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Institutional ownership and investment by private companies

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ABSTRACT

We examine the impact of institutional shareholders on the investment activity and external financing of established private companies. Our sample includes both VC and non-VC institutions, and both controlling and minority ownership stakes. Institutions give rise to higher levels of investment in intangible assets—but not in tangible assets—and higher funding via external equity. These results apply even if the institution has a small non-controlling stake, suggesting that institutions promote investment by alleviating funding constraints. Over 40% of our sample firms display ownership by non-VC institutions only, acting independently of VC funds.

1. Introduction

Institutional ownership in late-stage and other mature private companies has been growing in recent years. The investors include venture capital (VC) funds, and non-traditional investors in private markets such as mutual funds and banks (Chernenko, Lerner, & Zeng, 2021; Fang, Ivashina, & Lerner, 2015; Kwon, Lowry, & Qian, 2020). In early-stage start-ups, VCs provide capital and work closely with entrepreneurs to shape the company's business strategy and build the team (e.g., Hellmann & Puri, 2002). What are the roles of VCs and the rising non-VC institutions in private companies that are already established? One hypothesis is that institutions alleviate the funding constraints of investee companies, enabling them to sustain higher levels of investment than would otherwise be possible. There is no direct evidence on this hypothesis.

We examine whether VC investors, and other types of institution investing independently, alleviate constraints and promote investment in established private companies. Our analysis requires detailed accounting and ownership data on privately held firms, which are not widely available for most countries around the world, including the United States. We use data on UK-registered companies, which face more stringent disclosure requirements than their counterparts in many developed countries. Our comparatively rich data enable us to identify a group of private firms that are part-owned by institutions, and to measure firm investment and external finance directly using audited accounting data.[1]

To ensure that the sample consists of established firms, we require each firm to have non-zero revenue every year it is in the sample, and to have revenue exceeding £1m in at least one of the sample years. Our baseline sample consists of 1182 private firms, for the period 2009–19. The mean total assets of these firms during their years in the sample is £27.6m (median £10.4m) and their mean age is

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[1] The UK Companies Act requires that private companies file both annual financial statements and a register of shareholders at Companies House, a public registry.

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14.9 (11.0) years, so most are well beyond the startup stage. To help isolate the effects of institutional ownership, each company with institutional shareholders is matched to a control company by industry, size and age.

We find that institutional ownership is associated with higher investment by private firms, compared with control firms which do not have institutional shareholders. Total investment is higher by 6.2 percentage points per year, an increase of 26% compared with average investment by the control group. The effect is entirely concentrated on investment in intangible assets, with no discernible impact on investment in tangible assets. We decompose intangible investment into three components: investment in organisation capital, estimated by 30% of selling, general and administrative (SG&A) expenses; changes in the value of intangible assets, e.g. patents; and expenditure on research and development (R&D). Investment in organisation capital is the largest component, contributing 78% of the variance of total intangible investment, and capturing investment in 'know-how'—for example, distribution systems, business practices, and strategies for improving brand awareness (Corrado, Haskel, Jona-Lasinio, & Iommi, 2022; Peters & Taylor, 2017). Our results suggest that institutional ownership is positively linked to all three components of intangible investment.

Institutional ownership is also associated with higher levels of funding via equity, and this mostly takes the form of injections of funds in years after the initial ownership stake was acquired. Share issuance per year as a proportion of assets is more than three times higher in firms with institutions, compared with control firms. We show explicitly that there is a positive relationship between external finance and investment, supporting the view that external fundraising is used, in part, to finance investment.

The presence of institutional ownership is potentially endogenous with respect to company investment. It is possible that the relation between institutional ownership and investment outcomes is driven by institutional preference for investing in companies with significant growth opportunities. We address this concern by using the matched sample in the baseline regression, and we provide further evidence that makes a causal interpretation more plausible. First, we study firms that transition to having institutional ownership during the sample period. Second, we use firms' geographic location as an instrument for whether they have institutional ownership. The results from these tests support our baseline results.

Another explanation for our results, aside from endogeneity, is that institutions could promote investment by controlling investee firms' investment policies directly, as opposed to alleviating constraints. To test this possibility, we exploit differences in levels of institutional stakes across firms. Institutions with a minority stake have less ability and incentive to shape investment policy than those with a controlling stake. We find that minority (as well as controlling) institutional ownership is associated with higher intangible investment by investee firms, and with an increased propensity to raise external equity. This supports the view that institutions promote investment by alleviating constraints, rather than controlling investment policy.[2]

Finally, we examine the effects of VC and non-VC institutions separately. Our identification of the two groups is based on a number of data sources, including Financial Analysis Made Easy (FAME), Pitchbook, Capital IQ, Eikon, and also institutions' websites (Appendix 1). Our sample of non-VC investors consists of all identifiable institutions that employ professional investors, and are not classified as VC funds. The vast majority are of the following types: funds managed by asset-management companies (e.g. mutual funds), banks, pension funds, insurance companies, and consultancy firms. Such institutions do not necessarily invest by means of a VC-style closed fund structure with a fixed lifetime. In our sample, 58% of firms have at least one VC shareholder, and the rest have at least one shareholder that is a non-VC institution, with no VC involvement. We exploit this feature of the data and examine the impact of non-VC institutional investment independently in private companies. We find that non-VC institutions, acting independently, positively affect investment and external equity by investee firms, in a manner similar to that of VC funds, though their impact is smaller.

The paper proceeds as follows. In Section 2 we summarise related literature, state our contributions, and develop our hypothesis. Section 3 describes the ownership data we use, and how our sample is obtained and matched companies identified. Section 4 explains our empirical strategy, and then Section 5 presents the empirical results. Section 6 concludes.

2. Background

2.1. Related literature and contribution

Existing research has studied the impact of VC backing on early-stage startups. Hellmann and Puri (2002) show that VC backing is positively related to the professionalization of small companies, shaping their human-resource policies, compensation, and marketing. Puri and Zarutskie (2012) find that firms with VC backing grow more quickly in terms of sales and employment than matched firms. Bernstein, Giroud, and Townsend (2016) find that VC investors foster innovation. González-Uribe (2020) documents exchange of innovation resources between the investee companies of VC funds.

For late-stage startups, Chemmanur, Krishnan, and Nandy (2012) find that VC backing enhances the productivity of firms in the manufacturing sector. Ewens and Farre-Mensa (2020) examine firms that have received a third funding round from their primary VC investor, finding that they raise more external equity and debt from institutions after the National Securities Markets Improvement Act (NSMIA) was passed in October 1996. Investors in late-stage startups increasingly include mutual funds as co-investors with VC funds. Research on co-investment has examined the returns made by co-investors (Ewens, Rhodes-Kropf, & Strebulaev, 2016; Braun,

[2] This interpretation is also supported by a mediation analysis. Additionally, as a check on whether different levels of ownership of the ordinary shares are indeed associated with different levels of control, we examine the effect of institutions on the turnover of company directors. We find that institutional ownership is associated with significantly higher turnover of directors if institutions have a controlling stake in the company, but not if they have a minority stake.

Jenkinson, & Schemmerl, 2020; Kwon et al., 2020), their contractual rights (Chernenko et al., 2021), and the impact of co-investment on IPO underpricing (Huang, Mao, Wang, & Zhou, 2021).

Increasing institutional investment in late-stage private companies has been linked to the decreasing number of listed companies. Easier access to external funds is recognised as an advantage of being listed on a stock market, and institutional ownership could provide a similar benefit, serving as a substitute for a listing. A related question is why it might be beneficial for companies to stay private longer. Stulz (2020) and Davydova, Fahlenbrach, Sanz, and Stulz (2024) argue that it is costlier for some private firms, whose growth depends on intangible capital and particularly organisational capital, to go public due to higher costs of disclosure. This implies that funding from institutions might facilitate intangible investment in particular by private firms.

Our paper adds to the literature in several ways. First, we contribute to understanding about the reasons for institutional investment in established private companies. Ewens and Farre-Mensa (2020) and Kwon et al. (2020) argue that VC-backed startup firms are sufficiently able to raise external equity that they choose to remain longer as private firms, rather than listing on the stock market. Our evidence extends theirs, showing explicitly that both VC and non-VC institutional ownership promotes investment by more mature private firms, through reducing constraints that they face on raising external equity. Previous research does not examine the effects of institutions with minority stakes. Our evidence suggests that a motive to hold minority stakes is to provide external finance, rather than to exert managerial control. Also, many of the firms in our sample were not originally VC-backed startups: they first received institutional shareholders when they were already established, rather than at the startup stage.

We shed light on the nature of the investment expenditure promoted by institutions. Prior literature shows that control of firms by private equity (PE) funds promotes tangible investment and sales growth, and is associated with greater external funding that is mostly in the form of debt (Boucly, Sraer and Thesmar, 2011; Bernstein, Lerner and Mezanotti, 2019; Cohn, Hotchkiss, & Towery, 2022). We document that both VC and non-VC institutions promote investment in *intangible* rather than tangible assets, including organisational capital. In addition, we find that the greater external funding associated with institutional ownership is primarily via equity rather than debt. We use accounting data to measure investment, and complement existing evidence of a positive relation between VC backing and employment growth (Puri & Zarutskie, 2012) and innovation (Bernstein et al., 2016).

We add to the emerging literature on direct investment in private firms by non-VC institutions. Prior literature has focused on the role of non-VCs as co-investors with VC partners (e.g. Braun et al., 2020; Huang et al., 2021; Kwon et al., 2020).[3] We highlight the role of non-VC institutions as independent investors in private firms. In this capacity, they alleviate constraints and promote intangible investment in a similar manner to VC investors.

2.2. Hypothesis development

Companies are able to take more positive-NPV investment if they are less financially constrained. Institutions reduce the financial constraints facing a firm if external funds are available more readily or at lower cost than would otherwise have been the case. Most private firms are wholly owned by families or individuals, and there are reasons to expect such firms to be more constrained than similar firms which have accepted institutional shareholders. The family might be unable to provide funds themselves, and might be unwilling to raise external funds. Raising external equity implies dilution of the family's ownership. Raising debt implies an increase in equity risk, and in the risk of loss of control in the event of default. Institutions could improve access to funds through direct investment themselves, or by facilitating external investment or lending by other parties. For example, the adverse selection problem might be less severe for companies with an institutional presence. Institutions may require critical information from the company, and be able to verify the information (Bernstein et al., 2016; Sapienza, 1992). As a result, other outside investors might be more willing to invest. Institutions may also facilitate external financing by calling upon their professional network (Ewens & Sosyura, 2023; Hochberg, Ljungqvist, & Lu, 2007).

However, it is not certain that VC or other types of institution will in fact reduce constraints in the case of established companies, with material revenues. Such companies will often be able to fund investment from retained earnings or by borrowing, without institutional backing. Asker, Farre-Mensa, and Ljungqvist (2015) find that mature US private firms have a higher level of investment than matched public firms, and that their investment is more sensitive to investment opportunities, suggesting that they are not constrained compared with public firms. Therefore, it is uncertain whether institutional shareholders alleviate funding constraints in mature private firms. In contrast, startups often have no earnings and are likely to be constrained in the absence of VC backing.

In addition, institutional ownership need not be motivated by reduction of constraints. There are other potential mechanisms whereby institutions can add value for private companies, including the introduction of superior management or strategy into the company, and the reduction of agency costs through monitoring (e.g., Bernstein et al., 2016; Chemmanur, Krishnan, & Nandy, 2011).

In view of the above, we test the following three hypotheses.

H1. Institutions (both VC and non-VC) increase the amount of investment by established private companies.

It might also be the case that institutions improve the responsiveness of firms to investment opportunities. Such responsiveness is viewed as a measure of investment efficiency and might increase following alleviation of constraints (Mortal & Reisel, 2013; Phillips & Sertsios, 2017). We therefore also test.

H2. Institutions improve the responsiveness of investment by established private companies to investment opportunities.

[3] The only exception is Fang et al. (2015), who study independent investment by non-PE/VC institutions. But their paper is not concerned with the effects on investee companies.

Finally, if investment by firms increases because they are less financially constrained, we expect.

H3. Institutions increase the amount of external funds raised by established private companies.

3. Sample selection, institutional ownership and matched sample

3.1. Initial sample of private companies

Our ownership and financial data are from Financial Analysis Made Easy (FAME), produced by Bureau van Dijk. FAME derives its data from filings with Companies House, a public registry. Under the UK Companies Act, all companies registered in the UK are required to submit an annual financial statement to Companies House, though the level of detail depends on the size of the company. Companies also submit an annual confirmation statement, formerly known as an annual return, in which they disclose their share register, i.e. the names of shareholders and the numbers of shares held by class of shares in issue.

Our initial sample consist of limited companies and those public limited companies (PLCs) that are unlisted.[4] To ensure that the sample consists of established firms, each firm must have non-zero revenue every year it is in the sample, and it must have revenue exceeding £1m in at least one of the sample years.[5] We exclude financial-sector firms because their financial statements are not comparable with those of other companies. We then discard firms without ownership information across all sample years.[6]

We are interested in stand-alone and parent companies, rather than subsidiaries, because the impact of constraints is more likely to be observable at the level of the parent company (see, for example, Erel, Jang, & Weisbach, 2015). We therefore exclude subsidiaries, i.e. companies which are more than 50% owned by another operating company. For each stand-alone company, we identify their controlling owner, defined as the party with the largest holding of ordinary shares, subject to a minimum of 20%. Types of controlling owner include family or individual, institutional investor(s), operating company (with a stake between 20% and 50%), government or not-for-profit institution, and nominee accounts (the owners of which have not been disclosed). A company is classified as widely held if no controlling party is identified. For companies whose controlling party is not an institutional investor, we identify whether the company has any minority institutional shareholders. We also collect data on institution types through various data sources. Identifying ownership is a major task, and correct identification of owners involves extensive hand collection. We discuss the procedures in Appendix 1.

Table 1 presents an overview of the ownership of established UK private operating companies. The sample period is 2009–19; these were the years available in FAME online when we collected the data. Of the 97,633 companies that we classify, 47.7% are subsidiaries and 12.1% have missing or untraced owners. These companies play no further role. The remaining 39,317 (40.2%) are stand-alone companies that are eligible for inclusion in our sample, either as firms with institutional ownership or as matching control firms. The vast majority of stand-alone firms (86.1%) are controlled by a family or individual; 4.6% are controlled by an operating company, 3.9% by investing institutions, 1.1% by a government or non-for-profit institute, and 1.8% by nominee accounts, while 2.6% are widely held (some of these could be unidentified family firms).

3.2. Companies with institutional ownership

Table 2 presents the distribution of the 2388 stand-alone firms that we identify as having institutional ownership for at least one sample year. This is 6.1% of the 39,317 stand-alone firms. We believe that Table 2 captures most of the population of established private firms that have institutional ownership and are not subsidiaries, financial firms or infrastructure/special-purpose companies. In the remainder of the paper we exclude the 994 unique companies with PE or unclassified institutional owners (PE includes infrastructure and real estate funds). There is already evidence that PE funds, which specialise in buyouts, lead to higher tangible investment on the part of investee firms (Bernstein, Lerner, & Mezzanotti, 2019; Boucly, Sraer, & Thresmar, 2011). We focus instead on the effects of other types of institution on established private companies, about which less is known.

Our identification of VC funds is based on how they are classified in Pitchbook, Capital IQ and Eikon, and on institutions' own websites (Appendix 1). Our VC category extends to 'growth equity' funds, which focus on mid-market private companies and often take a hands-off approach. Growth equity could be considered as a distinct investor group (Lattanzio, Litov, Megginson, & Munteanu, 2023), but for our purposes we view growth equity funds as akin to VC. This is because they are structured similarly as close-ended funds, with a fixed amount of funding raised from outside investors (limited partners), and a fixed lifespan.

Table 2 also shows that non-VC institutions are important agents as independent investors. A non-VC institution is an organisation which employs professional investors, but is not classified as a VC or PE fund in our data sources or in the institution's website. The subtypes of institution under the non-VC heading are: investment funds including mutual funds and investment trusts (listed

[4] PLCs tend to be larger than limited companies, with more shareholders. Their shares can be offered to the public, though most PLCs are not listed companies. The only remaining distinct requirement for registration as a PLC is that the company must have shares in issue with a nominal value of at least £50,000 (Companies Act, 2006; section 763).

[5] Our results remain robust if we require sample companies to have revenue exceeding £10m in at least one sample year.

[6] Established firms according to our criteria number 120,458. We exclude 17,263 financial firms, i.e. those with UK Standard Industrial Classification (SIC) codes starting with 64, 65, or 66 (except for 64201, 64202, 64203, 64204 and 64209, which are holding companies), and those with SIC codes 68100 (buying and selling own real estate) and 68209 (letting and operating own or leased real estate). We then exclude 5562 firms due to lack of ownership data. This leaves 97,633 unique firms that we classify in Table 1.

Table 1
Classification of established private companies by type of ownership.

Type of ownership	*N* comp-anies by type	As prop'n of comp-anies by type (%)	Av. Holding of largest party (%)	Eligible for our sample?
Stand-alone company controlled by:				
Family or individual	34,869	86.1	79.2	Y
PE or VC party, or unclassified institution	1287	3.2	62.7	Y
Non-PE/VC institutional party	286	0.7	63.2	Y
Operating company	1877	4.6	44.6	Y
Government or not-for-profit institute	436	1.1	94.8	Y
Nominee account(s)	720	1.8	83.9	Y
Widely held	1034	2.6	11.6	Y
Total stand-alone companies by type	40,509	100.0		Y
Total unique stand-alone companies	39,317			Y
Subsidiary or owners not identified:				
Subsidiary	47,919		98.7	N
Owned by domestic holding co., owners missing	3162		98.4	N
Owned by foreign holding co., owners not traceable	9002		97.7	N
Total subsidiaries and owners not identified, by type	60,083			N
Total unique subsidiaries and owners not identified	58,316			N
Grand total of companies by type	100,592			
Grand total of unique companies	97,633			

The sample in this table consists of all UK-registered non-financial private operating companies with (i) positive revenue in every firm-year available during the sample period of 2009–19, and (ii) revenue of at least £1m in at least one firm-year. Section 3.1 and Appendix 1 explain our process for identifying and classifying shareholders. A controlling party is defined as one which owns at least 20% of the ordinary shares, and is the largest party. In the event of a tie, the firm is classified following the order: institutional control, corporate control, and family or other control. A company with no controlling party is classed as widely held. A shareholder party is either a single owner or a grouping of shareholders of the same type, e.g. members of the same family. A company more than 50% owned by an operating company is classed as a subsidiary. Companies that transition from one ownership type to another during the sample period are included under each type, and so they are counted more than once in the totals by type, which exceed the totals of unique companies. The average shareholding of the largest party is calculated over firm-years.

investment companies), banks, insurance companies, pension funds, and other institutions (mostly consulting firms making proprietary investments). Existing research identifies a growing role for mutual funds as co-investors in firms controlled by venture capital, especially in later funding rounds (e.g. Ewens & Farre-Mensa, 2020; Kwon et al., 2020). Consistent with this, some of our firms with VC ownership also have non-VC minority shareholders, though these cases are not identified in Table 2. But distinct from co-investments, 42.2% of the firms in our sample have non-VC controlling or minority stakes, and no VC involvement.

Table 2 also sheds light on the size of stakes held by institutions. Among the firms that we study, institutions have a minority stake in a substantial 52.0% of cases, leaving another party such as a family or individual in control. The controlling stakes are much larger on average than the minority stakes, for both VC and non-VC institutions. The average institutional stake is 57.7% in the VC control group, and 61.4% in the non-VC control group. This indicates that VC or non-VC control means outright control, with over 50% of the shares, in the majority of cases. Minority institutional ownership, in contrast, involves quite small holdings, of less than 15% of the ordinary shares on average.[7]

At what stage in sample firms' lifecycle do institutions first invest? Do the institutions arrive at an early stage and hold the shares until the companies become mature, or they arrive only after the companies have become more established? To examine the question, we randomly select a subset of 10% of the firms with institutions, identify the firm-year the institution is first recorded in the firm's confirmation statements, and hand-collect brief financial data for that year. In this subsample, 80% of the firms have positive revenues when the institution first arrives; the median value is £8.0m for revenue and £6.5m for total assets. Hence, most firms are already generating material revenues, and have accumulated substantial assets. The median profit after tax is negative, −£0.34 million, but 53% of the firms show a positive profit (median for profitable firms = £0.36m). This evidence indicates that over half the sample firms are making modest profits upon the arrival of an institution. The rest have either become loss-making, or have not yet started to make a profit.

We also explore the way in which the institution first acquires shares, by reading annual reports around the year the institution arrives. In 56% of cases an existing business is taken over by a newly created parent company, in which the institution has a stake. The

[7] Stakes are based on voting rights, as recorded by FAME. If an institution owns non-voting preference shares only, the firm is included as a 'firm with institutions', but not in the calculation of average sizes of stakes in Table 2.

Table 2
Classification of companies by type of institutional ownership.

Type of institutional ownership	*N* companies by type	By type as prop'n of sample total (%)	By type as prop'n of total (%)	Average holding of largest party (%)
Sample companies with institutional owners				
VC control	447	29.3	16.9	57.7
Non-VC institutional control				61.4
Investment fund	220	14.4	8.3	
Bank	37	2.4	1.4	
Insurance company, pension fund, other	29	1.9	1.1	
VC minority stake	436	28.5	16.5	14.6
Non-VC minority stake				11.2
Investment fund	178	11.6	6.7	
Bank	102	6.7	3.9	
Insurance company, pension fund, other	79	5.2	3.0	
Sample companies by type	**1528**	**100.0**		
Sample unique companies	**1394**			
Other companies with institutional owners				
PE	470		17.8	
Unclassified	644		24.4	
Total companies by type	**2642**		**100.0**	
Total unique companies	**2388**			

This table shows the classification of all companies with institutional ownership in at least one firm-year. The holdings of ordinary shares in a given company are grouped by type and subtype of institution, to form separate shareholder parties, and grouped by status of the holding (controlling or minority stake). The classification by the four main types of ownership is as follows. (i) VC control = VC-style funds are the largest party and own at least 20% of the shares. (ii) Non-VC institutional control = non-VC institutions are the largest party and own at least 20%. (iii) VC minority stake = VC funds are not the largest party, or own less than 20%. (iv) Non-VC minority stake = non-VC institutions are not the largest party, or own less than 20%, *and* there is no VC ownership. A holding of non-voting shares only is counted as a minority stake (and is excluded in calculating 'average holding of largest party'). We also report the number of companies with PE ownership or with institutional owners that we are unable to classify. The ownership types are mutually exclusive by firm-year. Companies that transition from one ownership type to another are included separately under each type, and are counted more than once, as in Table 1. This means that the total of companies by type exceeds the number of unique companies with institutional ownership. The number of companies with institutions exceeds that in Table 1 because Table 1 only shows companies in which the institution is the controlling party.

institution acquires a stake directly (and not via a new company) in 19% of cases. In the remaining 25% of cases the company is too small to report a P&L account, and can be considered as a startup; the annual report usually provides no information about how the institution arrives. Overall, our evidence suggests that the majority of sample firms receive institutional owners only *after* they have become established, with positive revenues, and a minority receive institutional owners at the startup stage.

3.3. Matched sample

In order to isolate better the impact of institutions on firm investment and other outcomes of interest, we attempt to match each firm with institutional ownership (a 'firm with institutions') with one control firm, drawn without replacement from the pool of stand-alone firms without institutions (Table 1). The matching is based on the firm's industry, size and age, variables that are likely to affect investment and that are used in analogous studies of the impact of PE control on firm outcomes (Bernstein et al., 2019; Boucly et al., 2011; Cohn et al., 2022). Matching is conducted as at the first year an institutional owner is present. We set the matching algorithm to find potential matches from firms in the same SIC section. We then match the firms based on two characteristics, *Size* and *Age*. For each firm with institutions, at the year in which it first enters the sample, we select companies without any institutions have a value of each matching variable within a 30% bracket around the value for the firm with institutions.[8] If more than one potential match is identified, we select the closest one based on the sum of the quadratic distances of the matching variables. If no match is found, the firm with institutions is excluded. We do not match on the key outcome variables themselves, i.e. investment and external finance. Doing so would bias downwards the estimated impact on these outcomes as most our firms with institution already have institutional ownership when they enter the sample. As a robustness check we alternatively match firms by entropy balancing, as explained in Section 5.

We find appropriate matches for 1182 firms with institutions, and these together with their control firms form the sample for our

[8] The selection of a 30% bracket follows Bernstein et al. (2019). This is more conservative than the 50% bandwidth used by Boucly et al. (2011).

analysis.[9] This is a large sample compared with those in similar studies noted above. Once a matched firm is identified, the firm is retained in the sample for all the remaining years that data on the firm are available.

4. Empirical strategy

4.1. Regression specifications

To test Hypotheses 1 and 3, we estimate the following regression:

$$Y_{it} = \alpha + \beta InstOwn_{it} + \gamma InvOpp_{it} + \delta X_{it} + \zeta_{it} + \varepsilon_{it} \quad (1)$$

Y_{it} is either a measure of investment or external finance. The key independent variable, *InstOwn*, is an indicator set to 1 if firm *i* has VC or non-VC institutional shareholders, either as controlling or minority shareholders, in firm-year *t*, and 0 otherwise. The coefficient of interest, β, is expected to be positive if H1 and H3 are supported. We use a dummy variable indicating institutional ownership because we are interested in the effect of the presence of institutions. We also use a continuous measure for institutional ownership in one of the further analyses in Section 5.5. X_{it} denotes a vector of control variables. We include industry-year fixed effects (ζ). Panel regression with matched firms is used by analogous studies that compare investment across public and private firms (Mortal & Reisel, 2013; Asker et al., 2015), and the growth of private firms with and without VC backing (Puri & Zarutskie, 2012). We do not include firm fixed effects because *InstOwn* = 1 for most firms for all the years they are in the sample, meaning that estimation of the coefficient on *InstOwn* would be based only on data from the small minority of firms which transition to or from having institutional ownership during the sample period. Firms which transition to having institutional ownership are examined in Section 5.2. We also consider a correlated random-effects model in a robustness check. We winsorize continuous variables at the 1st and 99th percentiles. Standard errors are clustered at the firm level.

An alternative measure of investment efficiency is the responsiveness of investment to changes in opportunities, measured by *InvOpp*. We run the following regression to test whether institutional ownership affects firms' sensitivity of investment to opportunities (Hypothesis 2):

$$Investment_{it} = \alpha + \beta InstOwn_{it} + \gamma (InvOpp \times InstOwn)_{it} + \delta InvOpp_{it} + \theta X_{it} + \zeta_{it} + \varepsilon_{it} \quad (2)$$

The key explanatory variable is *InvOpp* × *InstOwn*. Its coefficient captures the difference in the sensitivities of investment to opportunities between firms with institutions and control firms. We expect the coefficient to be positive if H2 is supported. The other explanatory variables are as in equation (1).

4.2. Dependent variables

Our measure of total investment includes estimates of annual investment in both tangible and intangible assets. We follow Asker et al. (2015) and measure investment in tangible assets by the change in property, plant and equipment (PPE), plus depreciation. This measure is a noisy estimate of capital expenditure (capex), and we discuss it further in Section 5.1. We are unable to use capex itself because it is not available as a data item, since most private companies do not report a cash flow statement.

To measure intangible investment, we follow studies of intangible and organisational capital, for example Peters and Taylor (2017). There are three components: (i) investment in organisation capital, measured by 30% of SG&A costs (excluding amortisation/impairment); (ii) investment in knowledge capital measured by R&D, which is an expense item in the income statement; (iii) the change in intangible assets on the balance sheet, plus amortisation. This last component captures investment in externally purchased intangible assets, plus the portion of R&D expenditure that has been capitalised, if any.[10] R&D is missing for 91% of the sample, and amortisation of intangible assets is missing for 46%. Missing cases are treated as zero, following Hirshleifer, Zhu, and Li (2013), for example.[11] To count 30% of SG&A as intangible investment is somewhat ad hoc, but we believe that this choice is more correct than complete exclusion of SG&A.[12] As a robustness check, we vary the proportion of SG&A that is counted as investment. All the investment measures are scaled by total assets as at the start of the firm's financial year.

[9] The steps to the final sample are: initial sample = 97,633 unique firms classified in Table 1, minus 58,316 subsidiaries and firms with unidentified owners, minus 36,929 stand-alone firms with no institution in at least one sample year, minus 994 firms with PE or unclassified institutions, minus 212 firms with institutions but no matching firm = 1182 firms with VC or other institutions in at least one sample year, and with a matching firm.

[10] Peters and Taylor (2017) do not include the change in intangible assets in their measure of intangible investment, presumably because they test the *q* theory which relates to investment in a firm's existing business only. As we wish to measure total intangible investment, we include the change in intangible assets.

[11] A possible concern is that intangible investment is affected by revaluations of intangible assets on the balance sheet (permitted under IFRS and UK accounting principles if the asset is actively traded). Firms that report a revaluation reserve are uncommon. Our results are unaffected if we exclude such firms. Also, our main results hold if we exclude firms with missing R&D, missing amortisation and impairment of intangible assets, or both.

[12] For a recent discussion of SG&A expenditure, and evidence that it creates intangible asset value, see Banker, Huang, Natarajan, and Zhao (2019). The proportion of 30% to count as investment originates in Hulten and Hao (2008) and is used by Peters and Taylor (2017) and others.

We use two measures each of cash raised via external equity and debt. Δ*ExtEquity* (Δ*Debt*) is the change in share capital plus the share premium account (change in debt), scaled by lagged assets. *Large*Δ*ExtEquity* (*Large*Δ*Debt*) is a dummy variable set to 1 if Δ*ExtEquity* (**Δ***Debt*) exceeds +10% of lagged assets, and zero otherwise. All the variables are defined in Appendix 2.

4.3. Control variables

Investment opportunities (*InvOpp*; expected sign: +) are measured by the change in sales in the relevant industry and year, proxied by the median change in sales for firms with the same 3-digit SIC code as the sample firm. We use an industry rather than firm-specific measure because the latter is likely to be endogenous.[13] Other studies which use *InvOpp* include Mortal and Reisel (2013) and Asker et al. (2015). Alternative proxies for investment opportunities in the literature include natural gas prices and shale gas discoveries for firms in the shale gas industry (Gilje & Taillard, 2016), and National Coverage approval decisions for firms in the medical device industry (Phillips & Sertsios, 2017).

Six further control variables are included: firm size measured by the natural log of total assets (*Size* +); lagged leverage ($Leverage_{t-1}$; −); return on assets (*ROA*; +); lagged cash holdings scaled by assets ($Cash_{t-1}$; +); dividends declared scaled by assets (*Dividend*; +); and the natural log of the firm's age (*Age*; ambiguous sign). Several of these are included by Asker et al. (2015) as variables on which to match firms in their augmented matching process, and by Bernstein et al. (2019) as control variables. The variables measure firm characteristics that are expected to influence investment. Our expectations are that larger, more profitable, cash-rich and dividend-paying firms are less constrained and hence able to invest more, whereas levered firms are more constrained. Regarding *Age*, smaller firms could have greater growth potential and therefore higher investment, but older firms have easier access to funds; we are unsure *a priori* which effect will dominate.

4.4. Summary statistics

Panel A of Table 3 shows summary statistics for the 2364 firms with institutions and the control firms. The data confirm that most of the firms are well established and profitable. They have average assets of £27.6m (median £10.6m), ROA of 9.9% (9.8%) and age of 15.3 years (11.0 years). Total investment is 26.1% (17.8%) of assets, of which intangible investment is 22.4% (13.7%), and tangible investment is 3.9% (1.9%). It is striking that intangible investment is much the larger component. This is due primarily to investment in organisation capital; data for the components of intangible investment are: mean (median) of 19.3% (12.2%) for organisational capital, 0.3% (0.0%) for R&D, and 2.6% (0.0%) for intangible assets. One limitation of our data is that they may understate R&D and investment in intangible assets. We assume that missing values are zero, as noted above, but the true values may be non-zero in some cases.

Our figures for tangible investment are comparable with estimates for US companies in Asker et al. (2015, Table 2, first row) using the same measure. They report mean (median) tangible investment of 4.1% (2.0%) in unmatched public firms, and 7.5% (1.4%) in private firms. We know of no previous evidence on intangible investment that uses our comprehensive measure.[14]

Panel B compares the means of the variables for firms with institutions and the control group. The differences are not significant for firm size and age, the two continuous variables on which the matching is conducted. There are substantial differences for several of the key variables of interest, namely investment, Δ*ExtEquity*, and *Large*Δ*ExtEquity*. These differences are illustrated in Fig. 1 for each sample year. Firms with institutional ownership have higher annual total investment, of 31.8% of assets compared with 23.5% for the control group. This difference is due entirely to investment in intangibles, which is 28.6% for firms with institutions and 19.4% for control firms. Both differences are significant at the 1% level. Hence, a simple comparison of means suggests that institutional ownership is associated with significantly higher intangible investment, though not with higher tangible investment.[15]

In addition, firms with institutions raise substantially more external equity. Mean Δ*ExtEquity* is 4.4% of assets for firms with institutions and 0.7% for control firms, a difference significant at the 1% level. In contrast, mean Δ*Debt* is 4.1% of assets for firms with institutions and 3.8% for control firms, a difference which is not significant. A final point is that mean lagged leverage is substantially higher in firms with institutions, at 39.4% compared with 28.9% in control firms.

We also present the distribution by SIC industry of our firms with institutions, in the Internet Appendix, Table IA1. The largest group is 'Information and Communication,' representing 23% of firms with institutions. Most high-tech companies fall into this category. The second-largest group is 'Manufacturing,' accounting for 18%, followed by 'Professional, Scientific, and Technical Activities' (14%), 'Wholesale and Retail Trade' (12%), and 'Administrative and Support Service Activities' (10%). The distribution by industry shows that institutions invest in a wide range of companies, including those in traditional sectors such as manufacturing and retail.

[13] As a robustness check we measure *InvOpp* by firm-specific sales growth instead, as in Mortal and Reisel (2013). Our results are qualitatively similar.

[14] Summary data in Peters and Taylor (2017) for US public firms indicate that intangible investment is larger than tangible investment, though the difference appears to be much less than in our data. Their measure of intangible investment excludes the change in intangible assets plus amortisation, which we include.

[15] In addition, firms with institutions have a mean ROA of 3.5%, compared with 14.0% for control firms. This difference in profitability is unintended. We do not match on ROA because it reduces our sample size by nearly 50%. As a robustness check, we include ROA as an additional matching variable, and obtain similar results (untabulated).

Table 3
Summary statistics and differences in means.

Panel A: Summary statistics	Mean	Std. Dev.	Min	Median	Max	*N* firm-years
Dependent variables						
Total investment	0.261	0.265	−0.047	0.178	1.417	9423
Inv in intangibles	0.224	0.261	−0.001	0.137	1.551	9423
Inv in tangibles	0.039	0.067	−0.092	0.019	0.432	10,254
ΔExtEquity	0.018	0.068	−0.029	0.000	0.312	9722
LargeΔExtEquity	0.081	0.273	0.000	0.000	1.000	9722
ΔDebt	0.034	0.236	−0.676	0.000	1.185	10,254
LargeΔDebt	0.239	0.426	0.000	0.000	1.000	10,254
Independent variables and control variables						
InstOwn	0.339	0.473	0.000	0.000	1.000	9423
Size (£m)	27.576	68.559	0.083	10.579	1179.746	9423
InvOpp	0.060	0.053	−0.664	0.060	3.297	9423
$Leverage_{t-1}$	0.302	0.373	0.000	0.176	1.862	9423
ROA	0.099	0.224	−0.534	0.098	1.042	9423
Age (years)	15.326	15.405	1.000	11.000	94.000	9423
$Cash_{t-1}$	0.176	0.189	0.000	0.107	0.840	9423
Dividend	0.014	0.044	0.000	0.000	0.298	9423

Panel B: Differences in means	Mean for companies with institutions	Mean for control companies	Difference	*p*-value of difference
Dependent variables				
Total investment	0.318	0.235	0.082	0.000
Inv in intangibles	0.286	0.194	0.092	0.000
Inv in tangibles	0.037	0.042	−0.005	0.149
ΔExtEquity	0.044	0.007	0.038	0.000
LargeΔExtEquity	0.185	0.034	0.151	0.000
ΔDebt	0.041	0.038	0.003	0.818
LargeΔDebt	0.296	0.224	0.072	0.001
Independent variables and control variables				
Size (£m)	23.459	23.162	0.297	0.914
InvOpp	0.056	0.055	0.001	0.577
$Leverage_{t-1}$	0.394	0.289	0.104	0.000
ROA	0.035	0.140	−0.105	0.000
Age (years)	11.126	11.223	−0.097	0.885
$Cash_{t-1}$	0.184	0.168	0.016	0.099
Dividend	0.007	0.018	−0.011	0.000
N companies	1182	1182		

The sample for our panel regressions (Tables 4–8) consists of 1182 unique companies with institutional ownership, and 1182 matched control companies. The sample period for financial data is 2010–19 (we lose 2009 because some variables require the year before to calculate). Our matching process is explained in Section 3. The variables are defined in Appendix 2. The values of the variables are proportions of $Assets_{t-1}$ except for *InstOwn*, *Size* (=$Assets_t$), *InvOpp* (= median sales growth in the firm's industry) and *Age* (the firm's age). In the regressions *Size* and *Age* are measured by their natural logarithms, but in this table they are shown before taking logs. Panel A shows summary statistics for all sample firms. *N* firm-years for each dependent variable matches its sample size in our baseline regression (Table 4); *N* firm-years for each independent variable matches its sample size when Total investment is the dependent variable. Panel B shows differences in means for each variable between firms with institutions and control firms, as at the year of matching only. The *p*-values are from a *t*-test of the difference. Values of the variables are shown after winsorization at the 1st and 99th percentiles. *** (**) (*) = significant at the 1% (5%) (10%) level.

5. Empirical results

5.1. Institutional ownership, investment and financing

The question we examine is whether institutional ownership in private companies promotes investment by reducing funding constraints. We show first that institutional ownership is associated with higher investment. We then test whether the impact on investment is due to greater external financing in firms with institutional ownership, as predicted if such ownership reduces constraints.

Panel A of Table 4 presents regression results with measures of investment as the dependent variable in equation (1). Column 1 shows results for total investment. The coefficient on *InstOwn* is 0.062 (t = 6.46), implying that institutional ownership promotes investment. Conditional on investment opportunities and the other controls, investment per year by firms with institutions is 6.2 percentage points higher than by control firms. Compared with mean investment by control firms of 23.5% of assets (Table 3), this implies that investment by firms with institutions is 26.4% higher per year, supporting Hypothesis 1. Since firms typically have

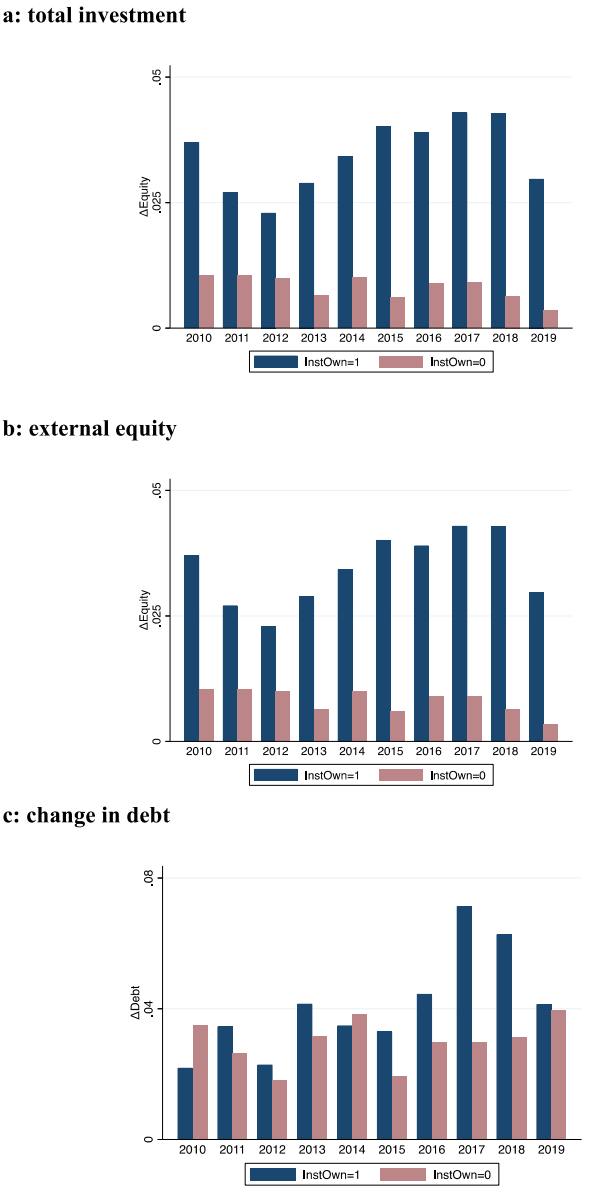

Fig. 1. Investment and external finance
The figures show equally weighted mean values for total investment, external equity (Δ*ExtEquity*) and changes in debt (Δ*Debt*) across 1182 companies with institutional ownership and 1182 control companies. The values are proportions of $Assets_{t-1}$.

institutional ownership for several years, this annual increment implies a large cumulative effect over time.[16]

Columns 2 and 3 show results for investment in intangible and tangible assets, respectively. The impact of institutional ownership is concentrated on intangible investment; in this regression the coefficient on *InstOwn* is 0.060 (t = 6.49). Compared with mean intangible investment by control firms of 19.4%, the coefficient implies that intangible investment by firms with institutions is 30.9% higher per year. When the dependent variable is tangible investment, the coefficient on *InstOwn* is only 0.002 and is not significant. This is consistent with Chemmanur et al. (2011), who find in a sample of manufacturing firms that capital expenditure does not increase following the first round of VC financing.

To further explore the results for intangible investment, we first decompose the variance of intangible investment, and find that investment in organisation capital contributes to 78% of the variation in intangible investments, change in intangible assets explains

[16] The average (median) number of years in which firms have institutional shareholders is 4.7 (4.0) years. This understates institutions' holding period, because some firms already have institutional ownership at the start of the sample period, and some still retain it at the end.

Table 4
Institutional ownership, investment and financing.

Panel A	Total investment	Investment in intangible assets	Investment in tangible assets	Total investment	Investment in intangible assets	Investment in tangible assets
	(1)	(2)	(3)	(4)	(5)	(6)
InstOwn	**0.062*** **	**0.060*** **	**0.002**	0.054***	0.057***	−0.001
	(6.46)	**(6.49)**	**(0.81)**	(3.99)	(4.34)	(-0.35)
InstOwn*InvOpp				**0.129**	**0.059**	**0.046**
				(0.79)	**(0.36)**	**(1.46)**
InvOpp	0.135	0.141	0.003	0.118	0.133	−0.004
	(1.43)	(1.48)	(0.25)	(1.30)	(1.38)	(-0.42)
Size	−0.053***	−0.053***	−0.001	−0.053***	−0.053***	−0.001
	(-10.51)	(-10.74)	(-0.73)	(-10.50)	(-10.73)	(-0.73)
$Leverage_{t-1}$	0.060***	0.056***	0.009***	0.060***	0.056***	0.009***
	(3.72)	(3.39)	(2.73)	(3.71)	(3.38)	(2.71)
ROA	−0.048	−0.093***	0.034***	−0.048	−0.093***	0.034***
	(-1.63)	(-3.11)	(5.82)	(-1.61)	(-3.09)	(5.84)
Age	−0.013**	−0.014**	0.001	−0.013**	−0.014**	0.001
	(-2.20)	(-2.50)	(0.68)	(-2.20)	(-2.50)	(0.67)
$Cash_{t-1}$	0.067**	0.088***	−0.020***	0.066**	0.087***	−0.020***
	(2.46)	(3.33)	(-4.08)	(2.43)	(3.30)	(-4.12)
Dividend	0.021	0.049	−0.020	0.021	0.049	−0.020
	(0.22)	(0.53)	(-1.01)	(0.22)	(0.53)	(-1.01)
Constant	0.729***	0.700***	0.041***	0.730***	0.701***	0.041***
	(14.18)	(13.94)	(3.93)	(14.22)	(13.97)	(3.97)
Industry-year FE	Y	Y	Y	Y	Y	Y
N firm-years	9423	9423	10,254	9423	9423	10,254
R^2	0.199	0.228	0.149	0.199	0.228	0.149

Panel B	*ΔExtEquity*	*LargeΔExtEquity*	*ΔDebt*	*LargeΔDebt*
	(1)	(2)	(3)	(4)
InstOwn	**0.016*** **	**0.072*** **	**0.003**	**0.017**
	(7.47)	**(8.35)**	**(0.48)**	**(1.57)**
InvOpp	0.004	0.011	0.027	0.024
	(0.29)	(0.17)	(0.36)	(0.19)
Size	0.000	0.003	0.010***	0.017***
	(0.04)	(0.80)	(2.90)	(3.47)
$Leverage_{t-1}$	−0.001	−0.012	−0.028	0.146***
	(-0.16)	(-0.87)	(-1.61)	(8.12)
ROA	−0.105***	−0.355***	−0.169***	−0.225***
	(-12.40)	(-12.20)	(-7.48)	(-9.30)
Age	−0.007***	−0.031***	−0.006*	−0.021***
	(-6.23)	(-6.31)	(-1.71)	(-3.17)
$Cash_{t-1}$	0.013**	0.027	−0.050***	−0.182***
	(2.24)	(1.16)	(-2.95)	(-6.60)
Dividend	0.059***	0.142**	0.176***	0.247**
	(4.20)	(2.43)	(3.11)	(2.22)
Constant	0.036***	0.132***	−0.014	0.130***
	(3.65)	(3.38)	(-0.45)	(2.59)
Industry-year FE	Y	Y	Y	Y
N firm-years	9722	9722	10,254	10,254
R^2	0.177	0.138	0.020	0.052

Regression results showing the relation between measures of company investment or external finance and *InstOwn* (=1 if the company has institutional ownership in the given firm-year). The variables are defined in Appendix 2. *t*-statistics are in brackets, using robust standard errors clustered at firm level. *** (**) (*) = significant at the 1% (5%) (10%) level.

21% and R&D explains 1%. We then run regression (1) separately with each of the three components as the dependent variable in turn (not tabulated). Institutional ownership appears to promote all three components. The coefficients on *InstOwn* are 0.037 ($t = 4.48$) for investment in organisation capital (i.e. 30% of SG&A), 0.020 ($t = 5.92$) for change in intangible assets plus amortisation, and 0.001 ($t = 2.73$) for R&D. We also run the regression using intangible investment including 10% or 50% of SG&A, instead of 30% (not tabulated). The resulting coefficients on *InstOwn* are 0.031 ($t = 7.02$) and 0.085 ($t = 5.79$), respectively. Our evidence for a positive association between institutions and SG&A expenditure complements the findings of Chemmanur et al. (2011) and Puri and Zarutskie (2012), from factory-level data, that VC backing is associated with higher expenditure on employment and production costs. Our sample of companies is broad—many are not involved in manufacturing—and we find that institutions are linked to higher expenditure for purposes that are often viewed as types of intangible investment. Our evidence is also broadly consistent with Stulz (2020) and Davydova et al. (2024), who underscore the role of institutions in funding private companies whose growth depends on intangible capital, particularly organisational capital.

An alternative measure of investment is change in total assets plus depreciation and amortisation. This is a broader measure than tangible investment, used recently by Bernstein et al. (2019). It includes change in intangible assets on the balance sheet, but does not directly capture expenditure on R&D or SG&A, which are items in the income statement. Table IA2 shows that, using this measure, the coefficient on *InstOwn* is 0.042 ($t = 4.32$), about two-thirds the size of the coefficient with total or intangible investment as dependent variable (Table 4).

Turning to the control variables, the coefficient on *InvOpp* (median sales growth in the relevant industry and year) is not significant, suggesting that investment is not affected by investment opportunities as measured. The results for some of the other control variables imply that the determinants of company investment differ materially between intangible and tangible investment. For intangible investment the coefficients on *Size*, *ROA* and *Age* are negative and significant at the 5% level or better, and $Cash_{t-1}$ is positive and significant, implying that smaller, less profitable and younger firms, with more cash holdings, have higher intangible investment. Our inference is that intangible investment is relatively high in firms at an earlier stage of their development, with small *Size*, low *ROA* and young *Age*. For tangible investment, in contrast, the coefficient on *Size* is almost zero, *ROA* is positive and significant at the 1% level, as expected, and $Cash_{t-1}$ is negative and significant, which is unexpected.

The results with respect to investment efficiency, from estimating equation (2), are shown in columns 4 to 6 of Panel A. The coefficient on the interaction term is positive but not statistically significant for any of the three measures of investment. The results suggest that firms with institutions are not more responsive to changes in investment opportunities than control firms, at least based on our measure of opportunities (median industry growth in sales during the year of investment).[17] This result is a little surprising, and does not support Hypothesis 2. Possibly institutions look to longer term opportunities which are not captured adequately by our measure.

To test whether institutions are associated with higher external funding, we estimate equation (1) with each of the measures for external finance as the dependent variable. The control variables are the same as before.[18] Panel B of Table 4 shows regressions for external finance. For external equity, the coefficients on *InstOwn* are positive and highly significant, and their size is economically significant. For example, the coefficient is 0.016 ($t = 7.47$) when $\Delta ExtEquity$ is the dependent variable, which implies that equity fundraising per year, net of any repurchases, is on average 1.6 percentage points higher by firms with institutional ownership than by control firms. This is a large increment, representing 229% of the mean $\Delta ExtEquity$ for control firms of 0.007%. However, *InvOpp* is not significant—external equity is not raised in response to investment opportunities as measured. Crucially, as shown in Fig. 1b, institution-backed firms display a greater level of equity finance throughout the entire sample period, suggesting that institutions provide external finance persistently, over a number of years after the year in which they first arrive. As a more formal test, we use one- or two-year forward measures of equity finance as the dependent variables in equation (3), and replicate the regressions in Panel B of Table 4. The estimated coefficients on *InstOwn* (untabulated) are all statistically significant at the 1% level. Regarding the control variables, equity financing is positively related to $Cash_{t-1}$ and *Dividend*, and negatively related to *ROA* and *Age*. These results imply that share issuance is greater among less profitable and younger firms, that are more dependent on external funding.

The results in columns 3 and 4 for measures of debt funding show a positive but insignificant effect of institutional ownership on borrowing, in contrast to the results for equity. The coefficient on *Size* (assets) is positive and significant, as expected since larger firms are better able to support debt. *ROA* is negative and significant, consistent with results for listed and private firms that more profitable firms borrow less (e.g. Brav, 2009). $Cash_{t-1}$ also has a negative and significant coefficient, in contrast to its sign when external equity is the dependent variable, suggesting that firms with relatively high cash holdings tend to borrow less or use their cash to repay debt.[19]

In summary, the evidence from Panel B indicates that institutional ownership is associated with substantially more equity issuance than occurs in control firms, but not more debt issuance. This supports Hypothesis 3, that institutional shareholders promote firm investment via alleviation of funding constraints, especially constraints in raising equity. The fact that increased external funding is via equity rather than debt could be because the funds are for intangible investment,[20] or the firm lacks cash flow and tangible assets to support debt, or aversion to leverage on the part of family owners. Our results differ in several respects from the evidence for firms under PE control following LBOs (Bernstein et al., 2019; Boucly et al., 2011; Cohn et al., 2022). Buyouts are followed by significant increases in tangible investment, whereas we find no increase in tangible investment; they are followed by significant increases in debt rather than equity; and by greater responsiveness of investment to opportunities, whereas we find no change in responsiveness.

To check whether external finance is indeed used to fund investment, we estimate the following regression separately for firms with institutions and control firms:

[17] We run alternative specifications (not tabulated). Instead of the *InstOwn* dummy we add (i) firm fixed effects, as in Mortal and Reisel (2013), or (ii) firm fixed effects and the control variables interacted with *InstOwn*, as in Asker et al. (2015). The coefficients on *InvOpp* × *InstOwn* are not statistically significant.

[18] An approximately correct set of control variables, to proxy for determinants of decisions to raise external funds, would include free cash flow. This is because the most important determinant is the existence of a cash flow shortfall (e.g. DeAngelo, DeAngelo and Stulz (2010), for share issues; Brav, 2009, for debt, using data for private firms). But we cannot include free cash flow, because cash flow is directly affected if institutions promote investment by reducing constraints. Firms that invest more because they are less constrained will have both lower free cash flows as a result, at least in the short term, and higher external funding.

[19] With $\Delta Debt$ as dependent variable, our results for several control variables (*Size*, *ROA*, *Age*) are consistent with those in Brav (2009, Table 4), with leverage as dependent variable and firm fixed effects.

[20] Brown, Martinsson, and Petersen (2013) find that easier access to equity finance, through being listed on a more developed stock market, promotes investment in intangible rather than tangible assets.

$$Investment_{it} = \alpha + \beta ExtEquityFinance_{it} + \gamma DebtFinance_{it} + \delta InvOpp_{it} + X_{it}$$

$$+\zeta_{it} + FirmFE_i + \varepsilon_{it} \quad (3)$$

where *FirmFE* is firm fixed effects. Table 5 displays the results. The coefficients on all the measures of external equity and debt are positive and highly significant, both for firms with institutions and control firms. This evidence confirms that in years when firms raise external equity or debt, total investment is higher than when they do not do so. The coefficients are larger for equity than for debt, and they are more significant for firms with institutions, indicating that the relation between investment and external funding is more reliable in firms with institutional ownership. For firms with institutions, one unit of external equity (debt) is associated with investment that is higher by 0.59 (0.20) units, in the year the funds are raised.

5.2. Transition to institutional ownership

It is possible that our results suffer from endogeneity. The results might arise because there is an unobserved variable, such as growth potential, that explains both higher firm investment and whether the firm has institutional ownership. Our results might also arise because of reverse causality: higher investment by a firm might itself attract institutional investors. In order to mitigate endogeneity concerns, especially reverse causality, we test whether transitioning by firms to institutional ownership tends to precede increases in firm investment and external funding. In Section 5.5 we also conduct an instrumental variable analysis.

We compare firms that transition with non-transitioning control firms which have zero institutional ownership during the sample period. A positive relation between firm investment and institutional ownership is more likely to be causal if institutions tend to arrive before or in the same financial year as a firm increases its investment and external funding, than if they arrive after investment and funding have already increased, without the benefit of institutions. In addition, inclusion of firm fixed effects helps to control for unobservable firm-level differences, and focusing on the transition sample enables us to implement matching by the outcome variables before transition. Our tests are similar in nature to those of recent studies that examine outcomes after takeovers by PE investors (e.g. Boucly et al., 2011; Davis et al., 2014; Bernstein & Sheen, 2016; Eaton, Howell, and Yannelis (2020).

There are 220 firms which transition to having institutional shareholders during the sample period, and which have at least one year of data before and after the year of transition. This is a much smaller sample than our full sample of firms with institutions and matches (1182 firms). The remainder either already have institutional ownership at the start of the sample period, or they join the sample afterwards but we lack their pre-transition data, or they lack one year of data after transition because they transition in the final sample year. The usual reason for lack of pre-transition data is that the institution arrives via a company newly created to take over an existing business (Section 3.2); the new company is the one in our sample, with no data before the takeover. Also, we exclude 68 firms which transition but the institution disinvested within two years of the transition year. Short transitory investments are unlikely to reduce funding constraints.

For the tests below, we match by industry and by the values of total investment, $\Delta ExtEquity$ and $\Delta Debt$ calculated over the two years before transition (years $t-2$ and $t-1$). It is crucial that transition and control firms share similar values for these variables before transition, because we test for differences in their values between transition and control firms on and after transition.[21] We find control firms for which the value for the variables is within a 30% calliper around the value for a given transition firm. If more than one potential match is identified, we select the closest one based on the sum of the quadratic distances of the matching variables. We find matches for 93 transition firms. Table IA3 shows the pre-transition means of explanatory variables for the transition and control firms. The means for the variables we match on—total investment, $\Delta ExtEquity$ and $\Delta Debt$—are not significantly different for transition and control firms, but the means for some of the control variables differ significantly. This is a consequence of requiring precise matching in the three key variables only.

Using the sample of 186 transition and control firms, we test whether transition leads to higher investment and external finance. Fig. 2 shows the means of the differences between transition and control firms for total investment, $\Delta ExtEquity$ and $\Delta Debt$, before and after the year of transition.[22] The differences are negligible in years $t-2$ and $t-1$, by construction. They become mostly positive in years $t=0$, 1 and 2. The most substantial increase in equity financing occurs during the year of transition, though transition firms also obtain significantly higher levels of equity financing in the subsequent year. This finding reinforces our argument that the observed higher level of external equity associated with institutional ownership is not merely mechanical (arising from acquisition of the stake), but arises because institutions provide or facilitate external financing on an ongoing basis. Moreover, Fig. 2a reveals that changes in total investment are modest in the year of transition but become more pronounced in the following years. These findings suggest that the increased external financing contributes to the observed growth in investment by transition firms. The higher investment levels are likely to be promoted by enhanced capacity for equity-raising following the transition to institutional ownership. Fig. 2c suggests that $\Delta Debt$ might be higher after transition, but this is not robust to the inclusion of control variables (Table 7, Panel C).

We test the effects of transition more formally through the following regression:

[21] For our main panel regressions the matching is different—we cannot match on investment, $\Delta ExtEquity$ or $\Delta Debt$ because we match as at the first year a firm with institutions enters the sample. Instead, we match by variables which might affect investment, rather than by investment itself.

[22] The dates of confirmation statements are not aligned with firms' year-ends, and the arriving institution acquires its stake some time before the institution first appears as a shareholder in a confirmation statement. These points mean that in some cases the actual firm-year of transition will be before the firm-year that we identify. We expect this error to bias downwards the results of the transition analysis.

Table 5
Investment and external finance.

Sample firms:	Inst. Ownership	Control	Inst. Ownership	Control
	(1)	(2)	(3)	(4)
ΔExtEquity	0.592***	0.835***		
	(7.83)	(5.25)		
ΔDebt	0.196***	0.177***		
	(7.03)	(5.97)		
LargeΔExtEquity			0.100***	0.114***
			(5.84)	(3.53)
LargeΔDebt			0.079***	0.057***
			(7.61)	(7.14)
InvOpp	0.132	0.019	0.115	0.027
	(0.86)	(0.91)	(0.72)	(1.29)
Control variables	Y	Y	Y	Y
Industry-year FE	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y
N firm-years	3863	4734	3863	4734
R^2	0.628	0.657	0.609	0.643

Regression results showing the relation between investment and external finance in the given firm-year, separately for companies with institutions and control companies. The dependent variable is total investment. Control variables are as in Table 4 and are omitted to conserve space. The variables are defined in Appendix 2. *t*-statistics are in brackets, using robust standard errors clustered at firm level. *** (**) (*) = significant at the 1% (5%) (10%) level.

$$Y_{it} = \alpha + \beta Post_{it} + \gamma(Transition_i \times Post_{it}) + \delta InvOpp_{it} + X_{it} + \zeta_{it} + \theta_i + \varepsilon_{it} \quad (4)$$

where *Y* is one of the variables measuring investment or external finance, *Transition* is a dummy variable equal to one for firms which transition, and *Post* is equal to one for years $t = 0$, 1 and 2, for each transition firm and its matched control firm. The effect of transition is captured by the interaction term *Transition* × *Post*. The coefficient on this term measures the difference in the outcomes between transition and control firms for years $t = 0$, 1 and 2. Also included are firm fixed effects (θ) in order that we measure the within-firm changes after transition; *InvOpp*; the same set of control variables (X) as in regression (1); and industry-year fixed effects (ζ). Data are included for up to two years before the year of transition ($t = 0$) and up to two years after, if available.

Table 6 shows abbreviated results. With total or intangible investment as dependent variable in Panel A, the coefficient on *Transition* × *Post* is positive, and significant at the 10% level of intangible investment. The values are smaller and less statistically significant than those in the equivalent panel regressions (Table 4). For example, with intangible investment as dependent variable, the coefficient is 0.040 ($t = 1.78$) on *Transition* × *Post* in Table 7, compared with 0.060 ($t = 6.49$) on *InstOwn* in Table 4. The coefficient is not significant when tangible investment is the dependent variable, as in the panel regressions. The results confirm that total and intangible investment increase, in relation to control firms, after firms first obtain institutional ownership, though the increase is modest.

Panel B shows results for whether firms become more sensitive to investment opportunities after transition. In these regressions the variable of interest is the triple interaction term *Transition* × *InvOpp* × *Post*, and we include *Transition* × *Post*, *InvOpp* × *Post* and *Transition* × *InvOpp* in the explanatory variables.[23] None of the coefficients on *Transition* × *InvOpp* × *Post* are significant, and the sign is negative with total or intangible investment as dependent variable. Hence, there is no evidence from these tests that firms become more sensitive to investment opportunities after transition.

Panel C shows results with measures of external equity and debt as dependent variable. For external equity, the coefficients on *Transition* × *Post* are positive and significant at the 1% level. With *ΔExtEquity* as dependent variable, the coefficient is 0.123 ($t = 4.10$). This compares with a coefficient on *InstOwn* of 0.016 ($t = 7.47$) in the equivalent panel regression (Table 4, Panel A). Our evidence suggests that institutions often acquire stakes by investing in newly issued shares—the positive effect on *ΔExtEquity* is not guaranteed, since institutions can acquire existing rather than new shares. With either measure of debt as dependent variable, the coefficient is not significant.

The evidence from the transition sample offers support for most of the evidence from the much larger sample analysis. After firms obtain institutional ownership, they raise more external equity, and to some extent they invest more. A plausible explanation for the modest short-term impact on investment is that financing by institutions takes place over several years. Firms raise external equity when institutions first invest, but do not spend all of the funds in the first one or two years, and institutions tend to provide more funds beyond the two-year horizon in the transition analysis.

[23] For an analogous panel difference-in-differences regression involving a triple interaction term, see Cohn, Nestoriak, and Wardlaw (2021, p. 4845).

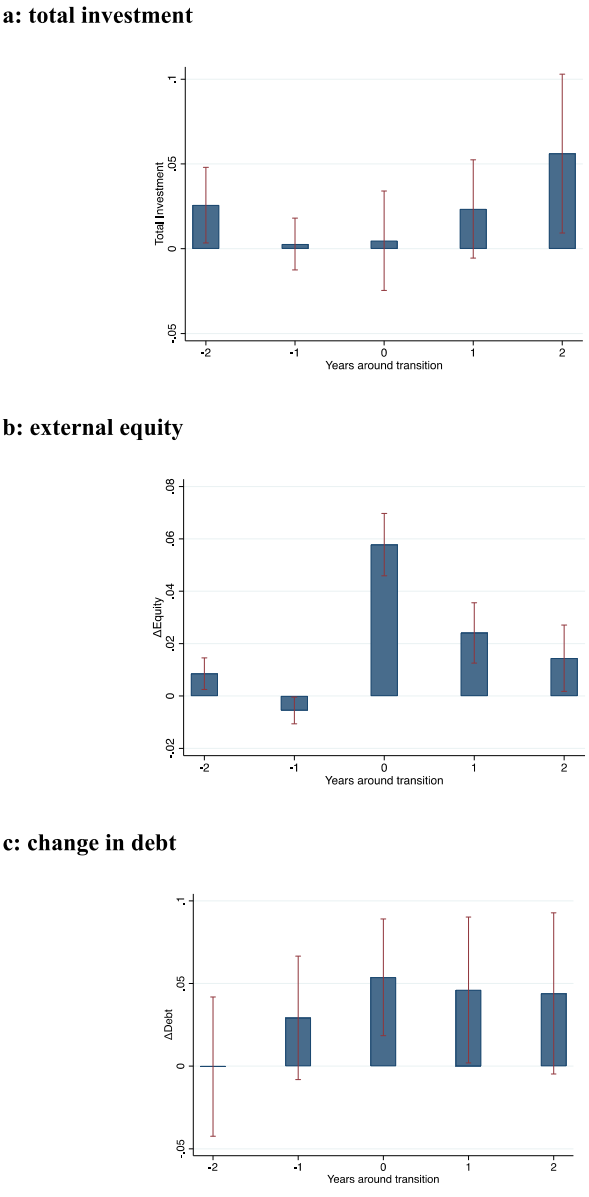

Fig. 2. Investment and external finance before and after transition to institutional ownership
The figures show the mean differences between 93 transition and 93 control firms in their values for total investment, external equity (Δ*ExtEquity*) and changes in debt (Δ*Debt*) over five years centred on the year of transition (year 0). This is the year a given transition firm first records institutional ownership. The values are proportions of $Assets_{t-1}$. The lines show ± one standard deviation around the means, i.e. the heights of the bars.

5.3. Results by controlling and minority institutional owner

We argue that the most plausible explanations for our results are either that institutions alleviate constraints, or that they intervene in firms' investment decisions. These explanations are not mutually exclusive, and which one dominates could vary across companies. Institutions with a majority stake can control their firm's investment policy, and investment could be higher in such firms because the institutions increase firms' investment for strategic reasons, not because the firm is less constrained. Institutions with a minority stake are less able to influence investment policy directly. Therefore, any effect on firm investment of institutions with minority stakes will more certainly be due to reduction in constraints. We note, though, that some VC and non-VC institutions own preference shares, which are likely to confer certain negotiated control rights (see, for example, Gornalls & Strebulaev, 2022). This point reduces the power of our test, because it implies that institutions with minority stakes have more control than is implied by their ownership of ordinary shares alone.

We now investigate whether the impact of institutions on investment differs between companies with controlling and minority stakes. Table 7 shows the subsample results in summary form for the regressions presented in Table 4. We observe positive and

Table 6
Tests around transition to institutional ownership.

Panel A	Total investment	Intangible investment	Tangible investment
	(1)	(2)	(3)
Post	−0.035*	−0.040**	0.003
	(-1.80)	(-2.19)	(0.55)
Transition* × *Post	**0.031**	**0.040***	**−0.005**
	(1.30)	**(1.78)**	**(-0.82)**
Control variables	Y	Y	Y
Firm fixed effects	Y	Y	Y
Industry-year fixed effects	Y	Y	Y
N firm-years	1306	1306	1367
R^2	0.616	0.628	0.363

Panel B	Total investment	Intangible investment	Tangible investment
	(1)	(2)	(3)
Post	−0.018	−0.030	0.013
	(-0.62)	(-1.13)	(1.17)
Transition × *Post*	0.076*	0.094**	−0.008
	(1.97)	(2.34)	(-0.85)
InvOpp × *Post*	−0.164	0.047	−0.212
	(-0.40)	(0.13)	(-1.40)
Transition × *InvOpp*	0.828*	0.920	−0.033
	(1.66)	(1.62)	(-0.35)
Transition* × *InvOpp* × *Post	**−0.830**	**−0.978**	**0.043**
	(-1.38)	**(-1.50)**	**(0.32)**
InvOpp	0.162	0.072	0.128
	(0.57)	(0.26)	(1.20)
Control variables	Y	Y	Y
Firm fixed effects	Y	Y	Y
Industry-year fixed effects	Y	Y	Y
N firm-years	1030	1030	1102
R^2	0.623	0.641	0.420

Panel C	Δ*ExtEquity*	*Large*Δ*Ext Equity*	Δ*Debt*	*Large*Δ*Debt*
Post	−0.036	−0.015**	−0.005	−0.015
	(-1.28)	(-2.04)	(-0.11)	(-0.63)
Transition* × *Post	**0.123*****	**0.021*****	**−0.005**	**−0.019**
	(4.10)	**(2.93)**	**(-0.13)**	**(-0.94)**
Control variables	Y	Y	Y	Y
Firm fixed effects	Y	Y	Y	Y
Industry-year fixed effects	Y	Y	Y	Y
N firm-years	1302	1302	1357	1357
R^2	0.389	0.445	0.175	0.202

The sample consists of 93 companies which transition to having institutional ownership during the sample period, and 93 matched companies using the matching procedure described in Section 4.3. Data are used for firm-years from $t = -2$ to $+2$, where $t = 0$ is the transition year. *Transition* is a dummy variable equal to one for firms that transition, and *Post* is a dummy equal to one for firm-years $t = 0$, 1 and 2. *t*-statistics are in brackets, using robust standard errors clustered at the *Firm* × *Post* level (Boucly et al., 2011). *** (**) (*) = significant at the 1% (5%) (10%) level.

significant effects of minority stakes on investment and the provision of external equity. This supports the idea that a motivation for minority ownership is alleviation of constraints, assuming that minority institutional owners have less control over investment policy. The positive effects of institutions are similar across the two groups. There is no significant effect of institutions on investment responsiveness for either group. We note that some of the external equity raised by firms in both groups is via issuance of preference shares, which does not increase institutions' holdings of ordinary shares, and helps explain how minority stakes can be associated with higher provision of external equity.

As a further test, we conduct a mediation analysis, to estimate the extent to which institutional ownership affects total investment through the financing channel. The analysis involves a two-equation system using a cross-sectional sample. In the first equation, the dependent variable is total investment and the key explanatory variables are *InstOwn* and Δ*ExtEquity*. In the second equation, the dependent variable is Δ*ExtEquity* and the key explanatory variable is *InstOwn*. Panel A of Table 8 reports abbreviated results, for the full sample and separately for firms with controlling and minority stakes. Panel B reports estimates of the direct and indirect effects of *InstOwn* on investment. The direct effect can be interpreted as the impact of institutional ownership that is separate from via financing, i.e. through influence or control over investment policy. The indirect effect estimates the impact of institutions via provision of finance. For the full sample, the coefficients on the two types of effect are similar in size, but the indirect effect (financing) is significant at the 1% level, whereas the direct effect is not reliably different from zero. The same applies to both subsamples. For firms with controlling institutional stakes, the direct effect (investment policy) is larger in relation to the indirect effect than for firms with minority stakes, as expected. However, the difference is not significant.

Table 7
Results by size of institutional ownership.

Dependent variable:	Total investment	Intangible investment	Tangible investment	*ΔExtEquity*	*LargeΔExt Equity*	*ΔDebt*	*LargeΔDebt*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Controlling stakes (1)	0.062***	0.064***	−0.000	0.017***	0.079***	0.006	0.019
	(4.00)	(4.17)	(-0.14)	(5.10)	(5.57)	(0.52)	(1.19)
N firm-years	3852	3852	4229	3946	3946	4229	4229
R^2	0.206	0.233	0.150	0.156	0.121	0.007	0.056
Minority stakes (2)	0.064***	0.060***	0.004	0.018***	0.079***	0.001	0.015
	(5.46)	(5.35)	(1.36)	(6.54)	(7.30)	(0.13)	(1.18)
N firm-years	6272	6272	6783	6481	6481	6783	6783
R^2	0.189	0.220	0.161	0.194	0.151	0.028	0.056
Difference: (1) − (2)	−0.002	0.004	−0.004	−0.001	0.000	0.005	0.004
t-stat	(-0.14)	(0.11)	(-1.07)	(-0.20)	(-0.01)	(0.38)	(0.22)

Summarised results for the regressions in Table 4, for subsamples of companies with institutions and control companies sorted by the size of institutional shareholdings. Control variables and industry-year fixed effects are included in all cases. *t*-statistics for the coefficients are in brackets, using robust standard errors clustered at firm level. *t*-statistics for the differences are calculated from regressions of the form $Y_{it} = \alpha + \beta(D \times InstOwn_{it}) + \gamma InstOwn_{it} + \delta(D \times X_{it}) + \theta X_{it} + D \times \zeta_{it} + \zeta_{it} + \varepsilon_{it}$ where D is a dummy variable indicating a subgroup, e.g. firms with controlling stakes. The standard errors are clustered at the $D \times Firm$ level. We report the *t*-statistic for the coefficient β. *** (**) (*) = significant at the 1% (5%) (10%) level.

Table 8
Mediation analysis.

Panel A	Full sample		Controlling stakes		Minority stakes	
	Total investment	*ΔExtEquity*	Total investment	*ΔExtEquity*	Total investment	*ΔExtEquity*
	(1)	(2)				
InstOwn	0.022*	0.016***	0.024	0.017***	0.019	0.016***
	(1.95)	(6.09)	(1.40)	(4.54)	(1.27)	(5.49)
ΔExtEquity	1.315***		1.087***		1.440***	
	(8.72)		(5.11)		(7.42)	
Controls	Y	Y	Y	Y	Y	Y
N firms	2364		1048		1498	

Panel B	Coefficient	Standard error	*Z*-statistics	Percentage of total effects
Full sample:				
Total effect	0.043***	0.012	3.67	
Direct effects (D)	0.022*	0.011	1.95	50%
Indirect effects (I)	0.021***	0.004	5.42	50%
Difference (D) − (I)	0.001	0.013	0.12	
Controlling stakes:				
Total effect	0.043***	0.017	2.48	
Direct effects	0.024	0.017	1.40	55%
Indirect effects	0.019***	0.006	3.36	45%
Difference	0.005	0.019	0.28	
Minority stakes:				
Total effect	0.042***	0.016	2.63	
Direct effects	0.019	0.015	1.27	45%
Indirect effects	0.023***	0.004	5.03	55%
Difference	−0.003	0.015	0.19	
Difference between controlling and minority stakes:				
Total effect	0.001	0.023	0.04	
Direct effects	0.003	0.023	0.13	
Indirect effects	−0.004	0.007	−0.52	

Mediation analysis showing the extent to which institutional ownership affects total investment through the financing channel. Panel A reports estimates of a two-equation system, using a cross-sectional sample. In the first equation, the dependent variable is total investment and the key independent variables are *InstOwn* and *ΔExtEquity*. In the second equation, the dependent variable is *ΔExtEquity* and the key independent variable is *InstOwn*. Control variables in the two equations are the same as the regressions in Table 4. The variables are defined in Appendix 2. *t*-statistics are in brackets, using bootstrap standard errors (iterations = 500). Panel B summarises the direct effects of having institutional ownership on total investment, and its indirect effects through alleviating financing constraints. The sum of *N* for the subsamples exceeds *N* for the full sample because firms which change ownership category during the sample period appear in both subsamples. *** (**) (*) = significant at the 1% (5%) (10%) level.

To pursue our argument further, we compare the turnover over time of directors between firms with institutions and matched firms, again splitting the sample between firms with controlling and minority institutional stakes. If controlling stakes confer more power and inclination of institutions to intervene in how investee firms are managed, we expect the turnover of directors to be greater in firms with controlling stakes. We obtain data on director name and tenure from FAME. Director turnover is measured as a dummy variable that equals one if a company terminates the appointment of a director in a given year, and zero otherwise. Table 9 shows the results. For the full sample, we find that institutional ownership is associated with a greater turnover of directors, as expected.[24] The coefficient on *InstOwn* is positive and significant at the 5% level. We also find that turnover is greater among firms with controlling institutional stakes; the coefficient on *InstOwn* is smaller, and not significant, for the sample of firms with minority stakes. However, the difference between the coefficients is not significant. This evidence suggests that the extent of institutions' involvement in how companies are managed is somewhat greater if they have control, as measured by their ownership of ordinary shares. If anything, institutions are more likely to control investment policy if they have a controlling than a minority stake. Therefore, in the case of firms with minority institutional stakes, the impact on investment is more likely to be through alleviation of constraints, rather than direct control of investment policy.

5.4. Results by VC and non-VC institutional owner

This section presents separately the effects of VC and non-VC institutions investing independently. A potential challenge for solo involvement by non-VC investors is their lack of experience in investing in private firms, as highlighted by Fang et al. (2015). Consequently, non-VC investors may not have the skills and connections with other private financiers to facilitate external financing, and to ensure that the additional funds provided translate into positive-NPV expenditure. On the other hand, non-VC investors might not operate under a defined time horizon that requires them to exit their companies after a certain number of years. The reduced pressure to exit may enable them to provide funds over a longer holding period. Hence, the effects of non-VC institutions on investee companies, compared with that of VCs, are uncertain.

Table 10 shows the subsample results in abbreviated form for the regressions in Table 4. Both VC and non-VC institutions are associated with greater levels of intangible investment than matched firms, and greater external equity finance, and we find in addition that VC investors have significantly more impact on external funding. For the group of VC-backed firms, the estimated coefficient on *InstOwn* when the dependent variable is intangible investment is 0.075 ($t = 5.49$); the coefficient for firms with non-VC investors is 0.050 ($t = 3.57$). However, the difference is not statistically significant. Turning to external equity finance, the coefficients on *InstOwn* for both VC and non-VC groups are positive and significant at the 1% level. The coefficients are larger for the VC group, and the difference is marginally significant ($t = 1.86$ when $\Delta ExtEquity$ is dependent variable). We also find that VC investors promote debt finance. The coefficient on *InstOwn* when $\Delta Debt$ is the dependent variable is positive and significant at the 10% level, and is significant at the 1% level when debt finance is measured by $Large\Delta Debt$. By contrast, we do not find that non-VC institutions facilitate debt finance; the coefficients are negative, though not significant. Overall, we find that both VC and non-VC institutions have a positive impact on reducing funding constraints and promoting investment by investee firms, though the effect turns out to be somewhat smaller for non-VC institutions.

We also investigate whether VC and non-VC investors have different levels of control over investee firms. Based on existing evidence, we expect VC investors to intervene in decision-making by their portfolio firms via the appointment of directors. It is uncertain *a priori* whether non-VC investors are as active as VC investors in monitoring. Column 8 of Table 10 shows the summarised results. VC ownership is associated with greater director turnover, as compared with control firms. However, the estimated coefficients are significant only at the 10% level. By contrast, non-VC ownership has no significant impact on director turnover.

5.5. Further tests

(i) *Analysis using an instrumental variable.* As a further step to reduce concerns about endogeneity, we conduct an instrumental variable analysis. Our instrument for institutional ownership is the percentage of companies with institutions within a given two-digit postcode area (*%Area*). The instrument predicts whether a given company has institutions, but arguably is not related to the level of investment or other features of the company, except through the potential impact of the institutions. The argument is that control firms in our study would have been more likely to receive institutions, had they been situated in the same geographic area as their counterparts with institutions, because proximity of a firm to an institution or lender facilitates investment in its equity or debt. Our use of *%Area* is consistent with location-based variables that have been used as instruments for a variety of company features. For example, Gogineni, Linn, and Yadav (2022) use UK companies' proximity to each other as an instrument for similarity in their ownership structure; Saunders and Steffen (2011) employ distance from London as an instrument for access to investment banks; Cumming and Zambelli (2017) use distance of VC funds from investee companies as an instrument for the extent of funds' due diligence before investing. However, we acknowledge that our instrument might not satisfy the exclusion restriction: firms with high growth potential could choose to locate or re-locate to be close to VC investors.

[24] We show results estimated by both probit and OLS models. We use probit because the dependent variable is a dummy variable, and OLS to enable inclusion of industry-year fixed effects. In the probit regression for the full sample, the marginal effect is 0.038, which implies that turnover per year is about 4% more likely.

Table 9
Director turnover by size of institutional ownership.

	Full sample		Controlling stakes		Minority stakes	
	Probit	OLS	Probit	OLS	Probit	OLS
	(1)	(2)	(3)	(4)	(5)	(6)
InstOwn	0.113**	0.039**	0.177*	0.061*	0.077	0.034
	(2.06)	(2.02)	(1.87)	(1.70)	(1.21)	(1.52)
Controls	Y	Y	Y	Y	Y	Y
Industry-year FE	N	Y	N	Y	N	Y
N firm-years	3616	3453	1292	1142	2523	2351
(Pseudo) R^2	0.015	0.020	0.019	0.024	0.013	0.018
Marginal effect	0.038		0.060		0.026	
Difference			0.100	0.027		
t-stat			(0.83)	(0.57)		

Regression results showing the relation between director turnover and *InstOwn*. The dependent variable is a dummy variable that equals one if a company terminates the appointment of a director in a given year, and zero otherwise. Columns (1), (3), and (5) show the estimates of probit regressions and columns (2), (4), and (6) show the estimates of OLS regressions, controlling for industry and year fixed effects. Pseudo R^2 is reported for the probit regressions. Difference = coefficient on *InstOwn* for controlling stakes minus the same for minority stakes; see Table 7 for calculation of the *t*-statistic. The sum of *N* for the subsamples exceeds *N* for the full sample because firms which change ownership category during the sample period appear in both subsamples. The variables are defined in Appendix 2. *t*-statistics are in brackets, using robust standard errors clustered at firm level. *** (**) (*) = significant at the 1% (5%) (10%) level.

Table 10
Results by type of institutional ownership.

Dependent variable:	Total investment	Intangible investment	Tangible investment	*ΔExtEquity*	*LargeΔExt Equity*	*ΔDebt*	*LargeΔDebt*	Director turnover
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VC stakes (1)	0.075***	0.073***	0.001	0.020***	0.096***	0.016*	0.041***	0.045*
	(5.49)	(5.43)	(0.44)	(6.63)	(7.73)	(1.67)	(2.89)	(1.81)
N firm-years	5261	5261	5782	5494	5494	5782	5782	1826
R^2	0.210	0.233	0.103	0.201	0.164	0.015	0.051	0.011
Non-VC stakes (2)	0.050***	0.048***	0.003	0.012***	0.048***	−0.011	−0.015	0.015
	(3.57)	(3.65)	(0.83)	(4.11)	(4.07)	(-1.30)	(-0.98)	(0.50)
N firm-years	4302	4302	4640	4373	4373	4640	4640	1680
R^2	0.185	0.218	0.186	0.154	0.115	0.011	0.055	0.018
Difference (1) − (2)	0.025	0.025	−0.002	0.008*	0.048***	0.026**	0.056***	0.030
t-stat	(1.27)	(1.34)	(-0.48)	(1.86)	(2.71)	(2.05)	(2.66)	(0.66)

Summarised results for the regressions in Tables 4 and 10, for subsamples of companies with institutions and control companies sorted by the type of institutions. In column (8) the dependent variable is a dummy variable that equals one if a company terminates the appointment of a director in a given year, and zero otherwise, and the coefficients shown are estimated via OLS including industry-year fixed effects (the results are qualitatively similar if estimated via Probit). The key independent variable is *InstOwn*. Control variables and industry-year fixed effects are included in all cases. Difference = coefficient on *InstOwn* for VC stakes minus the same for nonVC stakes; see Table 7 for calculation of the *t*-statistic. *N* = the number of companies with institutions in each subsample, for the regression for total investment (*N* varies slightly across the other regressions). *t*-statistics are in brackets, using robust standard errors clustered at firm level. *** (**) (*) = significant at the 1% (5%) (10%) level.

We construct *%Area* using the matched sample used in our baseline analysis. This ensures that firms with institutions and control firms share similar characteristics, including industry.

Panel A of Table IA4 shows the results for investment. In the first stage, *InstOwn* is regressed on *%Area*. The coefficient on *%Area* is positive and highly significant, confirming the predictive power of the instrument. In the second stage, the three measures of investment are regressed on the predicted value of *InstOwn* (*PredInstOwn*), using *%Area* for each firm and the coefficient from the first stage (*PredInstOwn* is a continuous variable rather than one or zero as for *InstOwn*). The Kleibergen-Paap rk LM statistic is significant, which rejects under-identification and suggests that the instrument is relevant. Weak identification is rejected by the Cragg-Donald Wald F statistic which exceeds the Stock-Yogo critical value, suggesting that the instrument is correlated with our endogenous regressor. With investment or intangible investment as the dependent variable, the coefficient on *PredInstOwn* is positive and highly significant, as in the main results in Table 4. With tangible investment as the dependent variable, the coefficient on *PredInstOwn* is slightly negative and significant.

Panel B shows results for responsiveness of investment. With investment or intangible investment as the dependent variable, the coefficient on *PredInstOwn* × *InvOpp* is positive and significant at the 5% level. With tangible investment, the coefficient is not

significant. Panel C shows results for external finance. With measures of external equity as the dependent variable, the coefficient on *PredInstOwn* is positive and highly significant, as in Table 4. With Δ*Debt*, the coefficient is also positive, and significant at the 5% level, which differs from the main results in which there is no significant relation between institutional ownership and borrowing. Overall, the results using *%Area* as an instrument for *InstOwn* offer strong support for the main results.

(ii) *Continuous measures of institutional ownership.* In our analyses so far, institutional ownership is captured simply by a dummy variable, or in Table 7 a distinction is made between controlling and minority stakes. A natural question is whether explanatory power improves using a continuous ownership variable. A continuous variable might capture better the potential for institutional impact, for example if institutions promote investment or external funding by creating a network of co-investing institutions. Such a network would be suggested by larger institutional ownership as a percentage of the shares, or a larger number of distinct institutional shareholders.

To investigate this possibility, we supplement *InstOwn* by either (i) the proportion of ordinary shares owned by institutions (*NInst*), or (ii) the number of separate institutions owning ordinary shares (*InstHolding*) (we do not have these data items for non-voting shares). We re-run the regressions in Table 4, for the level of investment and external finance. Table IA5 shows the summarised results. The coefficients on *NInst* and *InstHolding* are not significant With *InstOwn* replaced by one or other of the continuous variables, neither has greater explanatory power than *InstOwn* (not shown). This evidence suggests that the impact of institutional ownership on investment and external finance does not increase with the number of institutional shareholders, nor with the size of institutional ownership.

(iii) *Entropy balancing of matched firms.* Our tables show results in which each firm with institutions is matched with a single control firm. As a robustness check, we run the panel regressions after performing entropy balancing on the sample of control firms. This technique assigns different weights to the same set of control firms, with a view to balancing the two distributions of each continuous control variable across the two groups of firms (Hainmueller, 2012). The weights are estimated by minimising the differences between the first two moments across each pair of distributions, with a tolerance level (a maximum deviation across the specified moment) of 0.1. We conduct the rebalancing separately for firms within each industry, as measured by SIC code. The distribution of the weights is shown in Panel A of Table IA6.

The result of entropy balancing is that the distributions of firm size, age and other characteristics become more similar for the two groups of firms, as shown in Panel B, which arguably results in closer matching. Panel C shows that the results using entropy-balanced control firms are qualitatively similar to those shown in previous sections, indicating that our results are robust to entropy balancing.

(iv) *Correlated random effects.* In the baseline regression analyses, we do not include firm fixed effects. As an alterative to pooled OLS, we apply the correlated random-effects (CRE) method of estimation. This involves calculating the mean values of the time-varying variables (including year dummies) over the sample period, and adding the mean values as further control variables in equation (1). We then re-estimate the regressions. Table IA7 shows that the results estimated by the CRE method are similar to those estimated by pooled OLS in our baseline results. We note that, for a time-fixed variable such as *InstOwn* (our variable of interest), CRE does not necessarily deliver a coefficient that is less biased than the coefficient using pooled OLS (Woolridge, 2013, p. 27 notes that one must 'use caution' in interpreting the coefficient on a time-fixed variable). We confirm, through an unreported simulation exercise, that the coefficient from CRE can be more biased.

(v)*Results by size of firm, and excluding young firms.* We argue that a benefit of institutional ownership is alleviation of funding constraints in established firms that are not startups dependent on external funding to survive. The full sample of firms with institutions includes firms of various sizes and ages. Although all have positive sales for every firm-year they are in the sample, some of them are small or very young, and may be at the startup stage. To examine whether our results are explained by possible startups, we split the sample firms into quartiles each year by total assets within the firm's industry, and run the regressions in Tables 4 and 5 (columns 1 and 3) for each quartile. The results are summarised in Table IA8. We see that the results hold for firms of all sizes, and are not restricted to the smallest firms. We also run the regressions excluding firm-years in which the firm's age is three years or younger (not shown). The exclusion of young firms makes little difference to the results. This shows that the results apply to firms that are older than three years.

(vi) *Family firms only.* The above results involve firms with institutions and control firms with various different types of owner, aside from any institutional ownership. For example, some of the firms with minority institutional ownership are widely held, or controlled by an operating company, and they might be less financially constrained than family firms. In addition, the incidence of ownership classification errors in FAME is lowest for shareholders who are individuals, from whom we identify family control. To obtain a homogeneous and possibly more reliable sample in terms of controlling ownership, we restrict the sample to firms with minority institutional ownership that are controlled by a family, and to control firms that are all also controlled by a family. Table IA9 shows the results. The effects of minority ownership are similar to those for the full sample of firms with minority institutional stakes, summarised in Table 7. Therefore, the results in the full sample for minority stakes are not due to the inclusion of firms with non-family shareholders.

6. Conclusion

We test the hypothesis that institutions promote investment by established private companies via alleviating their financial

constraints. We use accounting data to measure investment, together with detailed ownership data, disclosed by private companies in the UK. Our evidence supports the hypothesis, showing that investment in intangible though not tangible assets is higher in firms with institutions, compared with otherwise similar control firms. External equity funding is also higher. These benefits arise even when the institution only has a minority stake, and might not control the company's policies. The evidence supports the view that that a primary motive for investing without taking control is to facilitate the provision of external funds, and to meet a demand for such funds on the part of investee firms. A large minority of our sample consists of firms with non-VC institutional ownership, in which there is no VC involvement. We find that the positive effects on firm investment and external fundraising apply to non-VC as well as VC ownership, though the effects are somewhat less for non-VC ownership.

Prior studies document positive effects of VC ownership in startups (for example, Hellmann & Puri, 2002; Bernstein et al., 2016; Gompers, Gornall, Kaplan, & Strebulaev, 2020). Our evidence suggests that the benefits of institutional ownership likely extend beyond the startup stage of a company. Both VCs and an increasing number of non-VC institutions supply funds to established private companies with growth opportunities, and those companies can benefit from institutional ownership in terms of better access to funds. Managers are not necessarily expected to relinquish control, as many institutions acquire only a minority stake. The evidence supports the view that mature private companies (not just startups) would benefit from attracting institutional shareholders. Owners and managers of private companies should therefore consider seeking out institutional investors, especially if the company has potential to expand.

One area for further study is the role and impact of each of the different types of institution that fall within our broad non-VC category. They could have differing objectives, and differing effects on firms. Another area is the market or selection process by which VC and non-VC institutions acquire stakes in private companies which are already well established, with material assets and revenues, and which have not previously received institutional investment.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.bar.2025.101585.

Appendix 1. Identifying ownership using FAME data

Missing or inaccurate data. FAME's ownership data have improved following a major upgrade in 2016. The online interface now provides historic data for ten years, rather than the most recent year only, and it provides lists of shareholders that are complete, rather than complete only if there are up to 25 shareholders.[25] However, ownership data are completely missing for some firm-years, and in other cases data about certain shareholders are missing or recorded into the wrong year, such that the total number of shares does not add up to around 100%.[26] Around 20% of firms have at least one year's ownership missing due to one or other of these reasons. We only retain firm-years for which the shareholdings shown sum to between 98% and 102%, otherwise we treat the data for the year as missing. To avoid discarding all these firms, we impute missing values of shareholdings as follows. For firms with institutional ownership, we use the previous year's holding if this is the same as the holding in the following year. Otherwise, we hand-collect the missing data. Potential control firms are much more numerous, and for them we simply use the previous year's holding, if available.

Identifying ultimate owners and the controlling party. We identify the ultimate owners of shareholders that are operating or holding companies with a combined stake of at least 20%, unless one shareholder is an operating company with a direct holding of more than 50%—in which case the investee company is identified as a subsidiary. A shareholding company is classed as a holding company if it has zero assets, sales and employees. The indirect stake of an ultimate owner is defined by the minimum stake in the ownership chain, rather than by multiplying the stakes. For example, if operating company A owns 20% of holding company B, which owns 50% of investee company C, A is an ultimate owner that indirectly owns 20% of C. We sum the direct and indirect stakes of each ultimate owner to arrive at their total stake. A company is identified as a subsidiary if the indirect, as well as direct, holdings of a given operating company exceed 50%.

We do not check the ownership of foreign-registered holding companies, because FAME does not include data on foreign companies. A company more than 50% owned by a foreign holding company is excluded from the sample eligible for our analysis (see Table 1). But a company with a stake owned by a foreign holding company of up to 50% is retained, and the stake is counted as

[25] Historic data were previously available on DVD. To confirm the reliability of the online data, we manually checked the shareholdings in FAME of the 100 largest companies in our sample against the holdings in the confirmation statements, for our most recent sample year (2019).

[26] In FAME the shareholdings shown should always sum to 100% of the number of shares given for the firm-year. This is because, if a shareholding exists but is not listed in FAME, the relevant shares are also excluded from the total, which will therefore be less than the number of shares actually in issue. Our checks against confirmation statements suggest that it is rare for FAME's total to be less than the number of shares in issue according to the Statements.

belonging to an operating company.

Based on the holdings of the ultimate owners, we then identify the controlling party of each firm, defined as the party with the largest holding of ordinary shares, subject to a minimum of 20%. If no party owns more than 20%, the firm is classed as widely held. Types of controlling owner include family or individual, institutional investor(s), operating company (with a stake between 20% and 50%), government or not-for-profit institution, and nominee accounts, the owners of which have not been disclosed. We distinguish between companies with a controlling institutional party and minority (non-controlling) party. A minority holding is defined as one that is not the largest holding, or is less than 20% of the ordinary shares, or is a holding of non-voting (including preference) shares. In addition, we assume that institutions of the same broad type (i.e., VC or non-VC) will co-ordinate their voting and monitoring. Hence, we sum the holdings of VC-style funds and treat the total as a single shareholding party, and the same for the holdings of non-VC investors. If a firm has both VC and non-VC minority holdings, it is classed as a firm with a VC minority stake even if the non-VC stake is larger. This rule enables us to cleanly isolate firms with non-VC minority ownership.

Identifying institutional investors. We start with all shareholders that are categorised by FAME under its headings 'bank', 'hedge fund', 'insurance company', 'private equity', 'venture capital', and the rather mixed group 'mutual fund and pension fund, nominee, trust and trustees'. In addition, we include any shareholder whose name contains 'LP', 'Limited Partner' or 'VCT', regardless of FAME's classification, because the shareholder is likely to be a PE fund. Since the 'mutual fund … ' group includes shareholders other than institutional investors, we only keep those that have certain key words in their names. For example, a potential pension fund is identified by the key words 'pension', 'retirement', 'RERT' or 'employee(s)'. To ensure that minority institutional ownership always involves a non-negligible stake, and to limit the task of checking shareholders, we check and classify institutional holdings of a minimum of two per cent of a firm's ordinary shares, plus any holdings of non-voting shares.

We check by hand the identity and type of all investors (over 3000) that could be institutions given FAME's classification as described above. We search for each institution's name in Pitchbook, and use the primary investor type indicated by Pitchbook. If the name is not in Pitchbook, we search in Capital IQ and Eikon. If that fails, we examine websites and media reports, and refer to the list of limited partners and general partners provided by the British Private Equity & Venture Capital Association (BVCA) and the European Private Equity & Venture Capital Association (EVCA). If we fail to establish an investor's identity from any of these sources, we exclude the investor and the companies it invests in from the sample eligible for analysis. The checks by hand are necessary; for example, many shareholders in FAME's 'mutual fund … ' group turn out not to be institutions, but rather family or individual trusts, or (holding companies of) operating companies.

Our classification of institutions as either VC or non-VC is based on manual checks using the above sources. In most cases the institution's type is clear, but sometimes judgement is called for. For example, a few large banks have subsidiaries that conduct PE or VC investment. For example, Barclays plc owns Barclays Unquoted Investment Ltd; Lloyds Banking Group plc owns Lloyds Development Capital Ltd. In these cases we class a shareholding held by the parent bank as non-VC (the investor is the bank), whereas a holding of the VC subsidiary is classed as VC. Similarly, if an asset manager has a separate VC operation, we follow the same classification rule as for a bank. If it has no separate VC operation, we judge its type by whether it is registered as a limited or a general partner with BVCA or EVCA, or we rely on its primary type as indicated by Pitchbook.

We include institutional ownership of non-voting shares. This is important because VC and mutual funds frequently invest via such shares, especially convertible preference shares (e.g. Chernenko et al., 2021). The FAME interface records the owners of non-voting shares for the most recent year available, which was 2019 when we collected the data. For the previous nine sample years we hand-collect whether non-voting shares have institutional owners from confirmation statements.

Identifying family ownership. To measure a family's holding, we sum the stakes held by family members and family trusts, on the assumption that shareholders in the same family co-ordinate their voting and monitoring. We use the surnames of shareholding individuals to determine whether they belong to the same family. A shareholding in joint names is counted as held by the first-named person. A shareholder is counted as a family trust only if its name includes the words 'trust' or 'trustee', and the relevant family's surname. If a trust represents more than one family, we split the shares it holds equally among the different families.

Appendix 2. Definition of variables

The financial variables are calculated from data in FAME. Our terminology in the definitions follows that of FAME. *t* refers to a firm-year.

Name	Abbreviation	Definition
Age	Age_t	Ln(firm's age in years) as at firm-year *t*
Assets	$Assets_t$	Total assets as at firm-year *t*
Cash: lagged cash holdings	$Cash_{t-1}$	Cash holdings$_{t-1}$/$Assets_{t-1}$
Debt: change in debt	$\Delta Debt_t$	(Total debt$_t$ − Total debt$_{t-1}$)/$Assets_{t-1}$
Debt: large increase in debt	$Large\Delta Debt_t$	Dummy variable set to 1 if $\Delta Debt > 10\%$, and zero otherwise
External equity: change in external equity	$\Delta ExtEquity_t$	{(Share capital + Share premium account)$_t$ − (Share capital + Share premium account)$_{t-1}$}/$Assets_{t-1}$
External equity: large external equity issuance	$Large\Delta ExtEquity_t$	Dummy variable set to 1 if $\Delta ExtEquity > 10\%$, and zero otherwise

(*continued on next page*)

(*continued*)

Name	Abbreviation	Definition
Institutional ownership	$InstOwn_t$	Dummy variable set to one if the firm has institutional ownership in firm-year t, and zero otherwise. Institutions included are stated in Section ??
Investment: total investment	n.a.	Investment in intangible assets + investment in tangible assets
Investment in intangible assets	n.a.	$\{R\&D\ expense_t + 30\%\ of\ Sales,\ general\ and\ administrative\ (SG\&A)\ expenses_t + (Intangible\ assets_t - Intangible\ assets_{t-1}) + Amortisation_t\}/Assets_{t-1}$
Investment in tangible assets	n.a.	$\{Property,\ plant\ and\ equipment\ (PPE)_t + Depreciation_t\}/Assets_{t-1}$
Investment opportunities	$InvOpp_t$	Median sales growth in the firm's industry, based on the UK Standard Industrial Classification. If firm-year t ends between 1 January and 30 June (1 July and 31 December), we use industry sales growth for calendar year $t-1$ (t).
Leverage: lagged leverage	$Leverage_{t-1}$	$(Total\ debt)_{t-1}/Assets_{t-1}$
Return on assets	ROA_t	$Operating\ profit_t/Assets_{t-1}$
Short-term debt: change in short-term debt	$\Delta ShortDebt_t$	$(Short\text{-}term\ debt_t - Short\text{-}term\ debt_{t-1})/Assets_{t-1}$
Size	$Size_t$	$Ln(Assets_t)$
Working capital: change in working capital	$\Delta WorkingCap_t$	$\{(Current\ assets - Current\ liabilities)_t - (Current\ assets - Current\ liabilities)_{t-1}\}/Assets_{t-1}$

Data availability

Data will be made available on request.

References

Asker, J., Farre-Mensa, J., & Ljungqvist, A. (2015). Corporate investment and stock market listing: A puzzle? *Review of Financial Studies, 28*, 342–390.
Banker, R. D., Huang, R., Natarajan, R., & Zhao, S. (2019). Market valuation of intangible asset: Evidence on SG&A expenditure. *The Accounting Review, 94*, 61–90.
Bernstein, S., Giroud, X., & Townsend, R. R. (2016). The impact of venture capital monitoring. *The Journal of Finance, 71*, 1591–1622.
Bernstein, S., Lerner, J., & Mezzanotti, F. (2019). Private equity and financial fragility during the crisis. *Review of Financial Studies, 32*, 1309–1373.
Bernstein, C., & Sheen, A. (2016). The operational consequences of private equity buyouts: Evidence from the restaurant industry. *Review of Financial Studies, 29*, 2387–2418.
Boucly, Q., Sraer, D., & Thresmar, D. (2011). Growth LBOs. *Journal of Financial Economics, 102*, 432–453.
Braun, R., Jenkinson, T., & Schemmerl, C. (2020). Adverse selection and the performance of private equity investments. *Journal of Financial Economics, 136*, 44–62.
Brav, O. (2009). Access to capital, capital structure, and the funding of the firm. *The Journal of Finance, 64*, 263–308.
Brown, J. R., Martinsson, G., & Petersen, B. C. (2013). Law, stock markets, and innovation. *The Journal of Finance, 58*, 1517–1549.
Chemmanur, T. J., Krishnan, K., & Nandy, D. K. (2011). How does venture capital financing improve efficiency in private firms? A look beneath the surface. *Review of Financial Studies, 24*, 4037–4090.
Chernenko, S., Lerner, J., & Zeng, Y. (2021). Mutual funds as venture capitalists? Evidence from unicorns. *Review of Financial Studies, 34*, 2362–2410.
Cohn, J., Hotchkiss, E., & Towery, E. (2022). Sources of value creation in private equity buyouts of private firms. *Review of Finance, 26*, 257–285.
Cohn, J., Nestoriak, N., & Wardlaw, M. (2021). Private equity buyouts and workplace safety. *Review of Financial Studies, 34*, 4832–4875.
Corrado, C., Haskel, J., Jona-Lasinio, C., & Iommi, M. (2022). Intangible capital and modern economies. *The Journal of Economic Perspectives, 36*, 3–28.
Cumming, D., & Zambelli, S. (2017). Due diligence and investee performance. *European Financial Management, 23*, 211–253.
Davis, S. J., Haltiwanger, J., Handley, K., Jarmin, R., Lerner, J., & Miranda, J. (2014). Private equity, jobs and productivity. *The American Economic Review, 104*, 3956–3990.
Davydova, D., Fahlenbrach, R., Sanz, L., & Stulz, R. M. (2024). *Why do startups become unicorns instead of going public?* National Bureau of Economic Research working. paper 30604.
DeAngelo, H., DeAngelo, L., & Stulz, R. M. (2010). 'Seasoned equity offerings, market timing and the corporate lifecycle. *Journal of Financial Economics, 95*, 275–295.
Eaton, C., Howell, S. T., & Yannelis, C. (2020). When investor incentives and consumer interests diverge: Private equity in higher education. *Review of Financial Studies, 33*, 4024–4060.
Erel, I., Jang, Y., & Weisbach, M. S. (2015). Do takeovers relieve target firms' financial constraints? *The Journal of Finance, 70*, 289–328.
Ewens, M., & Farre-Mensa, J. (2020). The deregulation of the private equity markets and the decline in IPOs. *Review of Financial Studies, 33*, 5463–5509.
Ewens, M., Rhodes-Kropf, M., & Strebulaev, I. (2016). *'Insider financing and venture capital returns'*. working paper.
Ewens, M., & Sosyura, D. (2023). *'Irreplaceable venture capitalists'*. working paper.
Fang, L., Ivashina, V., & Lerner, J. (2015). The disintermediation of financial markets: Direct investing in private equity. *Journal of Financial Economics, 116*, 160–178.
Gilje, E. P., & Taillard, J. P. (2016). Do private firms invest differently than public firms? Taking cues from the natural gas industry. *The Journal of Finance, 71*, 1733–1777.
Gogineni, S., Linn, S. C., & Yadav, P. K. (2022). Vertical and horizontal agency problems in private firms: Ownership structure and operating performance. *Journal of Financial and Quantitative Analysis, 57*, 1237–1278.
Gompers, P. A., Gornall, W., Kaplan, S. N., & Strebulaev, I. A. (2020). How do venture capitalists make decisions. *Journal of Financial Economics, 135*, 169–190.
González-Uribe, J. (2020). Exchanges of innovation resources inside venture capital portfolios. *Journal of Financial Economics, 135*, 144–168.
Gornalls, W., & Strebulaev, I. A. (2022). *'The contracting and valuation of venture capital-backed companies'*. working paper.
Hainmueller, J. (2012). Entropy balancing for causal effects: A multivariate reweighting method to produce balanced samples in observational studies. *Political Analysis, 20*, 25–46.
Hellmann, T., & Puri, M. (2002). Venture capital and the professionalization of start-up firms: Empirical evidence. *The Journal of Finance, 57*, 169–197.
Hirshleifer, D., Zhu, P.-H., & Li, D. (2013). Innovative efficiency and stock returns. *Journal of Financial Economics, 107*, 632–654.
Hochberg, Y. V., Ljungqvist, A., & Lu, Y. (2007). Whom you know matters: Venture capital networks and investment performance. *The Journal of Finance, 62*, 251–301.
Huang, S., Mao, Y., Wang, C., & Zhou, D. (2021). Public market players in the private world: Implications for the going-public process. *Review of Financial Studies, 34*, 2411–2447.
Hulten, C. R., & Hao, X. (2008). *What is a company really worth? Intangible capital and the "market to book value" puzzle*. National Bureau of Economic Research working. paper 14548.
Kwon, S., Lowry, M., & Qian, Y. (2020). Mutual fund investments in private firms. *Journal of Financial Economics, 136*, 407–443.

Lattanzio, G., Litov, L. P., Megginson, W. L., & Munteanu, A. (2023). Capitalizing entrepreneurship: The rise of growth equity. *The Journal of Applied Corporate Finance, 35*, 75–89.
Mortal, S., & Reisel, N. (2013). Capital allocation by public and private firms. *Journal of Financial and Quantitative Analysis, 48*, 77–103.
Peters, R. H., & Taylor, L. A. (2017). Intangible capital and the investment-*q* relation. *Journal of Financial Economics, 123*, 251–272.
Phillips, G. M., & Sertsios, G. (2017). Financing and new product decisions of private and publicly traded firms. *Review of Financial Studies, 30*, 1744–1789.
Puri, M., & Zarutskie, R. (2012). On the life cycle dynamics of venture-capital- and non-venture-capital-financed firms. *The Journal of Finance, 67*, 2247–2293.
Sapienza, H. J. (1992). When do venture capitalists add value? *Journal of Business Venturing, 7*, 9–27.
Saunders, A., & Steffen, S. (2011). The costs of being private: Evidence from the loan market. *Review of Financial Studies, 24*, 4091–4122.
Stulz, R. (2020). Public versus private equity. *Oxford Review of Economic Policy, 36*, 275–290.
Wooldridge, J. M. (2013). 'Correlated random effects panel data models'. https://conference.iza.org/conference_files/SUMS_2013/slides_1_linear_iza.pdf.