Public firm presence, growth opportunity and investment in fixed intangible assets of private UK firms

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Abstract

Purpose: Prior studies suggest that, in an industry in which several public firms operate (i.e., greater public firm presence), uncertainty about business operations within the industry is reduced due to greater analyst coverage and quality of information disclosure. In this study, we examine how UK private firms respond to investment opportunities in fixed intangible assets in an environment characterised by greater public firm presence.

Design/method/approach: Using data from 61,278 (1,358) private (public) UK firms operating in ten (10) sectors spanning from 2006 to 2016, we conduct our analysis by using panel econometric techniques.

Findings: We observe that private firms are more responsive to their fixed intangible asset (FIA) investment opportunities when they operate in industries with more public firm presence. Also, we find that firms in industries with better information quality use more debt and have longer debt maturity security but less internal cash flow. Overall, our findings indicate that public firm presence generates positive externalities for private firms by lessening industry uncertainty and enhancing more efficient FIA investment. Our results are robust to endogeneity concerns.

Originality/value: While this paper builds on the information disclosure and corporate investment literature, it is one of the first attempts, to the best of our knowledge, to explore how private UK firms respond to investment in fixed intangible assets in an environment characterised by greater public firm presence.

Key words: information disclosure; growth opportunity; fixed intangible assets, UK

1. Introduction

Existing evidence shows that mandatory corporate disclosures (i.e., financial statements and annual reports) offer various information about firms and the environments in which they operate (Beyer *et al.*, 2010; Gox and Wagenhofer, 2009; Palepu *et al*., 2000). Such disclosures provide important information about firms' sales, profitability, creditors' contract, investment outlays, capital structure, and strategic directions, which are crucial for firms' investment decision-making and growth (Dixit and Pindyck, 1994). For instance, Li *et al*. (2013) and Li (2010a) suggest that forward-looking statements in the Management Discussion and Analysis (MD&A) section in 10-Ks provide valuable information about firms' competitive environment and future profitability. Information disclosed by public firms includes both mandatory and voluntary information such as earnings forecasts, cash flow forecasts, capital expenditure, management turnover, and new product launches to increase market confidence as well as alerting the market about the economic growth opportunity in that environment (Goodman *et al*., 2014; Beyer *et al*., 2010; Li, 2010b; Gox and Wagenhofer, 2009).

Thus, it is argued that increased information disclosure reduces uncertainty and enables more efficient investment decisions (Goodman *et al*., 2014). Additionally, scholars widely agree that the effectiveness of corporate investment is influenced by growth opportunities (Asker et al., 2015; Peters and Taylor, 2017). So, if increased information production in an industry affects creditor uncertainty (Li and Lin, 2006) and subsequently influences the cost and conditions of obtaining debt, it is probable that firms operating in that sector will actively respond to growth opportunities (Bharath *et al*., 2008; Santos and Winton, 2008; Saunders and Steffen, 2009). Drawing upon the theoretical framework of investment under uncertainty (Dixit and Pindyck, 1994), we assert that increased presence of public firms enhances the information environment within the sector, leading to greater responsiveness of firms operating in that sector to investment opportunities (Baderscher *et al.*, 2013).

Notwithstanding the growing scholarly interest in corporate disclosure, our understanding of the extent to which an increase in public firms' presence in an industry influences private firms' responsiveness to investment in fixed intangible assets (hereafter **FIA**)[3], remains scant despite its growing importance in this knowledge-based economy. In this study, we fill this knowledge

[3] A firm's purchases of software, patents, trademarks, brands, licences and franchise rights, copyrights, customer-related activities, and distribution networks. The definition has been offered by prior research (e.g., Adu-Ameyaw *et al*., 2022; Lim *et al*., 2020).

gap by examining how private firms' investment in **FIA** is sensitive to growth opportunities in an environment with more public firm presence by using data from 61,278 private UK firms. Next, we assess how private firms with high **FIA** in information-centred industries access debt to finance their investment activities and whether these firms minimise liquidity risk by using more long-term maturity debt. Lastly, we explore whether, in the presence of more public firms, private firms with high **FIA** are more likely to rely on internal cash flow to finance their activities.

Focusing on these issues is important because it provides a unique insight into how managers of private firms with high **FIA** rely on industry information and analyst coverage to take advantage of investment opportunities. Indeed, **FIA** investment has outpaced tangible investment since the 2000s, with its estimated annual (2000 - 2013) average contribution of 9% and 8.8% to the UK and US economies respectively (Corrado *et al*., 2018; Goodridge *et al*., 2016; *Lim et al.,* 2020). Such activity has become an important source of competitive advantage for firms as these assets are hard for competitors to imitate (Kaplan and Norton, 2004).

Our empirical setting is limited to UK private firms because of their economic importance, because they are known to experience lesser agency issue; and because they tend to be more responsive to investment opportunities compared to public ones (Asker *et al.,* 2015; Ang *et al.,* 2000). Yet, it is unclear how these firms benefit from public firms' externalities (via information production) to influence managerial **FIA** investment decisions.

By way of a preview, the results obtained show an incremental sensitivity of **FIA** investment to growth opportunities in sectors with greater public firm presence, implying that industry-related information conveys an important signal to managers as to whether they should embark on such opportunities. Further, on the external credit market's willingness to offer debt and long-term maturity loans to **FIA**-intensive private firms, we find that those firms tend to contract debt to finance their activities. We also observe that firms with substantial **FIA** operating in a sector with greater public firm presence use more debt with long-term maturity. These findings suggest that privately held firms with high **FIA** that operate in information-centred industries are likely to use more debt and longer maturity debt. Additionally, we find that such firms use fewer internally generated funds to sponsor their **FIA** investment. This is because firms operating in an information-centred industry can easily access external debt markets, albeit with lower industry uncertainty (Saunders and Steffen, 2009; Santos and

Winton, 2008). This makes it easy for firms with high **FIA** to have high debt levels and lower internal cash (i.e., higher debt-servicing payments), leading to a decreased relation between **FIA** investment and internal cash for those firms. Finally, we also find limited indications of growth opportunities significantly affecting tangible assets (TAN) and research and development (R&D) initiatives among privately-owned companies operating in sectors primarily controlled by public corporations.

We perform several tests to check the robustness of our results. First, we apply an alternative measure of public firm presence (*PFP2*). Second, we employ the fixed effects model to deal with time-invariant covariates. Third, we adopt more sophisticated estimators: instrumental variable (IV using 2SLS), three-stage least squares (3SLS), and generalised method of moments (*GMM*) to deal with endogeneity concerns. In all these analyses, our results remain qualitatively the same.

The study makes important contributions to the literature. First, it contributes to the literature on information disclosure (see e.g., Ding and Wei, 2022; Goodman *et al.,* 2014; Beyer *et al.,* 2010; Li and Lin, 2006) and how this information disclosure affects firm investment decisions (see e.g., Adu-Ameyaw *et al.,* 2022; Danso *et al.,* 2019a; Kahle and Stulz, 2013; Dang, 2011). While this paper builds on the information disclosure and corporate investment literature (Ding and Wei, 2022; Goodman *et al*., 2014), it is one of the first attempts, to the best of our knowledge, to explore how private UK firms respond to investment in **FIA** in an environment characterised by greater public firm presence. Second, we show that an increased public firm presence reduces creditor uncertainty about industry prospects, thereby inducing creditors to lend to private firms to fund **FIA** investment. Thus, private firms operating in an industry with an increased public firm presence are more likely to have easy access to external financing than their counterparts in industries with low presence of public firms (Bharath *et al*., 2008; Santos and Winton, 2008). In particular, because of the reduced level of creditor uncertainty, our study demonstrates that private firms operating in an industry with public firm presence use more debt with a longer maturity period to minimise possible **FIA** underinvestment. That is, short-term debt maturity is likely to impose financial constraints which can consequently lead to underinvestment problems (Diamond, 1991, 1993; Sharpe, 1991). Thus, our study demonstrates the importance of public firms' information production in lowering a firm's use of short-term debt, which imposes financial constraints and underinvestment challenges.

We outline the rest of the article as follows: in section 2, we discuss related literature. Section 3 considers data and methods, while section 4 presents findings and discussion, and finally concludes.

2. Related literature

A risk-neutral firm may suspend or postpone investment projects in an uncertain period because of the irreversible nature of investment decisions (McDonald and Siegel, 1986). Such uncertain period creates an opportunity to invest now or wait for new information to arrive before committing resources (McDonald and Siegel, 1986; Dixit and Pindyck, 1994). Consequently, as corporate managers wait to get better information before they invest, firms are confronted with two options: (a) delay investment for new information to arrive, which lowers the risk of an ex-post suboptimal decision but increases the risk of missing a profitable opportunities, or (b) invest now, which reduces the risk of missing a valuable opportunity, but increases the chance of making an ex-post suboptimal decision. In their investment under uncertainty model, McDonald and Siegel (1986) suggest that investment has an option value and the value of waiting for new information before investing or disinvesting is greater when there is greater uncertainty, and that the rule "invest if benefits exceed costs" does not account for the option value of waiting for additional information. This essentially means that the level or amount of information available in the market is likely to affect when firms should execute or pursue their investment opportunities (Foucault and Fresaid, 2014; Pindyck, 1991).

Empirical evidence suggests that firms' voluntary disclosure of management forecasts enhances managerial optimal capital investment decisions (Goodman *et al*., 2014). Indeed, voluntarily disclosed revenue forecasts do not only provide vital information to external stakeholders, but they also reveal crucial information about how management views the firm's operating environment and its future economic prospects (Trueman, 1986). Related to this view, Bonsall *et al*. (2013) show that firms whose revenue forecasts are exposed to economy-wide activities or news often supply timely information about the industry-specific incidents and broader macroeconomic activities. Furthermore, others including information intermediaries – i.e., market analysts, financial analysts, and the business press – also benefit from firms' disclosures. That is, analysts use corporate information to evaluate, analyse, forecast, and distribute vital information about the individual firms, industry, and the economy-wide trend (see Kadan *et al*., 2012; Frankel *et al.*, 2006; Asquith *et al*., 2005). For instance, Hutton *et al.* (2012) find analysts' earnings forecasts to be more accurate than management

ones, particularly for those firms whose earnings are exposed to macroeconomic factors. Kadan *et al.* (2012) also share a similar sentiment when they reveal that analysts' industry-level recommendations are closely connected with industry future performance, while others including Bhojraj *et al.* (2009) show that firms myopically cut discretionary spending such as research and development, or maintenance expense in order to beat analysts' earnings forecasts. Essentially, these studies suggest that disclosures by firms enhance information production in the economic environment.

In the UK, private firms disclose financial statement information to the public. However, such disclosures are often seen to be of relatively lower quality due to different market expectations, demands, and regulations (Chen *et al.,* 2011). The low information demand on private firms by potential investors and the press reduces the likelihood of analysts' coverage of these firms, which makes it more difficult – if not impossible – for markets to continually monitor their operational and performance activities. In a related way, Farre-Mensa (2011) shows that private firms' proprietary information benefits induce them to stay private, and thereby avoid disclosing crucial information to their competitors.

Noting the apparent existing differences among publicly listed and privately held firms with respect to public information production, the composition of these firms in a particular sector may have an important impact on the sector or industry information environment in general. Thus, as more sets of listed companies in a sector voluntarily and publicly share information and are covered by market analysts, a relatively more complete view of the sector's economic environment and the future opportunity emerges. Such increase in sector-level information resulting from greater public firm presence reduces sector or industry uncertainty, thereby creating an opportune advantage for private firms to exploit the growth opportunities in that sector (Badertscher *et al*., 2013). While Foucault and Fresaid (2014) suggest that the peer firm's valuation provides reliable information about the market and industry-wide growth opportunities, Asker *et al*. (2015) show that private firms' investments are more sensitive to growth opportunities than public ones. Therefore, given the differences in investment activities between listed and unlisted firms, it is plausible to predict that the active response of private firms to investment opportunities is likely to be induced by the industry-level information environment in which they operate. That is, if managers of private firms learn from the public peer's presence, then the level of investment-to-investment opportunities is likely to be higher. Based on this, we argue that privately held firms operating in industries with more public firm

presence (i.e., signalling more information production) are able to better identify and exploit potential growth opportunities, thereby increasing their responsiveness to investment opportunities. Moreover, noting the fact that the rate of investment in fixed intangible assets (**FIA**) has outclassed that in the tangible ones in this current knowledge-based economy (Lev and Gu, 2016; Goodridge *et al.*, 2016) and that the **FIA** has been found to have high Tobin's Q (Peters and Taylor, 2017; Eisfeldt and Papanikolaou, 2013), it is interesting to find out if indeed unlisted or private firms' responsiveness to growth opportunities is due to the externalities generated by public firms' presence.

Although the theoretical literature on investment–uncertainty is ambiguous, most evidence suggests a negative relationship (Leahy and Whited, 1996; Guiso and Parigi, 1999). However, Hartman (1972) and Abel (1983) share an opposing view by suggesting that firms increase their investment in periods of high uncertainties, especially those operating in a competitive environment. In a closely related vein, Bloom *et al.* (2007) put forward the notion that in times of uncertainty, there is a diminished responsiveness of firm's investment activities to investment opportunities. Asker *et al.* (2015) suggest that privately held firms exhibit greater responsiveness to investment opportunities. Additionally, Peters and Taylor (2017) note that investment in **FIA** is better explained by investment opportunities (measured by Tobin's Q) compared to investment in fixed tangible (TAN) assets. The notable **FIA**-growth sensitivity can be partly attributed to the fact that lenders are willing to accept **FIA** as collateral (Loumioti, 2012). This acceptance has resulted in a decrease in moral hazard, lenders' monitoring costs, and financing constraints (Bharath et al., 2008; Brown *et al.*, 2011; Lim *et al.*, 2020).

Unsurprisingly, recent evidence indicates that investment in **FIA** has surpassed investment in tangible assets, resulting in enhanced labour productivity and increased cash flow and overall value (Adu-Ameyaw *et al.*, 2022; Goodridge *et al.*, 2016). For instance, Corrado et al. (2018) report significant investment in **FIA** in the UK and the US, with this type of investment outperforming tangible assets in the UK (Goodridge *et al.*, 2016). Marrano and Haskel (2006) also suggest that private firms in the UK invested approximately £127 billion in FIA during the 2004 period, surpassing the £116 billion invested in tangible assets. Motivated by the above highlights, it is plausible to suggest that private firms operating in a more information-oriented environment are likely to actively respond to growth opportunities. Consistent with this notion, Badertscher e*t al.* (2013) show that public firms' information disclosures enrich industry information environment, thereby reducing uncertainty. Thus, the underlying idea is that, when

a greater number of listed firms in an industry publicly disclose information and receive coverage from information intermediaries, it leads to a more comprehensive understanding of the current economic landscape and prospects for that industry. This decline in uncertainty within the industry can subsequently empower peers to make better-informed investment choices. Specifically, we argue that, when a greater number of public firms are present within an industry, information flow is enriched, making it easier for private firms operating within that environment to identify those investment opportunities and respond appropriately. Our adopted model extends the work of Bloom *et al.* (2007) by arguing that private firms' investment activities and the associated opportunities are dependent on the industry-level information. Thus, the lower industry uncertainties resulting from more public firms' information production (greater listed firms' presence) increase the level of private firms' FIA investment to investment opportunities.

Furthermore, it is also plausible to argue that, as industry uncertainty diminishes (due to increased presence of public firms), external creditors are more likely to have a comprehensive understanding of industry prospects. As a result, they may be more inclined to extend credit to private firms to fund their FIA activities. This increased accessibility to debt financing makes it more likely for private firms to rely less on internal cash flow to support FIA activities. We also delve deeper into these logical assumptions by conducting further analysis on the issues.

Essentially, although this study's key idea of examining the effects of public firm presence covers both listed and unlisted firms' investment behaviour, our focus here is limited to only private firms' investment activity for the following reasons. First, sampling only private firms affords us the opportunity to better isolate and understand the channel through which listed (public) firms' presence affects firms' investment opportunities. As Asker *et al.* (2015) argue, privately held firms are more responsive to investment opportunities. Again, the agency issue is lessened through enhanced monitoring in private firms, which can lead to lower cost of debt and lower information asymmetry problem via improved managerial behaviour. Second, considering public firm externalities within the public firms' investment decisions can lead to an endogeneity bias (Badertscher *et al.,* 2013). Finally, although private firms make enormous contributions to the UK economy, little is known about their FIA investment behaviour in this service-oriented economy.

3. Data and method

3.1. Data

We obtain our study's data from the Amadeus database provided by Bureau van Dijk, which mainly covers financial information of European firms including the UK. The database compiles data on both private and public firms from various well-established national information sources (Badertscher *et al.,* 2013). The coverage of the database (i.e., covering both listed and unlisted firms' financial reports) allows the study to capture public firm presence. Consistent with prior studies (e.g., see Lim *et al.*, 2020; Badertscher *et al*., 2013), we do not include financial and utilities firms in our analysis because investment models are not well suited for those firms. Further, firms with less than three years of complete data are excluded. Applied sampling techniques results in a total number of 61,278 (1,358) private (public) firms with final firm-year observations of 604,369 (12,356). Thus, the overall analysis is based on a total of 616,725 yearly observations of firms operating in ten (10) sectors spanning from 2006 to 2016.

3.2. Measurement of variables

3.2.1. Dependent variable

Fixed (identifiable) intangible assets investments (**FIA**) is our dependent variable. Such investment activity is non-monetary assets without physical presence or substance bought by firms (Adu-Ameyaw *et al.,* 2022)[4]. We measure this as the annualised fixed intangible assets divided by total book value of assets, like prior research (e.g., Lim *et al.*, 2020; Adu-Ameyaw et al., 2022).

3.2.2. Independent variables

As suggested, public firm presence improves industry information production, thereby enabling private firms to learn more about the sector and take advantage of the growth opportunities in that industry, leading to more FIA investment. To capture the public firm presence (*PFP*) in an industry, which is our independent variable, we use two measures like Badertscher *et al.* (2013).

[4] They include firm's purchases of software, patents, trademarks, brands, licences, and franchise rights, copyrights, customer-related activities, and distribution networks. The data is obtained from the Amadeus database.

The first one is the number of public firms divided by the total number of firms in that industry, and the second one is proxied as the total sales of public firms divided by total sales value of all firms in that sector or industry (*PFP2*). Our next variable of interest is investment growth opportunities, which is often proxied as Tobin's *Q* or sales growth. Prior works (e.g., Badertscher *et al.,* 2013) proxy Tobin's *Q* as the ratio of the market value of a firm's total assets to its book value. However, given that privately held firms are not traded on a stock exchange and hence their market share values are unavailable, we use sales growth (*GR*) and it is measured as log of sales divided by lagged sales (Badertscher *et al.,* 2013; Lim *et al.,* 2020; Adu-Ameyaw *et al.,* 2022).

3.2.3. Control variables

Like prior studies (e.g., Asker *et al.,* 2015; Adu-Ameyaw *et al.,* 2022), we include additional control variables in our investment (**FIA**) model. These are leverage (*LEV*); cash flow (*CF*), firm size (*SZ*); net working capital (*NWC*); cash holdings (*CH*); firm years of incorporation (*FY*); profitability (*PR*); and long-term debt (*MAT*). We also account for fixed effects by including industry and year effects in the model. All variable definitions and acronyms are shown in Table I.

[Table I about here]

3.3. Model specification

Our study's main idea is that private firms operating in industrial sectors with greater public firm presence (*PFP*) are likely to be more responsive to their **FIA** – *GR* than those in industries with lesser public firm presence. That is, our key independent variable is the interaction effect of both public firm presence and growth opportunities (i.e., ***PFP*GR***) on fixed intangible assets activity. Like Badertscher *et al.* (2013), we specifically state and estimate this econometric model:

$$FIA_{it} = \alpha + \beta_1 PFP_{it-1} + \beta_2 GR_{it-1} + \beta_3 PFP_{it-1} \times GR_{it-1} + \beta_4 Controls_{it} + \varepsilon_{it} \quad \ldots\ldots (1)$$

In model (1), ***FIA*** is the ratio of fixed intangible assets investment to total assets, $\boldsymbol{PFP_{t-1}}$ is the ratio of the number of public firms to total firms in industry *j* and year *t*-1, or the ratio of public

firms' sales to total industry sales (i.e. public firms' presence variable), $\boldsymbol{GR_{t-1}}$is the log of sales scaled by lagged sales, interaction term $\boldsymbol{PFP_{it-1} \times GR_{it-1}}$(our key independent variable) and other investment explanatory variables are ***Controls***. Mainly, we employ two estimators to analyse the data: ordinary least squares (OLS) and fixed effect (FE) regression. Our model used one year lag of independent variables to minimise potential reverse causality and also included year and industry fixed effects to capture possible changes in investment across periods and sectors. The regression standard errors are clustered at the firm level. We conduct further analyses by using an alternative measure of public firm presence (*PFP2*) and also employ a more powerful estimators, e.g., instrumental variable (IV-2SLS), GMM to deal with any endogeneity concerns.

4. Results and discussion

4.1. Descriptive statistics and bivariate correlations

In Table II, the descriptive statistics show our key variables used in the empirical model. We point out some of the key findings. Our dependent variable, **FIA**, is 3% of total assets for the sampled period while TAN and R&D show 17% and 0.1% respectively. The average statistics show that the proportion of public firms to all firms in that sector or industry (*PFP*) is 2% and that of public firms' sales to total industry sales (*PFP2*) is 97% respectively, while sales growth (*GR*) shows an average of 1.00. Further, we reveal that private firms finance 26% of their assets by debt (*LEV*) with 34% in longer debt maturity (*MAT*) and also have cash flow (*CF*) and cash holdings (*CH*) equal to 6% and 11% of total assets, respectively. Our sampled firms are reasonably profitable, with an average of 5%, and have an average lifespan (*FY*) of 20 years with an average firm size (*SZ*) of 7.22 in assets. In all, the low standard deviation figure among dependent and independent variables signifies a reasonable degree of heterogeneity.

Table III also reports the correlation analysis of the sample variables used in our regression and is mostly in tune with our expectations. For instance, there is a positive correlation between **FIA** and *GR* (Peter and Taylor, 2017). We also find that *PFP* and **FIA** are positively correlated but *PFP* and *PFP2* are negatively correlated. Overall, the correlation matrix findings show no major issues of multicollinearity among our sample variables.

[Tables II & III about here]

4.2. Public firm presence, growth opportunity and fixed intangible assets (FIA) investment

Our key idea is that private firms operating in sectors or industries with greater public firm presence are likely to be more responsive to investment opportunities than those operating in sectors with less public firm presence. That is, greater public firm presence enhances information production in the industry, thereby providing privately held firms with the opportunity to actively respond rapidly or appropriately to the supposed potential growth opportunities in that sector (Bradertcsher *et al.,* 2013). Our main argument is similar to Bradertcsher *et al.* (2013), who observe that the sensitivity of private firms' tangible investment-to-investment opportunities is strongly influenced by the public firm presence, implying that the interaction effects of growth opportunities and public firm presence (signalling industry information production) determine capital investment changes. Our economic model is stated along this line by arguing that private firms' fixed intangible assets investment (**FIA**) changes are more sensitive to the interaction effects of growth opportunities and public firm presence in that industry. We estimate the baseline regression equation (1) and our variable of interest is the interaction term (*PFP*GR* and/or alternative measure *PFP2*GR*).

Table IV shows the findings of our main regression model which captures the incremental changes of private firms' fixed intangible assets (**FIA**) investment to growth opportunities and public firm presence. We apply two estimation techniques to test our model: ordinary least squares (*OLS*) and fixed effects (*FE*). The OLS models (1 & 2) show our main results including models 5 & 6 where we show the results of the alternative measure (*PFP2*GR*). It is worth indicating that the results of models 5 & 6 (alternative measure of public firm presence) and fixed effect models (3 & 4 and 7 & 8) serve as robustness checks on the main models.

Specifically, in models 1 & 2, our results indicate that the coefficient for *PFP*GR* in both the simple model (without control variables) and full model (including control variables) is positive and statistically significant at the 1% confidence level, indicating privately held firms' **FIA** is more responsive to investment opportunities in industries with greater information production (i.e., greater public firm presence). Thus, our fully specified model, model 2, shows an estimated coefficient of 0.578 (t-statistics 3.96), which is in support of the theoretical prediction that greater public firm presence reduces industry uncertainty (through enhanced industry information production) and encourages more private firm **FIA** investment. In economic terms, we report that a 1% increase in the proportion of public firms increases **FIA** – growth opportunities sensitivities by 9.23% from the mean level.

Further, our results remain robust across the alternative measure of public firm presence (i.e., *PFP2*) variable in models 5 to 8, where the covariate *PFP2*GR* still exhibits positive and statistically significant relationship to **FIA** investment, providing further support to the earlier reported results (in models 1 to 4).

[Table IV about here]

4.3 Additional analyses

4.3.1 Endogeneity concerns

Our main finding shows that private firms' fixed intangible assets (**FIA**) investment is more responsive to investment opportunities in sectors dominated by public firms. Thus, we argue that the presence of public firms generates a greater flow of industry information, allowing private firms within that industry to identify growth prospects and make efficient investments in fixed intangible assets. However, this reasoning may be affected by these potential vulnerabilities: firstly, a private firm may deliberately choose to establish itself in an industry dominated by public firms due to certain characteristics or advantages. Another concern is that a high presence of public firms might reduce creditors' uncertainty regarding industry prospects, thereby enabling private firms to obtain credit more easily for funding their **FIA** activities. Additionally, changes in public firm presence could be influenced by overall industry-wide growth patterns, creating a strong correlation between public firm presence and growth opportunities. It is also possible that both our measurement of public firm presence and investment opportunities serve as imprecise proxies for industry-wide growth prospects (Badertscher *et al*., 2013).

Indeed, given these issues raised, it is plausible that they could impact the reliability of the findings presented in Table IV. To address these potential concerns, we conduct the following tests. Specifically, we employ more robust specifications, such as the instrumental variable (IV-2SLS) model, simultaneous equation model (SEM) using the 3SLS estimator, and the generalised method of moments (GMM). By utilising these approaches, we aim to verify the validity of our results under these different techniques.

First, we employ an instrumental variable (IV – 2SLS) method to further analyse our data. By utilising this instrumental variable approach, our model can effectively consider potential variations attributed to both public firm presence and growth opportunities. As mentioned

earlier, private firms with certain characteristics can choose to be in an industry dominated by public firm presence. Again, the change in the public firm presence is likely to be influenced by industry-level growth. An increased public firm presence improves private firms' access to the external credit market. Based on the reasoning above, we use changes in public firm presence as our first instrument. We include this in the model to purge the direct effect on the *PFP*GR*. We also use lagged changes in leverage as our second instrument. Prior research shows that bank financing is the main external capital source for privately held firms (Berger and Udell, 1998). Specifically, we claim that unlisted firms' debt changes may occur because of an increased public firm presence (i.e., high number of public firms within an industry facilitates the production of industry information, which, in turn, allows credit providers to identify growth opportunities and allocate funds accordingly). Our final instrument is industry-median earnings. It has been suggested that managers with exceptional skills can effectively manage corporate resources to generate greater shareholder value (Lee *et al.,* 2018). These managers possess the ability to identify industry trends, select appropriate financing strategies, and invest in high-growth projects. For instance, prior studies (e.g., Lee *et al.,* 2018; Demerjian *et al.,* 2012) have highlighted a significant connection between managerial ability and growth opportunities. With this in mind, we reason that managerial ability (proxied as industry-median earnings/profits) is likely to impact a firm's capacity to identify opportunities and effectively manage resources. It is also possible that private firms can employ skilled managers to strategically leverage the advantages offered by an increased presence of public firms. Of course, as such, stating these economic reasonings and arguments, we anticipate that the selected instruments would exhibit statistical significance and that the overall model should show a higher F-statistic (typically above 10 as a general guideline). To perform this analysis, we first regress our endogenous variable (*PFP*GR*) on the instrumental variables: industry-median earnings, lagged changes in public firm presence (dPFP), and changes in debt level (dLEV) to obtain the fitted values of the independent variable which is subsequently included in the investment (FIA) model along with other controlled variables. The coefficient estimate on the *PFP*GR* variable is our key variable of interest.

More specifically, we find the coefficient on *PFP*GR* is still positive and statistically significant, supporting the initial assertion that private firms operating in an industry with heightened public firm presence invest more in **FIA** activity. We further point out a few statistical results in our IV model: Sargan statistic of overidentification test is 54.12, under identification test (Anderson Cannon correlation LM statistic) is 64000, and Cragg-Donald

wald F-statistic is 28000 and the overall model F-statistics 491.32. These statistics show that our chosen instruments are valid and are important in the analysis. Again, we construct a simultaneous equation model (SEM) and estimate it using three-stage least squares (3SLS). Here, we regress our independent variable *PFP*GR* on the instruments together with other control variables in the first-stage regression and then include the predicted values in the second-stage FIA model; these analyses are performed simultaneously. Again, Table V still shows the estimated coefficient on *PFP*GR* to be positive and significant. Our instruments are statistically significant, satisfying the relevance test.

In Table VI, we re-estimate our regression using GMM specification to further deal with any potential endogeneity issue. Still our results remain unchanged after performing this check. In short, our varying techniques show the incremental sensitivity of private firms' **FIA** – *GR*, particularly in sectors with more public firm presence.

[Tables V & VI about here]

4.3.2 Public firm presence, growth opportunity and fixed tangible assets investment and research and development

Up until now, our analysis has focused exclusively on fixed intangible assets (FIA) investments, without considering fixed tangible assets (TAN) and research and development (R&D) activities. However, we assert that private firms may allocate resources towards TAN and R&D activities as well, despite recent evidence indicating a greater emphasis on resource allocation towards FIA (Goodridge *et al*., 2016; Marrano and Haskel, 2006). Related to this, Badertscher *et al*. (2013) find no support for public firm presence influencing private peers' tangible investment in high-growth sectors using UK data. We undertake a similar exercise to understand the extent to which high-growth private firms invest in TAN and R&D activities, especially when they operate in sectors dominated by public firms. To perform this test, we replace the dependent variable (**FIA**) in our base model (1) with these respective *TAN* and R&D activities. All variable (including *TAN, R&D*) measurements are in the appendix. Specifically, in Table VII, we observe that both fully specified regression models 2 (TAN) and 4 (R&D) exhibit a statistically insignificant positive coefficient on PFP*GR. This indicates that private firms with growth potential display a limited inclination to invest in tangible assets

(TAN) and research and development (R&D) when operating in sectors predominantly controlled by public firms. This is consistent with prior research (e.g., Badertscher *et al.*, 2013).

[Table VII about here]

4.4. The interaction effects of public firm presence and leverage on fixed intangible assets investment

It is plausible that, as industry information production increases due to greater public firm presence, creditors' uncertainty about industry prospects is likely to reduce, thereby making it easier for private firms in that industry to have access to debt finance. In other words, creditors' willingness to supply funds because of an increased public firm presence helps mitigate the costly financing problem of private firms, thereby making it easy for them to borrow to finance investment activities. That is, as information in an industry improves due to public firm presence, the uncertainty about demand, supply, and cost conditions relating to debt acquisition is likely to be reduced, giving these firms in the industry easy access to external financing. Supporting this view, Bharath *et al*. (2008) show that syndicate lenders demand extra premium for lending if firms operate in an opaque informational environment; while Santos and Winton (2008) suggest that lenders may extract an information-based rent when borrowers' activities are opaque. Saunders and Steffen (2009) also show that, in a more transparent information environment, private firms do not pay an additional premium for being private, implying that private firms enjoy a similar borrowing cost as their public counterparts, thereby relaxing the financing constraints of these firms. This assumption is further confirmed by Brav (2009), who shows that privately held firms rely more on debt financing. More directly, we argue that, as private firms' financial constraints are relaxed, due to more public firm disclosures, these (private) firms tend to increase debt, and thus increase investment. We test the possibility that private entities operating in a high industry information environment are likely to borrow more to fund fixed intangible assets (**FIA**) investment. That is, we test the interaction effects of public firm presence and leverage on **FIA** investment.

To achieve this, we augment our fully specified model by including the interaction effect of public firm presence and leverage (*PFP*LEV*) in our baseline model. Specifically, in Table VIII, our OLS model 1 shows the coefficient estimates on *PFP*LEV* to be positive and

statistically significant. This implies that those privately held firms operating in sectors with larger public firm presence are able to borrow more to sponsor **FIA** activity. That is, an increase in industry public firm presence is associated with a positive change in private firm debt level, hence higher **FIA** investment. The underlying implication of this finding is that greater public firm presence incrementally affects financing constraints by reducing creditor uncertainty as they (creditors) lend to private firms to fund **FIA** investment.

4.5. The interaction effects of public firm presence and debt maturity on fixed intangible assets investment

The liquidity risk hypothesis suggests that a firm's choice of short-term debt maturity is likely to impose financial constraints, which can consequently lead to an underinvestment problem (Diamond, 1991; Sharpe, 1991). Thus, a firm with larger short-term debt balance may likely face liquidity risk and possible bankruptcy costs and debt constrain problem (Childs *et al.*, 2005; Diamond, 1993). We further this argument by suggesting that private firms operating in a higher information environment are likely to use debt with longer maturity to mitigate the liquidity risk problem. That is, private firms that maintain long-term debt maturity in a sector with more public firm presence may seem to face low liquidity risk and are likely to have an incentive to increase fixed intangible assets (**FIA)** investment. The economic relation suggests that a positive correlation between debt maturity and public firm presence affects investment activities. With this in mind, it is argued that the interaction of public firm presence and debt maturity (*PFP*MAT*) will induce a positive effect on **FIA** activity.

To test this, we modify equation (1) to include the interaction term of public firm presence and debt maturity (*PFP*MAT*) together with firm fixed effects in the model. Our reported results in Table VIII, models 3 & 4 show that the interaction term coefficient on *PFP*MAT* is positive and significant at 1% confidence level. The OLS estimate on this covariate *PFP*MAT* is 0.078, confirming the notion that private firms operating in a sector with greater public firm presence use more debt with a longer maturity period to minimise possible **FIA** underinvestment. Thus, the higher industry information produced by public firm presence induces creditors (as they become aware of the industry opportunities) to offer extended credit to private firms, thereby enabling these firms to invest more in **FIA** activities.

4.6. The interaction effects of public firm presence and internal cash flow on fixed intangible assets investment

The literature offers two arguments (i.e., agency problem and information asymmetry) on the relationship between a firm's internal cash and its investment (Harford *et al.,* 2009; Pawlina and Renneboog, 2005; Myers and Majluf, 1984). For instance, risk-averse managers may cut down risky investment activities to safeguard their position, particularly if the firm's internally generated cash is low (Makadok, 2003). However, others suggest that firm managers prefer to sponsor investment activities from the internal cash to avoid costly external finance due to the presence of an information asymmetry problem (Myers and Majluf, 1984; Myers 1984). Intangible activities have a high information asymmetry problem and are riskier (Borisova and Brown, 2013; Brown *et al*., 2009). This makes such activity prone to facing an underinvestment problem, especially if the internal fund is inadequate. However, given the nature of fixed intangible assets activity and its attractiveness to credit suppliers (Lim *et al*., 2020), it is likely that FIA-intensive firms may rely less on internally generated cash to fund such activities. Based on this, we reason that a private firm which operates in a sector with high public firm presence is less likely to rely on its internally generated cash to finance **FIA** investment.

To further test this assertion, we augment our empirical model (1) by adding an interaction term (*PFP*CF*). The results in Table VIII, models 5 & 6, show the coefficient estimates on *PFP*CF* to be negative and are both statistically and economically significant at 1% confidence level. Specifically, the OLS estimate is -0.447, suggesting that privately held firms operating in an environment with high public firm presence use less internal cash to finance **FIA** investment, which is in support of our expectation. That is, with reduced creditor uncertainty (via an increased information flow by higher public firm presence), firms may have easy access to external credit (Saunders and Steffen 2009; Santos and Winton, 2008) as creditors are willing to lend to those entities. This makes it easy for the highly fixed intangible assets firms operating in an information-centred industry to accumulate more debts and lower internal cash (i.e., higher debt servicing payments), leading to a decreased relation between **FIA** investment and internal cash for those firms. In other words, private firms operating in a sector with public firm presence use less internal cash to sponsor **FIA** investment.

[Table VIII about here]

5. Conclusion

In this paper, we examine how growth-potential private UK firms operating in an industry characterised with greater public firms invest in fixed intangible assets (**FIA)** activity. We also look at the extent to which these private firms in such an industry use debt and internal cash flow to support **FIA** investment. Our main argument is rooted in the investment under uncertainty literature that underscores the importance of information flow in firms' investment decisions. That is, we argue specifically that greater public firm presence within an industry enhances information production, and such information enables the private firms to identify growth opportunities in that sector and respond appropriately. Our primary finding supports this hypothesis i.e., privately held firms operating in a sector with a greater number of public firms invest more in **FIA** activity. We also find strong evidence that those (private) firms operating in a higher information environment have better access to external finance and are likely to use more long-term debt to mitigate the liquidity risk problem. Further, these firms rely less on internal funds to support **FIA** activities. However, the observed interaction effect of *PFP*GR* on tangible investment and research & development is statistically insignificant. In general, the takeaway from this empirical study is that the externalities caused by public firm presence influence **FIA** investment decisions of growth-potential private firms. Indeed, our findings remain qualitatively unchanged after using more sophisticated estimators to deal with possible endogeneity concerns. However, despite this study's findings, it is essential to acknowledge its potential limitations. Our study focuses on a single country (the UK) and therefore there is the likelihood that the results found are specific to this setting but not others, particularly developing and emerging economies. Moreover, due to a lack of data, our analysis only goes up to 2016. More studies appear warranted, and we suggest that future studies could explore these ideas from the viewpoint of multiple countries, using data beyond 2016 once they become available.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Table I: Description of variables

Dependent Variable	**Description**	**Literature**
Fixed intangible assets investment (F*IA*)	Fixed intangible assets scaled by Total Assets	Lim *et al.* (2020); Adu-Ameyaw *et al*. (2022).
Tangible assets investment (TAN)	Tangible assets (defined as net property, plant, and equipment) scaled by Total Assets	Lee *et al.* (2018); Adu-Ameyaw *et al*. (2022).
Research & Development (R&D)	Research and development expense scaled by Total Assets	Brown et al. (2012); Adu-Ameyaw et al. (2022).
Key Independent variables		
Sales Growth (*GR*)	Log of sales /lagged sales	Lim, Macias and Moeller (2020); Adu-Ameyaw *et al*. (2022)
Public firms' presence - (*PFP*)	Number of public firms in each four-digit NAICS industry, divided by the total number of firms in the same four-digit NAICS industry.	Badertscher *et al*. (2013)
Public firms' presence - (*PFP2*)	The sum of all public firm sales in each industry, divided by total firm sales in the same industry.	Badertscher *et al*. (2013)
Control variables		
Leverage (*LEV*)	Total Debt scaled Total Assets	Lim *et al.* (2020) Lewellen and Lewellen (2016),
Cash flow (*CF*)	EBITDA scaled Total Assets	Adu-Ameyaw *et al*. (2022).
Firm Size (*SZ*)	Natural logarithm of Total Assets	Adu-Ameyaw *et al*. (2022). Chijoke-Mgbame, *et al*. (2020); Danso *et al.* (2020)
Cash holdings (*CH*)	Cash holdings scaled by Total Assets.	Lim *et al.* (2020); Lewellen and Lewellen (2016)
Net Working Capital (*NWC*)	Net Working Capital – Cash Equivalent / Total Assets	Lewellen and Lewellen (2016)
Firm years (*FY*)	Firm number of years of operation	Borisova and Brown (2013)
Profitability (*PR*)	Profit for the period scaled by Total Assets	Lewellen and Lewellen (2016); Adu-Ameyaw *et al.* (2022).
Debt maturity (*MAT*)	Long-term debt that matures after one year divided by total debt.	Dang (2011)

Source (s): Table I created by authors

Table II: Descriptive statistics

	.						
	Mean	Std	25%	50%	75%	95%	N
FIA	0.03	0.11	0.00	0.00	0.01	0.22	604369
TAN	0.17	0.22	0.00	0.04	0.27	0.65	604369
RD	0.00	0.02	0.00	0.00	0.00	0.02	604369
PFP	0.02	0.02	0.01	0.01	0.02	0.04	604369
PFP2	0.97	0.02	0.97	0.98	0.98	0.99	604369
GR	1.00	0.08	0.99	1.00	1.01	1.07	390644
LEV	0.26	0.26	0.00	0.17	0.53	0.65	604369
CF	0.06	0.13	0.00	0.01	0.11	0.30	604369
SZ	7.22	1.08	6.76	7.22	7.73	8.75	604368
CH	0.11	0.18	0.00	0.03	0.14	0.52	604369
NWC	0.78	0.02	0.78	0.78	0.78	0.78	604369
FY	20.00	20.52	6.00	13.00	26.00	65.00	601154
PR	0.05	0.06	0.00	0.02	0.07	0.19	604277
MAT	0.34	0.40	0.00	0.05	0.76	1.00	468510
N	604369						

Source (s): Table II created by authors

Table III: Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
FIA	1.00													
TAN	-0.04*	1.00												
RD	0.02*	-0.00*	1.00											
PFP	0.04*	0.02*	0.00*	1.00										
PFP2	-0.03*	-0.00	-0.00	-0.91*	1.00									
GR	0.04*	0.00	0.00	0.01*	-0.00	1.00								
LEV	0.10*	0.05*	-0.00	0.01*	-0.01*	0.01*	1.00							
CF	0.05*	0.12*	0.01*	0.02*	-0.00	0.06*	-0.11*	1.00						
SZ	0.05*	0.01*	0.00	0.05*	-0.06*	0.07*	0.24*	-0.03*	1.00					
CH	-0.04*	-0.12*	0.02*	-0.01*	0.01*	0.00	-0.23*	0.13*	-0.24*	1.00				
NWC	-0.03*	-0.08*	-0.01*	-0.02*	0.02*	-0.00	0.08*	-0.03*	-0.01*	-0.06*	1.00			
FY	-0.10*	0.09*	0.01*	0.03*	-0.03*	-0.02*	-0.11*	0.01*	0.12*	-0.04*	-0.04*	1.00		
PR	-0.02*	-0.02*	0.02*	0.01*	-0.01*	-0.00	-0.13*	0.29*	-0.08*	0.16*	-0.02*	0.02*	1.00	
MAT	0.12*	0.26*	-0.01*	-0.03*	0.02*	0.00*	0.24*	-0.02*	0.10*	-0.10*	-0.02*	-0.12*	-0.12*	1.00

Source (s): Table III created by authors

Table IV: The interaction effects of public firm presence (*PFP*) and growth opportunity (*GR*) on Fixed Intangible Assets (*FIA*) investment

	Main Measure				Alternative Measure			
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model5**	**Model 6**	**Model 7**	**Model 8**
	(OLS) FIA	**(OLS) FIA**	**(FE) FIA**	**(FE) FIA**	**(OLS) FIA**	**(OLS) FIA**	**(FE) FIA**	**(FE) FIA**
PFP*GR	0.734***	0.578***	0.263***	0.179***				
	(5.28)	(3.96)	(9.16)	(5.61)				
PFP	-0.241	-0.395*	-0.032	0.031				
	(-1.18)	(-1.84)	(-0.47)	(0.43)				
PFP2*GR					0.052***	0.037***	0.013***	0.008***
					(12.25)	(8.73)	(10.46)	(6.14)
PFP2					-0.041	0.162***	-0.128***	-0.094**
					(-1.01)	(3.26)	(-6.81)	(-4.17)
GR	0.067***	0.051***	0.033***	0.0272***	0.071***	0.053***	0.034***	0.028***
	(13.89)	(10.19)	(21.23)	(15.62)	(13.67)	(10.13)	(22.00)	(16.10)
LEV		0.009***		0.007***		0.009***		0.007***
		(8.11)		(8.43)		(8.18)		(8.39)
CF		0.047***		0.005***		0.046***		0.005***
		(25.17)		(4.47)		(24.92)		(4.31)
SZ		0.014***		0.017***		0.014***		0.017***
		(38.10)		(30.41)		(37.53)		(29.94)
CH		-0.025***		-0.033***		-0.025***		-0.033***
		(-26.31)		(-30.62)		(-26.51)		(-30.59)
NWC		-0.253***		-0.002		-0.253***		-0.002
		(-13.25)		(-0.23)		(-13.26)		(-0.20)
FY		-0.001***		-0.001***		-0.001***		-0.001***
		(-61.97)		(-3.40)		(-61.72)		(-3.40)
PR		-0.085***		0.014***		-0.085***		0.014***
		(-22.49)		(6.25)		(-22.44)		(6.29)
MAT		0.029***		0.009***		0.029***		0.009***
		(44.28)		(20.07)		(44.40)		(20.02)
_Cons	0.057***	0.071***	0.005***	-0.088***	-0.055	-0.113**	0.120***	-0.001
	(-5.97)	(3.91)	(2.00)	(-8.60)	(-1.45)	(-2.25)	(6.53)	(-0.05)
Year effect	YES	YES	YES	YES	YES	YES	YES	YES
Industry	YES	YES	NO	NO	YES	YES	NO	NO
N	308853	268650	308853	268650	308853	268650	308853	268650
R^2	0.01	0.06	0.01	0.02	0.01	0.06	0.01	0.02

PFP = public firm presence is measured as the number of public firms in each four-digit NAICS industry, divided by the total number of firms in the same four-digit NAICS industry whilst our alternative measure (PFP2) is the sum of all public firm sales in each industry, divided by total firm sales in the same industry (Badertscher et al. 2013). GR = sales growth (growth opportunity) is measured as log sales scaled by lagged sales (Lim et al. 2020). PFP*GR = public firm presence multiplied by growth opportunity and fixed intangible asset (FIA) The OLS is our main regression results whilst FE and alternative measure of information quality variable (PFP2) is for robustness purposes. All variable definitions are described in Table I.*, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

Source (s): Table IV created by authors

Table V: Public firm presence (*PFP*) and growth opportunity (*GR*) on Fixed Intangible Assets (*FIA*) investment

Instrumental Variable Method		Three-Stage Least Squares (3SLS) Method	
	(IV-2SLS) *FIA*	(1st Stage) *PFP*GR*	(2nd Stage) *FIA*
PFP*GR	0.426***		0.427***
	(2.72)		(2.72)
PFP	-0.341*	0.940***	-0.341*
	(-1.84)	(211.74)	(-1.84)
GR	0.050***	-0.003***	0.050***
	(12.60)	(-33.77)	(12.60)
LEV	0.009***	-0.000	0.009***
	(8.33)	(-0.31)	(8.33)
CF	0.047***	0.001***	0.047***
	(26.28)	(13.83)	(26.28)
SZ	0.014***	0.0002***	0.014***
	(40.97)	(25.84)	(40.97)
CH	-0.025***	0.0001***	-0.025***
	(-16.86)	(3.24)	(-16.86)
NWC	-0.253***	0.0001	-0.253***
	(-16.92)	(0.15)	(-16.92)
FY	-0.001***	-0.000***	-0.001***
	(-63.23)	(-11.35)	(-63.23)
PR	-0.085***	-0.0004***	-0.085***
	(-20.95)	(-4.21)	(-20.95)
MAT	0.029***	-0.000***	0.029***
	(48.08)	(-3.04)	(48.08)
dPFP		-0.910***	
		(-285.45)	
dLEV		-0.0001**	
		(-2.31)	
IND_PR		0.005***	
		(4.34)	
Cons	0.075***	0.004***	0.075***
	(5.03)	(11.14)	(5.03)
Year & Industry	YES	YES	YES
N	268647	268647	268647
R^2	0.06	0.06	0.98
F-Statistics	28000		
Sargan Stat	54.12		
Endogeneity Test	1.24		
Chiz			15724.14
P>Chiz			0.0000

The table shows IV-2SLS and 3SLS estimation results of the interaction effects of public firms' presence (PFP) & sales growth (GR) – PFP*GR on fixed intangible asset investment (FIA). The regression results are used for robustness purposes. All variable definitions are described in Table I. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels respectively

Source (s): Table V created by authors

Table VI: Alternative specification – GMM estimation approach

	Main Measure		Alternative Measure	
	Model 1 FIA	**Model 2 FIA**	**Model 3 FIA**	**Model 4 FIA**
PFP*GR	5.556**	10.160**	0.845***	0.387**
	(2.02)	(2.26)	(6.54)	(2.41)
PFP	7.340*	15.160**	-1.342	-2.544**
	(1.86)	(2.45)	(-1.38)	(-2.28)
GR	0.337**	0.671***	2.301***	1.123***
	(2.04)	(2.57)	(6.71)	(2.62)
LEV		-0.109*		-0.099*
		(-1.84)		(-1.67)
CF		0.030		0.009
		(0.37)		(0.11)
SZ		0.974***		0.948***
		(3.22)		(3.00)
CH		-0.103*		-0.149***
		(-1.88)		(-2.99)
NWC		0.380		0.427*
		(1.46)		(1.64)
FY		-0.498		-0.276
		(-1.14)		(-0.93)
PR		0.012		0.038
		(0.27)		(1.25)
MAT		0.001		0.021
		(0.06)		(1.10)
Year effect		YES		YES
N	250200	205541	250200	205541
N_Clust	49931	43065	49931	43065
F-Stats	48.49	11.58	69.83	25.02
Sargan	187.52	75.28	153.11	186.02
Hansen	71.70	37.45	72.53	70.22
AR(1)	0.048	0.114	0.000	0.000
AR(2)	0.345	0.088	0.000	0.118

The table shows GMM estimation results of the interaction effects of public firms' presence (PFP) & sales growth (GR) – PFP*GR on fixed intangible asset investment (FIA). Models 1 &2 use the main measure (PFP) whiles the alternative measure (PFP2). The regression results of GMM are used for robustness purposes. All variable definitions are described in Table I. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels respectively.

Source (s): Table VI created by authors

Table VII: Additional Analysis: Fixed Tangible Assets & Research & Development Investments

	Fixed Tangible Assets		Research & Development	
	Model 1	Model 2	Model 3	Model 4
	(OLS) TAN	(OLS) TAN	(OLS) R&D	(OLS) R&D
PFP*GR	0.172	0.200	0.003	0.003
	(1.08)	(1.26)	(0.34)	(0.32)
PFP	0.237	-0.008	-0.149***	-0.152***
	(0.70)	(-0.02)	(-3.53)	(-3.79)
GR	-0.004	-0.001	0.002**	0.002**
	(-0.53)	(-0.11)	(2.61)	(2.43)
LEV		0.006***		-0.0001
		(3.17)		(-0.35)
CF		0.215***		-0.004***
		(68.49)		(-4.32)
SZ		-0.014***		0.0001
		(-21.78)		(1.30)
CH		-0.249***		0.002***
		(-138.65)		(5.59)
NWC		-1.261***		-0.010***
		(-83.51)		(-12.57)
FY		0.001***		-0.000**
		(52.80)		(-2.24)
PR		-0.286***		0.009***
		(-43.36)		(7.57)
MAT		0.158***		-0.001***
		(133.63)		(-5.94)
Cons	0.188***	1.275***	0.002	0.009***
	(12.43)	(64.52)	(1.24)	(5.10)
Year	YES	YES	YES	YES
Industry	YES	YES	YES	YES
N	308853	268650	308853	268650
R^2	0.03	0.17	0.01	0.01

The table shows OLS estimation results of the interaction effects of public firms' presence (PFP) & sales growth (GR) – PFP*GR on tangible asset (TAN) investment and research & development (R&D). Models 2&4 show fully specified models. These regression results are used for robustness purposes. All variable definitions are described in Table I. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels respectively

Source (s): Table VII created by authors

Table VIII: The interaction effects of public firm presence and financing decisions on Fixed Intangible Assets investment

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	(OLS)	(FE)	(OLS)	(FE)	(OLS)	(FE)
	FIA	*FIA*	*FIA*	*FIA*	*FIA*	*FIA*
PFP*GR	0.569***	0.178***	0.572***	0.187***	0.611***	0.189***
	(3.89)	(5.58)	(3.86)	(5.73)	(4.19)	(5.90)
PFP	-0.397*	0.029	-0.458**	0.027	-0.321	0.044
	(-1.85)	(0.41)	(-2.12)	(0.37)	(-1.50)	(0.61)
GR	0.051***	0.027***	0.052***	0.027***	0.049***	0.027***
	(10.17)	(15.62)	(9.99)	(15.27)	(9.95)	(15.46)
LEV	0.007***	0.007***	0.009***	0.007***	0.008***	0.007***
	(5.86)	(8.13)	(7.74)	(8.24)	(7.77)	(8.18)
CF	0.047***	0.005***	0.049***	0.005***	0.053***	0.005***
	(25.15)	(4.46)	(25.66)	(4.25)	(25.80)	(4.93)
SZ	0.014***	0.017***	0.015***	0.018***	0.014***	0.017***
	(38.10)	(30.42)	(37.60)	(30.65)	(38.23)	(30.53)
CH	-0.025***	-0.033***	-0.024***	-0.033***	-0.025***	-0.033***
	(-26.24)	(-30.61)	(-24.75)	(-29.81)	(-26.40)	(-30.55)
NWC	-0.253***	-0.002	-0.253***	-0.001	-0.253***	-0.002
	(-13.24)	(-0.23)	(-12.83)	(-0.14)	(-13.26)	(-0.22)
FY	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(-61.94)	(-3.40)	(-61.62)	(-2.73)	(-61.98)	(-3.42)
PR	-0.085***	0.014***	-0.086***	0.014***	-0.083***	0.014***
	(-22.41)	(6.24)	(-22.14)	(6.24)	(-21.82)	(6.13)
MAT	0.029***	0.009***	0.028***	0.009***	0.029***	0.009***
	(44.24)	(20.06)	(35.59)	(19.07)	(44.38)	(20.08)
PFP*LEV	0.077*	0.010				
	(1.71)	(0.46)				
PFP*MAT			0.078***	0.035***		
			(2.84)	(2.63)		
PFP*CF					-0.447***	-0.104***
					(-6.88)	(-4.09)
Cons	0.071***	-0.088***	0.070***	-0.098***	0.069***	-0.089***
	(3.90)	(-8.61)	(3.74)	(-9.34)	(3.82)	(-8.65)
Year effect	YES	YES	YES	YES	YES	YES
Industry effect	YES	NO	YES	NO	YES	NO
N	268647	268647	259418	259418	268647	268647
R^2	0.06	0.02	0.06	0.02	0.06	0.02

The results show how a private firm in industry with greater public firms' presence use leverage, cash flow and structure debt to intangible assets investment. Thus, the interaction effects of PFP and Leverage (PFP*LEV), PFP and Debt Maturity (PFP*MAT) & PFP and Cash Flow (PFP*CF) on fixed intangible assets Investment (FIA). Our key interests are the interaction covariates: PFP*LEV, PFP*MAT and PFP*CF. The OLS models 1, 3 & 5 show our regression results, while models 2, 4 & 6 are for FE. The *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels respectively.

Source (s): Table VIII created by authors