(32.7)	(139.9)
*I(SG-) * PUBLIC*	0.015***	0.005***	0.018***	0.187***	0.027***	-0.041***	0.869***	0.272***	0.361***	0.234***
	(4.9)	(16.2)	(4.5)	(24.7)	(7.3)	(-5.3)	(117.2)	(43.0)	(55.7)	(90.9)
Sales growth	0.035***	-0.000***	0.038***	0.278***	0.053***	0.261***	-0.040***	0.047***	0.016***	0.005***
	(154.5)	(-4.5)	(131.9)	(507.7)	(201.3)	(468.8)	(-89.9)	(124.0)	(7.6)	(26.3)
ROA	0.046***	0.001***	0.087***	0.723***	0.031***	-0.036***	-0.160***	0.072***	-0.113***	-0.010***
	(112.9)	(25.1)	(166.2)	(731.2)	(65.5)	(-36.2)	(-200.6)	(105.9)	(-27.6)	(-31.2)
Observations	1,832,646	1,832,642	1,832,650	1,832,650	1,832,650	1,832,650	1,795,095	1,795,095	37,571	1,832,650
R^2	3.4%	8.1%	4.3%	39.7%	10.0%	11.7%	24.2%	12.4%	25.9%	4.2%
Adjusted R^2	3.4%	8.1%	4.2%	39.7%	10.0%	11.7%	24.2%	12.3%	25.5%	4.2%
F statistic	249.8***	615.9***	311.1***	4,611.3***	780.2***	926.3***	2,185.2***	965.4***	59.4***	307.7***

The table reports OLS coefficients from estimating equation (4) for the full sample, *, **, and *** denote that a coefficient is significant at the 10%, 5% and 1% level, respectively. Each observation represents a firm-year and the time period covered by the data is 1998 to 2019. Fiscal years ending on or before May 31 are considered as ending the previous calendar year, but the financial values are not calendarized. Continuous variables are winsorized at the 2.5% level at both tails, except change in logged number of employees and logged patent count. Variations in the number of observations can be explained by missing values. *t*-statistics are reported in parentheses below each coefficient. Dependent and independent variables are defined in Appendix A.

empire-building hypothesis, predicting that firms invest even when investment opportunities are bad, and inconsistent with the financing hypothesis.

For investment in human capital and innovation, we similarly find implications of empire-building for personnel expenses to sales, personnel expenses per employee and innovation. However, the result for investment in the number of employees shows a negative coefficient for *I(SG-) * PUBLIC*, and in the context of α_0, this means that public firms invest less in employee count when investment opportunities are bad ((-0.004) + (-0.041)). This prediction contradicts the empire-building hypothesis, while it could be, but is not necessarily, in line with the financing hypothesis.

In summary, the regression results show that public firms generally invest more than private firms in the case of negative investment opportunities. Asker et al. (2015) find agency problems to be an underlying channel driving public firms' investment behavior. We similarly find that agency problems could shape public firms' investment behavior, but in the opposite direction and in the form of empire-building rather than short-termism. Hence, our research then approaches Asker et al. (2015) on this dimension and Sheen (2020) as they find that separation of ownership and control in public firms could explain differences in investment behavior compared to that of private firms. Our suggested channel contrast Gilje and Taillard (2016) as they rule out overinvestment as an explanation to their finding that public firms in the natural gas industry react more to investment opportunities, and instead find support of better access to capital. However, as our analysis of investment sensitivities in section 4.2 revealed that public firms overall are more responsive to changes in investment opportunities, and as one investment measure contradicts empire-building in our extended analysis, we note that we cannot fully confirm whether empire-building is the mechanism underlying our results. Rather, we conclude that we cannot rule out that empire-building has a role in driving public firms' higher investment levels.

6. Conclusion

By comparing investment levels and investment sensitivities of public and private firms, we study how a stock market listing affects corporate investment behavior along three dimensions; assets, human capital and innovation. In our main sample, capturing a broad universe of firms, we find empirical evidence that public firms invest more than private firms, and are more sensitive to changes in investment opportunities. The differences are economically meaningful and apply to all investment categories. Heterogeneity between public and private firms is reduced when comparing a size and industry matched sample, as well as a group of transition firms. Nevertheless, on the investment dimensions for which we still observe statistically significant differences, it holds true that public firms invest more than private firms.

Our paper contributes to a better understanding of differences between public and private firms. This is interesting in and of itself, given that the research area is less studied because of worldwide limited data availability. Further, the main reason for using this research design is to add to the literature studying the trade-off between staying private and going public. Based on the analyses of investment levels and investment sensitivities alone, our findings indicate that the decision to go public does not come at the expense of less investment, which otherwise would have been predicted by the view that stock markets induce short-term behavior. However, when studying the channel driving the results, our findings indicate or, more cautiously, cannot rule out that public firm managers' empire-building preferences have a role in shaping the higher investment levels of public firms. Hence, given economically meaningful differences between public and private firms, we conclude that the effects on investment behavior and, as suggested, corporate governance should be considered in a firm's decision to be publicly listed or privately held.

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Appendix A. Variable Definitions

Variable	Definition
A.1 Summary statistics	
Total assets	Book value of total assets
Sales growth	[sales(t) - sales(t-1)] / sales(t-1)
Return on assets (ROA)	EBIE(t) / total assets(t-1) *EBIE(t)* = operating income(t) + financial income(t), and *Financial income(t)* = profit from participation in group companies(t) + interest income from group companies(t) + external interest income(t) + other financial income(t). Profit from participation in group companies is only included in the calculation if positive
Cash holdings	[cash and equivalents(t-1) + investment in securities(t-1)] / total assets(t-1)
Book leverage	[long-term debt(t-1) + short-term debt(t-1)] / total assets(t-1)
RE/TA	retained earnings(t) / total assets(t)
Number of employees	Number of employees in year t according to a company's financial statements
Age	Calculated as the number of years between a company's registration date according to the Swedish Companies Registration Office and the relevant calendar year. Fiscal years ending on or before May 31 are treated as belonging to the previous calendar year
A.2 Investment measures and dependent variables	
Tangible fixed assets	[tangible fixed assets(t) - tangible fixed assets(t-1)] / total assets(t-1)
Intangible fixed assets	[intangible fixed assets(t) - intangible fixed assets(t-1)] / total assets(t-1)
Total fixed assets	[total fixed assets(t) - total fixed assets(t-1)] / total assets(t-1)
Total assets	[total assets(t) - total assets(t-1)] / total assets(t-1)
CapEx	CapEx(t) / total assets(t-1) *Capital expenditures (CapEx)* (t) = [tangible fixed assets(t) - tangible fixed assets(t-1)] + [intangible fixed assets(t) - intangible fixed assets(t-1)] + depreciation & amortization(t)
Change in number of employees	As an investment measure, defined as the annual change in number of employees. As a dependent variable, the change in number of employees is measured as ln(total number of employees(t)) - ln(total number of employees(t-1))
Personnel expenses to sales	abs(personnel expenses(t)) / sales(t)
Personnel expenses per employee	abs(personnel expenses(t)) / total number of employees(t)
R&D	abs(research & development expenditures(t)) / sales(t)
Patent	As an investment measure, patent count is defined as the amount of patents a firm has applied for in a given year. As a dependent variable, patent count is measured as ln(1 + number of patent applications during year t)
A.3 Independent variables	
PUBLIC	Dummy variable set equal to 1 if the firm-year belongs to a public firm and 0 if the firm-year belongs to a private firm. The year a firm changes its status from public to private or private to public is treated as an event year and neither considered as public nor private. These years are excluded when the public dummy is used, and does therefore not take on an own value
Sales growth	[sales(t) - sales(t-1)] / sales(t-1)
ROA	EBIE(t) / total assets(t-1)
Log assets	The natural logarithm of total assets(t)
Change cash	[(cash and equivalents(t) + short-term securities(t)) - (cash and equivalents(t-1) + short-term securities(t-1)] / total assets(t-1)
I(SG+)	Dummy variable which takes the value 1 if sales growth is positive in a given year, and 0 otherwise
I(SG-)	Dummy variable which takes the value 1 if sales growth is negative in a given year, and 0 otherwise

Appendix B. Sample Construction

	No. of observations	Comment
Constructing our own dataset		There are 6 files in Serrano's set of files where we use two of them, Bokslut (containing 7,862,327 observations) and Serrano (containing 12,033,083 observations) to construct our own dataset. Initially, we clean these as per the steps to the left, before merging, as the files are too large to handle in our system of R.
Legal form	-3,252,334	Keep only limited liability companies.
Business category	-46,335	Exclude state, county council, municipal and other business categories to only keep the private business category.
Independent firms	-2,468,208	Keep independent firms. This step is done in the Serrano datafile, and we have 6,266,206 observations left.
Top parents	-8,008,217	Keep top parents. This step is also taken in the Serrano file, but in a separate one, and here we have 726,197 observations left.
Consolidated groups	-7,603,691	Keep consolidated financials. This step is done in the Bokslut datafile, and we have 258,636 observations left.
Cleaning our dataset	**5,402,558**	Until now we have separate files that we will merge in order to get a dataset with independent firms' financials and top parents' consolidated group financial information.
Independent firms with consolidated financials	-2,053	Remove firm-years belonging to independent firms with consolidated financial statements as independent firms should not be part of corporate groups.
Accounting period of shorter or longer than 12 months	-680,400	Keep only those firm-years with accounting periods of 12 months.
Duplicates	-151,607	Remove duplicates.
Industry	-595,466	204,905 observations concern those that have no information on industry, and 390,561 concern financial and utility firms.
Active firms	-143,344	Remove all firms that are not active, such as inactive firms.
Firms that have initiated and/or closed bankruptcy	-739	Exclude firm-years under which a bankruptcy was initiated, ongoing and/or completed.
Firms that have ordered and/or closed liquidation	-25,378	Exclude firm-years under which a liquidation was ordered, ongoing and/or closed.
Audited and recommended	-1,059,881	Keep observations for which the financials have been audited/recommended.
Basic accounting identities	-1,265	1. Sales should be non-negative and 2. total assets should be non-negative. 1,264 observations are deleted on (1) and 1 observation is deleted on (2).
Number of employees	-449,980	Number of employees has to be greater than 0.
At least three years of consecutive financial data	-211,995	Firms need to have at least three years of consecutive financial data, so remove those that do not.
Final sample	**2,080,450**	

Appendix C. Matching Procedure

Table C1
OLS estimates for differences in investment levels between public and private firms (equation (1), matched samples for robustness)

		Investment in assets					Investment in human capital			Investment in innovation	
Sample	Coefficient estimate	Tangible fixed assets	Intangible fixed assets	Total fixed assets	Total assets	CapEx	Change in number of employees	Personnel expenses to sales	Personnel expenses per employee	R&D	Patent
Base match with size restriction 1.5	*PUBLIC*	-0.004	0.039***	0.016	-0.007	0.019	-0.017	0.481***	0.083***	0.615	0.043*
		(-0.9)	(3.8)	(1.2)	(-0.3)	(1.4)	(-1.1)	(3.7)	(8.2)	(1.3)	(1.9)
Base match with size restriction 2	*PUBLIC*	-0.006	0.041***	0.019	0.015	0.022*	-0.001	0.475***	0.076***	0.537	0.037*
		(-1.5)	(4.4)	(1.5)	(0.7)	(1.8)	(0.0)	(4.0)	(8.1)	(1.6)	(1.8)
Matching on more variables; size, industry, sales growth, ROA, book leverage, cash holdings	*PUBLIC*	-0.019*	0.040**	0.007	-0.032	-0.004	-0.046	0.634**	0.060**	0.330	0.016
		(-1.9)	(2.4)	(0.3)	(-0.6)	(-0.2)	(-1.3)	(2.3)	(2.5)	(1.1)	(0.3)

The table reports OLS coefficients from estimating equation (1) for matched samples based on different size restrictions and matching variables. *, **, and *** denote that a coefficient is significant at the 10%, 5% and 1% level, respectively. Each observation represents a firm-year and the time period covered by the data is 1998 to 2019. Fiscal years ending on or before May 31 are considered as ending the previous calendar year, but the financial values are not calendarized. Continuous variables are winsorized at the 1.0% level at both tails, except change in logged number of employees and logged patent count. Variations in the number of observations can be explained by missing values. *t*-statistics are reported in parentheses below each coefficient. Dependent and independent variables are defined in Appendix A.

Appendix D. Transition Sample

Table D1
OLS estimates from investment level regression for the transition sample

	Investment in assets					Investment in human capital			Investment in innovation	
	Tangible fixed assets	Intangible fixed assets	Total fixed assets	Total assets	CapEx	Change in number of employees	Personnel expenses to sales	Personnel expenses per employee	R&D	Patent
PUBLIC	0.002	0.095***	0.055**	0.046	0.046*	-0.018	0.542***	0.078***	0.286***	0.067
	(0.3)	(5.5)	(2.1)	(0.9)	(1.9)	(-0.5)	(3.8)	(4.6)	(2.7)	(1.3)
Sales growth	0.018***	0.038***	0.074***	0.275***	0.071***	0.195***	-0.277***	0.001	-0.266***	0.026
	(5.2)	(5.0)	(6.6)	(12.6)	(6.7)	(12.6)	(-4.8)	(0.1)	(-4.0)	(1.2)
ROA	0.003	0.014	0.032	0.084	-0.046	0.004	-1.156***	-0.060***	-0.908***	-0.153**
	(0.3)	(0.6)	(0.9)	(1.2)	(-1.3)	(0.1)	(-6.1)	(-2.7)	(-4.8)	(-2.1)
Observations	1,187	1,187	1,187	1,187	1,187	1,187	894	894	292	1,187
R^2	24.1%	20.5%	19.5%	26.7%	24.9%	26.4%	53.6%	68.7%	74.7%	70.0%
Adjusted R^2	15.5%	11.5%	10.3%	18.3%	16.3%	18.0%	47.2%	64.4%	68.9%	66.6%
F statistic	2.8***	2.3***	2.1***	3.2***	2.9***	3.2***	8.4***	16.0***	13.0***	20.6***

The table reports OLS coefficients from estimating a revised equation (1), with firm fixed effects instead of industry fixed effects, for the transition group. *, **, and *** denote that a coefficient is significant at the 10%, 5% and 1% level, respectively. Each observation represents a firm-year and the time period covered by the data is 1998 to 2019. Fiscal years ending on or before May 31 are considered as ending the previous calendar year, but the financial values are not calendarized. Continuous variables, except the change in logged number of employees and logged patent count, are winsorized at the 2.5% level at both tails. Variations in the number of observations can be explained by missing values. *t*-statistics are reported in parentheses under each coefficient. Dependent and independent variables are defined in Appendix A.