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What drives SME investment in digitalisation? Micro-data evidence for Ireland

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Abstract

In this paper, we use novel firm-level microdata for Ireland to explore the factors that determine the investment in digitalisation for micro, small and medium-sized enterprises (SMEs). More specifically, we use cross-sectional survey data to explore whether firm fundamentals or constraints act to impact digitalisation. Furthermore, we explore whether the factors determining digital investment differ from those that impact other capital expenditures (tangible fixed assets and intangibles) using both a logit and tobit approach to deal with the censoring of the investment variable and to model separately the propensity to invest and the level of investment. We also explore heterogenous effects across age, size and sector. We find that typical indicators of firm performance such as the marginal profitability of capital and overall firm profitability are strong explanatory variables for investment in digital assets. We do not find any major impact of credit market factors such as access to finance or indebtedness but interest rates have a negative effect. We find considerable variation across size, sector and age with micro and older firms much less likely to invest in digital assets.

Non-Technical Summary

In this paper, we have undertaken a detailed analysis of the factors that drive digitalisation investment including profitability, firm growth, access to finance and interest rates. We have explored these relationships across a larger group of investment assets as comparisons and using a larger group of firm types than has been completed to date in the literature.

A number of cross cutting themes can be summarised in terms of the main findings. First, firm performance and quality matter. We find a strong relationship between profitability and whether a firm invests in digital assets and we find a strong link between the return on additional capital and the level of investment. Both of these findings clearly point towards better performing firms being first to invest and adopt digital technologies. If policymakers are aiming for a broad-based digitalisation of enterprises, then a focus on poorer performing firms is likely required.

Second, we find that interest rates have a negative effect on investment in digital assets but we dont establish a role for over indebtedness or credit constraints in our sample. This suggests that the barriers to digital investment may be less sensitive to credit supports than other types of investment but a lower cost of credit would likely be supportive in terms of the digital transition. On the other hand, the descriptive analysis across the financing structure shows a high share of digital activity is financed by internal funds. Understanding better what is holding back the non-investing firms from a financing perspective (be it risk aversion, information asymmetries or other barriers to investment) can inform whether additional digital financing instruments are necessary.

Thirdly, we find very specific patterns across firms and sectors in terms of digital investment; micro firms and older firms have the lowest activity. For older firms, it could be the case that their capital stock is less digitised or more traditional in nature and therefore the cost of retrofiting that stock in a digitalisation sense is more difficult. Targeting this group of firms in terms of supports is likely to be required to ensure that all enterprises can see a digital pathway, even if its not part of their current operating capital stock. Furthermore, noticeable differences exists within sectors such as construction and retail between investment activities of firms. This highlights the fact that the digital gaps likely to be associated with very specific sub-sectors or groups of firms. From a policy formation perspective, bespoke digitalisation strategies are likely to be needed.

1 Introduction

The issue of productivity-enhancing digitalisation at the firm level has recently come to the fore as a critical challenge for the development of small firms. Recent research both internationally (Chen & Lee, 2023; Mattsson & Reshid, 2023) and in Ireland (OECD, 2019) has suggested notably lower productivity levels for small firms and this is likely acting as a constraint to their growth. Therefore understanding how productivity can be improved for these enterprises is a critical issue for policymakers and researchers.

A range of factors have been suggested to explain these productivity differentials such as lower investment levels and access to finance (Krishnan et al., 2014), however, one further factor which has recently been put forward is the issue of digitalisation by smaller enterprises in particular. Gal et al. (2019) find that digital adoption at the industry level is positively associated with productivity gains at the firm level with big sectoral differences and heterogeneity across firms. Similar findings are also reported by Mattsson & Reshid (2023). Acemoglu et al. (2020) also report positive impacts on productivity of labour-replacing robotic automation. While digitalisation has been shown to be directly productivity enhancing, it has also been linked to a range of other economic benefits such as increased innovation, reduced informational asymmetries, better data production and analytics to inform decision making, and facilitate access to finance and improve recruitment (Hogan et al., mimeo). It has also been linked directly to growth outcomes (Daud & Ahmad, 2023).

Given the clear benefits of digital technologies, the question arises as to what factors impact investment in digitalisation and the adoption of digital technologies. In this paper, we use novel firm-level microdata for Ireland to explore the factors that determine the investment in digitalisation for enterprises. More specifically, we use cross-sectional survey data to explore whether firm fundamentals or constraints act to impact digitalisation. Furthermore, we explore whether the factors determining digital investment differ from those that impact other capital expenditures (tangible fixed assets and intangibles). We also explore heterogenous effects across age, size and sector. In terms of the factors that directly impact investment activity, we focus on disentangling access to finance such as indebtedness and credit access from factors that determine the profitability and general performance of the enterprise.

Our research is linked to a number of studies in the existing literature. First, our research is related to the studies that explore the determinants of digital investment and technology adoption. Two factors that are critically important, and explored in the literature, are education and training. Cirillo et al. (2023) find positive effects of education and training on digital adoption as well as second-level collective bargaining. They also find considerable heterogeneous effects across firm size and sector. Trinugroho et al. (2022) explore the adoption of digital technologies for micro and small businesses in Indonesia and find that business factors as well as owner characteristics play a significant role in explaining the barriers to adopting digital innovations. Guerrieri et al. (2011) consider the macro determinants of ICT investment across countries and find the general business environment, as well as human capital, R&D spend, and market regulation. Nicoletti et al. (2020) use data on digital technology usage across 25 industries in 25 countries to explore the impacts of digital adoption. They find diffusion of high-speed broadband internet correlates positively with adoption. They also note that low managerial quality, lack of ICT skills and policies curbing market access, competition in services, hiring and firing and availability of venture capital are associated with lower digital technology adoption. Hollenstein (2004) tests the timing and intensity of a firm's adoption of Information and Communication Technologies (ICT) using a large sample of firms. Using a dataset of Indian firms, Lal (1999) find that skills, information and qualifications matter for adoption as well as the size of operations and skill intensity of the firms influenced the extent of IT use. Lucchetti & Sterlacchini (2004) test the adoption of ICT and find different relationships between firm characteristics and the adoption of different technologies. Giunta & Trivieri (2007) use Italian firm-level data to explore the determinants of ICT adoption and find that firm size, geographical location, functional composition of the workforce, R&D activity, subcontracting, exports and collaboration between firms are all highly significant determinants. A final related study by Giotopoulos et al. (2017) explores the adoption of ICT by Greek firms and finds that innovation and R&D activities and collaborations, well-educated and skilled workers, decentralized decision-making and visionary leadership increase the likelihood of adopting new technologies in SMEs.

Second, our research is tangentially related to the broader research on the impact of digitalisation on production, productivity and employment. Acemoglu & Restrepo (2018) explores the relationship between automation and labour inputs and finds that while automation can be labour replacing, innovation and the creation of new tasks can employ more labour inputs as

previous tasks are automated. Acemoglu et al. (2014) finds that productivity increases rapidly in IT related industries following automation and labour inputs do decline in tandem. Finkelstein Shapiro & Mandelman (2021) show a strong and negative link between firm digital adoption and self-employment rates controlling for a range of factors. The magnitude of the effect is dependent on the cost of technology adoption. Gan et al. (2023) also finds an impact of technology adoption on the green agenda. Mattsson & Reshid (2023) look at productivity distributions and the dispersion of productivity and find increases in productivity differences over time, with greater increases in digital-intensive sectors and sectors characterised by a large share of intangible assets. Santos et al. (2023) undertake a cross country study and find an average positive effect of ICT on employment.

Given these existing studies, our contribution is as follows: we explore heterogenous effects in more detail than other studies to identify specific patterns in terms of digital investments. This has been shown to be critically important in the literature on investment, in particular on intangibles (Arrighetti et al., 2014). We also explore the difference in effects on digital assets versus other fixed capital assets. This approach extends the work of Thum-Thysen et al. (2019) who consider the differences across tangible and intangible assets. Our study is therefore also similar to Bacchini et al. (2018) who test across investment types at a macro level. From an Irish perspective, we are the first study to explore the determinants of investment in digitalisation considering this range of factors on a dataset for small-and-medium sized enterprises. Our work builds on previous Irish research in the area (Haller & Siedschlag, 2011) which tests the impact of ICT adoption for manufacturing firms over the period 2001-2004. They find notable heterogeneous effects which we also explore in this research.

A number of findings emerge from the research. First, in relation to the probability of investing, we explore the differing impact of fundamental factors, credit market factors and firm-level characteristics across 4 types of investment (all assets, fixed tangible assets, intangible assets, digital assets). Regarding firm fundamentals, we find that profitability is a key determinant of who invests with a profitable firm nearly 18 per cent more likely to invest in any asset relative to loss making firms; and 4.4 per cent more likely to invest in digital assets. For digitalisation, we also find a clear firm growth effect; with growing firms more likely to invest in digital assets than contracting firms. In terms of the impact of credit markets on the likelihood of a firm investing, we do not find a role for debt overhang which is unsurprising given the low leverage balance sheet approach taken by many Irish firms

since the financial crisis. We do find a strong effect of the interest rate in pushing down the likelihood of investment. Unsurprisingly, firms with no credit demand have a low likelihood of investing in any assets. Exploring differences across firms we find a clear size effect with larger SMEs more likely to invest in digital assets and exporters are also more likely to invest in digital assets. Our assessment across sectors, size classes and ages finds considerable heterogeneity in the effects.

Regarding investment financing, we find that digital assets are disproportionately financed through internal funds with little to no leasing or loan finance used. Equity financing is used in some cases but it is only a minority tool in terms of the overall funding. Digital financing through internal funds is the highest across all of the assets classes considered.

In terms of the models considering the level of investment (as a share of total assets), a number of findings emerge. First, the sales to assets ratio (the main indicator of the marginal value product of capital ratio) is positive and highly significant for all investment, fixed assets and for digital assets. It is not statistically significant for intangible assets. This suggests that for digital and fixed assets, firms invest in line with the underlying profitability of capital. The size of the marginal effect is much larger for the fixed investments than for digital investments which may reflect the smaller nature of digital investments as a per cent of assets (thus the reaction is less per increase in unit profitability). In terms of the profitability indicators to distinguish loss making, break even and profit making firms, they are positive and significant for break even and profit making firms for all investments and fixed tangible capital. They are not significant for intangible or digital assets. In terms of the turnover change variables, we find a positive and significant effect for growing firms relative to shrinking firms for digital assets which may indicate that firms with a positive growth trajectory are committed to the digital transformation. We do not find any major effect of credit access or the cost of capital. Nor do we find any negative effects of high indebtedness. We do find notable size and age effects with smaller, older firms much less likely to invest in digital assets.

From a policy perspective, there are a number of implications which arise from our analysis. Firstly, noticeable differences exists within sectors such as construction and retail between the investment activities of firms. From a policy formation perspective, it is therefore critical that bespoke digitalisation strategies are deployed that are unique and specific to sub-sectors and sub-groups of firms. Within these groups, bridging the gap between leading

firms and laggard firms is likely to be important and distilling the learnings of heavily digitised firms can inform the policy response. Targeting older firms is also likely to be important, specifically if those firms have older capital stocks which may need upgrading. In this regard, credit and financing instruments may be worth deploying for these firms.

The rest of this paper is structured as follows: section 2 outlines the dataset and provides summary statistics and trends. Section 3 outlines the empirical methodology. Section 4 presents the results and section 6 concludes.

2 Data and Summary Statistics

2.1 Data, Survey and Questions

2.1.1 Survey and Questions

The data used in this research are collected through a bespoke investment module included in the Irish Ministry (Department) of Finance's bi-annual Credit Demand Survey (CDS). As outlined in previous research using these data, the CDS is collected through a nationally representative telephone survey of approximately 1,500 firms. The sample is restricted to those firms who have fewer than 250 employees, and less than €50 million of annual turnover in the past year. The sample selection and sampling accuracy of the survey are described in B&A (2021). The dataset includes sampling weights based on company size and sector quota, which are then used throughout the descriptive statistics.

The main aim of the survey is to collect information on firms' credit demand requirements for both working capital and capital expenditure issues as well as to gain information on a range of factors related to credit availability, financial distress, banking sector interactions and the outlook for firms in terms of their credit requirements. The survey has been collected since 2009 but changes have occurred to the questionnaire on multiple occasions. Since 2017, a specific module has been added to the survey once a year which incorporates a range of questions on investment activity, the sufficiency of investment, capital stock, employment and indebtedness. The aim of this module was to gain information on the investment activities of small firms in Ireland of which there are few timely surveys available at a granular level.[1] Extensive details on the survey and the questions can be found in Gargan et al. (2018) which presents the module in detail.

[1] The EIB EIBIS survey is one notable exception.

In terms of the information collected on investment activities at the firm level, the CDS provides detailed information on investment by type of asset (i.e. buildings, transport, machinery, intangibles and staff), and also on the value of firms' total assets. More specifically, the survey asked firms to provide the euro value of their investments for the following five main asset classes:

(1) Buildings or other construction activities;

(2) Vehicles and other transport equipment;

(3) Other fixed assets (including machinery and equipment);

(4) Intangible assets (i.e. research and development, patents, trademarks and copyrights); and

(5) Investment in staff.

Since 2021, there is a subsequent question on investments in digital assets regardless if they are fixed or intangible assets. Firms were asked to indicate the level of expenditure on the following: *Digital technologies or e-commerce activities (such as automation, robotics, artificial intelligence, blockchain, data analytics infrastructure, internet communication devices etc)*. We use the reported information on expenditure for these items as our measure of investment in digital activities. The 2019 data was requested retrospectively in the 2020 questionnaire. Some slight differences occur in the questions between the two survey periods.[2]

As a comparison indicator, we define: a) total fixed asset investments as a sum of (1)+(2)+(3). Furthermore, total fixed assets are summed together with (4) into 'total (capital) investments'. For some observations the value of digital investments exceeds the sum reported in the main investments question. In those causes, digital investments are added into the total investments. Information on (5) are not used in this paper.

2.1.2 Data Cleaning

Some additional data cleaning was required to ensure maximal sample size and data quality. The approach here follows the practices used in previous research using Credit Demand surveys such as Martinez-Cillero et al. (2020) or O'Toole et al. (2021).

[2] For more details, see survey questionnaires.

Firstly, some firms refused to provide the exact number of employees or their turnover. However, in subsequent questions they have provided the band in which the value is located. In these cases, the missing value is imputed using the middle value of the band as a proxy for the continuous data point.

Secondly, on the question of the share of each investment financing option, adjustments were made when provided answers did not sum to 100 per cent. In most cases, the sum is close to (but not exactly) 100 per cent which is likely due to rounding error. Thus, the values were either scaled up or down accordingly. However, when the answer was incomplete then all shares were set to missing and thus ignored.

Thirdly, we construct a credit access indicator with three possible values: a) firms that applied and received a loan, b) firms that unsuccessfully applied for a loan or did not apply because they believed they would have failed, and c) firms that didn't apply for a loan for any other reason, such as "no need for a loan".

Fourthly, the questions which capture turnover growth were asked differently in the two surveys. In the first survey, firms' were asked for nominal turnover in both 2019 and in 2020. In the second survey, firms were asked to report only three categorical options (decrease/no change/increase) to capture the change in 2021 compared to 2020. For consistency, the growth rate in 2020 converted to three discreet values, with ∓5% threshold for the no-change option.

2.2 Summary Statistics

In this section, we present summary statistics for the main variables in relation to digitalisation. To begin, we define a number of indicators which are used to describe the investment activity of Irish SMEs. The indicators are as follows:

(1) the Per cent of investing firms; and

(2) the Level of investment (in euro medians or means).

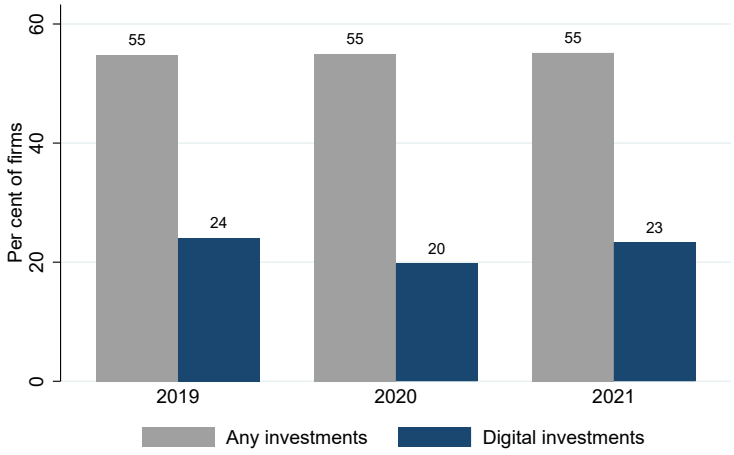
The indicators provide simple explanatory statistics for what is happening in terms of expenditure in digital activities. These indicators are presented for digital investments as well as all other capital investments as a comparison. To explore the heterogeneity in investment activity across enterprises, we

also provide breakdowns of the data across firm size (micro, small, medium), for high level sectors and by age group.

2.2.1 Per Cent of Firms Investing

Figure 1 presents the share of firms' investment in any capital items and making digital investments for each survey year from 2019 to 2021. Overall, the proportion of firms' investment remained relatively constant at approximately 55 per cent for all capital items; this is despite the Covid-19 pandemic hitting during 2020. However, the share of digital investors is only half the level of the overall investment category at approximately 20-24 per cent of firms. This proportion is lower in 2020 during the pandemic than in 2019 or 2021.

Figure 1: Per cent of firms investing



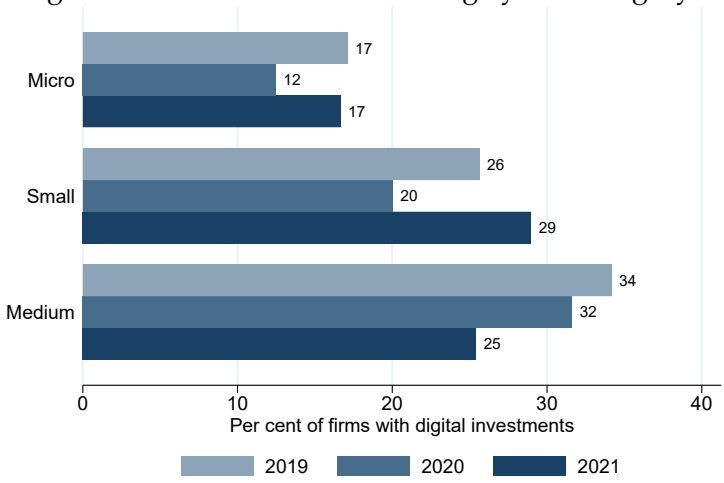
Source: DoF Credit Demand Survey 2021 and 2022.

It is highly likely that digital investment is correlated with firm characteristics as investment constraints (such as access to finance, digital skills, absorption capacity) all differ across firms. This is a well established empirical result in the literature (Beck & Demirguc-Kunt, 2006; Beck et al., 2008). We split out the investment in digital activities by firm size in figure 2 to explore whether any patterns are evident for the Irish case. Three firm size groupings are used as follows: micro firms (less than 10 employees), small firms (10-49 employees) and medium-sized firms (50-250 employees). The per cent of investing firms is presented in the chart for each year of the sample. Two empirical findings emerge clearly from these data. First, investment in digitalisation increases by firm size; based- on the latest year of available

data, the share of investment by micro-firms is 17 per cent as compared to 29 and 25 per cent for small and medium-sized firms.

Second, there appears to be a general decline in the proportion investing in digitalisation for medium-sized firms in each of the years while the two smaller firm groups have experienced a rise from 2020 to 2021. For the latter, there may have been a drop due to Covid-19 as the need for digitalisation was outweighted by financing constraints, uncertainties and other pandemic specific effects. The drivers of the trend for medium-sized firms is not as easy to rationalise.

Figure 2: Per cent of firms investing by size category

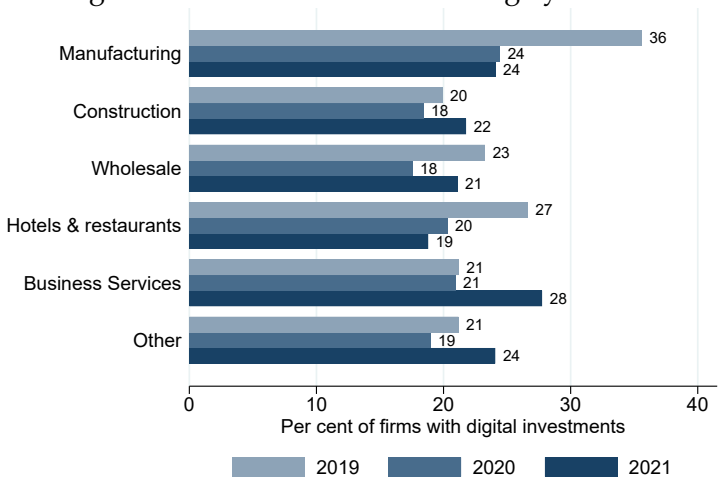


Source: DoF Credit Demand Survey 2021 and 2022.

Part of the variation in investment proportions across firms may be driven by sector-specific capital needs. We therefore explore the per cent of firms investing by sector in figures 3 and 4; the first chart provides higher level sector aggregations but includes the data for all three years while the second chart provides more disaggregated sectoral data averaged across the full sample period (this is required as some sectors have small sample sizes for any one individual year). Beginning with data for the most recent year, the sectors with the highest proportion of firms investing in digitalisation were business services (28 per cent) and manufacturing and other (24 per cent). Domestic focused sectors such as construction, wholesale and hotels and restaurants are marginally lower with the proportion of investment firms being 22, 21, and 19 per cent respectively. Interestingly, the per cent of investing firms grew notably for business services between 2020 and 2021, increasing by 7 percentage points. The per cent of investing firms in construction and

wholesale sectors also increased by four and three percentage points between 2020 and 2021.

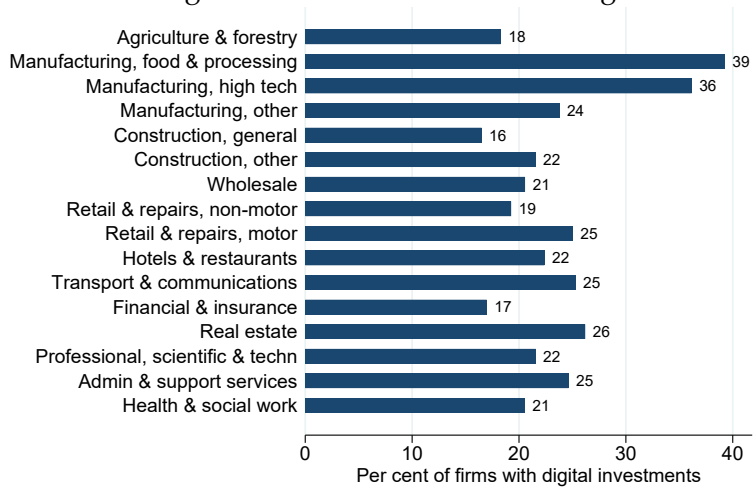
Figure 3: Per cent of firms investing by sector



Source: DoF Credit Demand Survey 2021 and 2022.

To provide more granular detail by sector (where available), the average proportion of firms over the three year period 2019-2021 is presented for more detailed sectors in figure 4. Two sectors clearly standout as having notably higher shares of firms investing in digital assets: high tech manufacturing and also the manufacturing of food and food processing. The proportion of investing firms is much higher than the other manufacturing sector, which is at 24 per cent. This is likely due to the nature of these activities which require high-end digital inputs as part of the production process. In terms of the construction sector, real estate firms have a much higher rate of investment in digital services relative to general construction firms (24 to 16 per cent). If fact, construction (general) is the sector with the lowest proportion of firms investing in digital technologies. Given the findings of previous research (Hogan et al., mimeo) that the adoption of digital technologies is low for Irish construction firms, this is potentially an area where further investment could be supported and lead to sectoral productivity enhancements. Within the wholesale and retail sector, there is also a divergence with the motor industry having a higher share of firms investing in digital technologies (25 per cent) relative to non-motor. This highlights the likely differences in the application of digital technologies across industries within their sub-sectoral production structures.

Figure 4: Per cent of firms investing



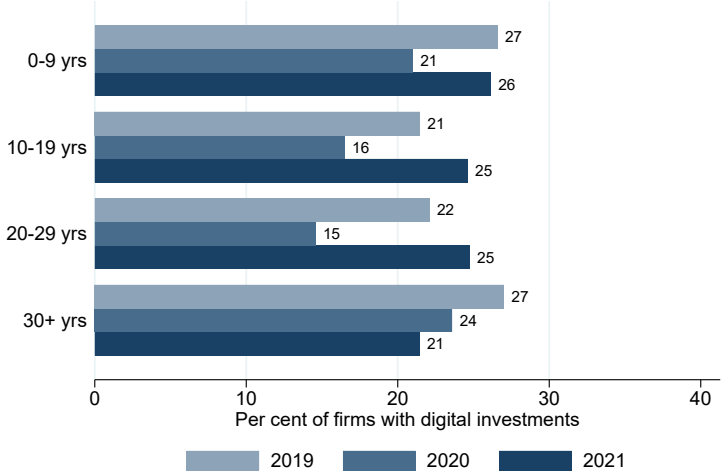
Source: DoF Credit Demand Survey 2021 and 2022.
Average over 3-year period.

Having considered firm size and sector, we turn to trends in the proportion of firms investing in digital technologies by firm age. Firm age has been shown to be an extremely important indicator in terms of firm growth (Lawless, 2014); young firms are much more likely to be fast growing than small firms. If firms are older and still remain small, the growth prospects are low. In terms of digitalisation investment, it is also possible that younger firms who have been established more recently are more linked in with recent technologies; any establishment capital that is purchased may be digital ready as opposed to firms with older capital. This is a useful hypothesis to test as it may provide insights as to how policies can target increased digital spend. Figure 5 presents the proportion of firms investing in digital technologies by age groups: 0-9 years; 10-19 years; 20-29 years; and 30+ years. Focusing on 2021, more firms in the younger age groups were investing: 26 per cent of firms in the youngest group as compared to 21 per cent for those firms older than 30 years.

2.2.2 Level of Investment (Euro)

The preceding section presented information on the proportion of enterprises that invested in digitalisation activities. In addition to understanding how many firms invested, it is also critically important to understand how much capital they are committing as well. In this section, we present statistics for the volume (in euro terms) of the investment. It must be noted that we limit

Figure 5: Per cent of firms investing by age category



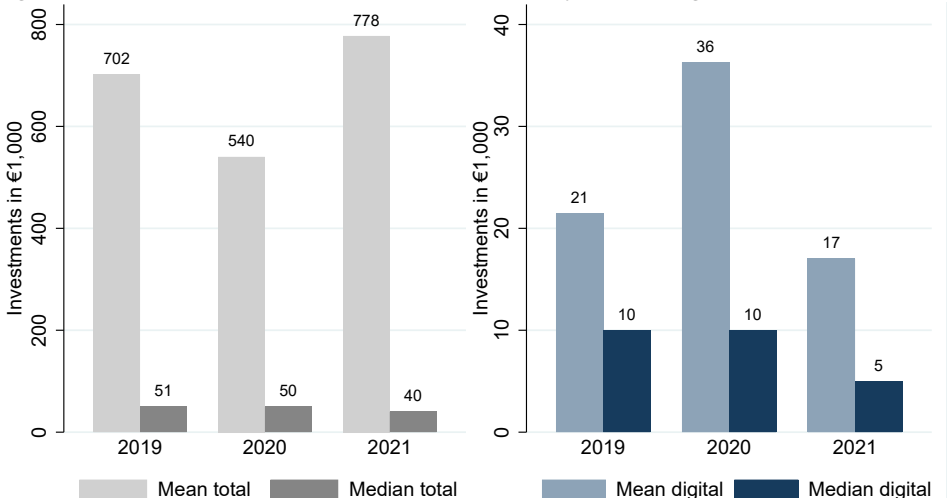
Source: DoF Credit Demand Survey 2021 and 2022.

the sample in these data to *investing firms only* i.e. those firms who reported positive expenditures. Therefore only a subset of the data presented in the above charts are used to generate these statistics.

Figure 6 presents the mean and median level of investment for two capital asset groups: 1) overall investments and 2) digital investments for each of the three years for which data is available. As is typical with capital expenditure, there is a huge difference between the mean and median statistics, highlighting the right skew in the distribution i.e. some firms make very large investments while a majority of enterprises make notably smaller investments. In 2021, the average investment across all firms was 778,000 euro but the median investment was only 40,000 euro. It is also noteworthy that the level of digital investment is much lower than that for all capital assets. The median investment in digital is only 5,000 euro per firm. This is not unsurprising however when one considers the nature of the underlying assets. The broader category includes investment in buildings, and very large fixed machinery which are much bigger capital outlays and pull the typical spend upwards relative to digital.

To highlight the impact of large investments on the mean and median, figure 7 presents a kernal density plot of the distribution of investment for digital (blue line) and total investments (grey line). The distribution means are presented as dashed lines and the medians are solid lines. It is clearly identifiable that there are large right tails on the distributions and the medians sit well to the left of the means for both series. These data are log

Figure 6: Mean and median investments (only investing firms) - euro 1,000



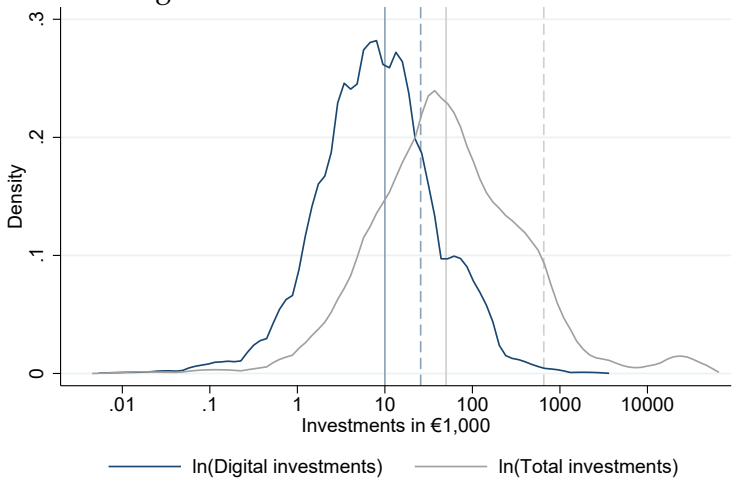
Source: DoF Credit Demand Survey 2021 and 2022.

adjusted and appear to (with the exception of the tails) have a log normal distributional shape. The distribution for total investment lies mainly to the right of the digital investment distribution demonstrating the additional expenditure occurring in this group.

To provide more information on the heterogeneity in expenditure patterns across firms, we present the level of expenditure by firm sector, exporting status, size and age in figures 8 and 9 . We present the median level of investment by sector as well as the interquartile range, the value at 25th (Q1) and 75 (Q3) percentiles of the distribution. The interquartile range provides information on the skew in the data which we have noted above is considerable. For 2021, the sector with the highest level of investment is manufacturing at 15,000 euro per firm median. Construction was the second highest in terms of the levels while wholesale, retail, hotels, and other services all have a median investment of 5,000 euro.

In terms of firm size, for 2021, micro-sized firms indicated a typical investment of 3,000 euro with small firms posting 10,000 euro and medium-sized firms indicating 12,000 euro. Focusing on the differences across age groups, for 2021, very similar investments were made for enterprises across the age groups with the exception of the oldest firms. For firms less than 30 years of age, the typical investment was approximately 5,000 euro whereas older firms posted a median investment of double that figure.

Figure 7: Distribution of investments



Source: DoF Credit Demand Survey 2021 and 2022.
Kernel density estimates with data for all 3 years. Vertical lines represent medians (solid line) and means (dashed).

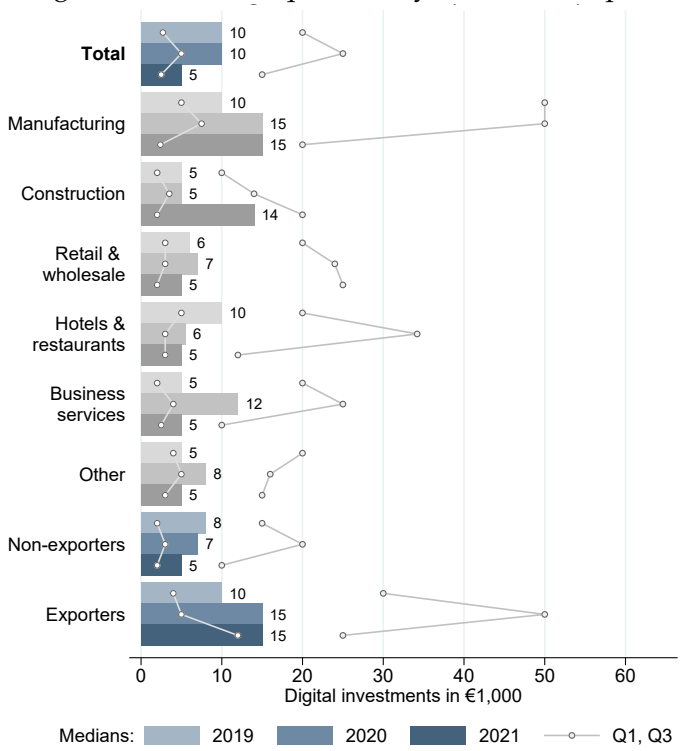
3 Empirical Methodology

In this section, we outline our econometric approach and methodology for testing the determinants of investment in digitalisation. There are a number of features of the data covering investment activity for small firms that present particular challenges in terms of selecting a suitable modelling approach. The first, as well documented in section 2 above, is the fact that investment activity for these smaller firms is lumpy and infrequent i.e. not all firms invest in a given year, and when they do, these investments are potentially multi-annual in nature. Indeed, in the summary statistics, we see that just over half of the enterprises in our data invested each year in any type of capital and approximately 25 per cent invested in digital assets. This behavioural pattern introduces a type of censoring of the dependent variable with 0 values observed from a large number of firms and levels for others which can be represented by a latent variable process as follows:

$$I_i = \begin{cases} I_i^* & \text{if } I_i^* > 0 \\ 0 & \text{if } I_i^* = 0 \end{cases} \tag{1}$$

where the investment activity of firm i ($I(A)_i$) is either positive or equal to 0.

Figure 8: Digital investments quartiles by sector and export status



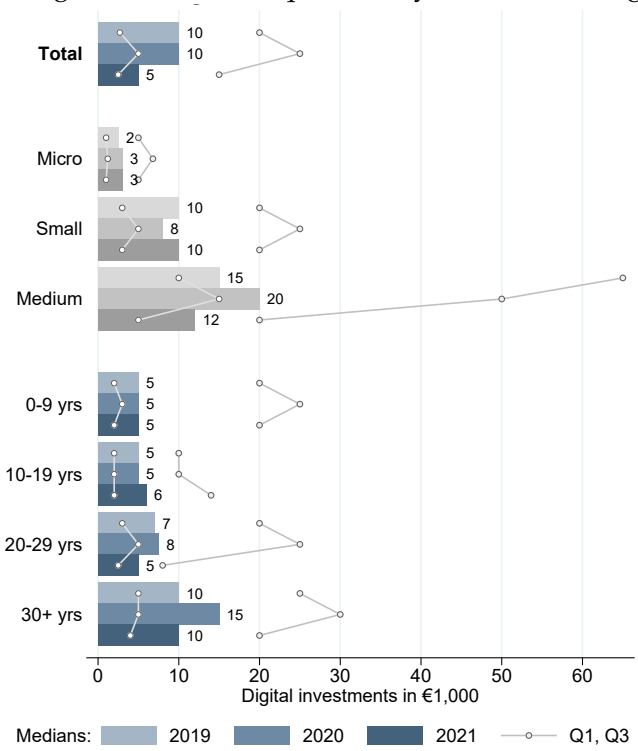
Only firms with digital investments.
Source: DoF Credit Demand Survey 2021 and 2022.

To deal with this issue, we deploy two separate analytical assessments. The first focuses only on the decision to invest and the second applies a censoring investment model to the level of investment. For the first model, we begin by defining the latent dependent variable for investment type A for firm i in period t as:

$$\frac{I^A_{i,t}}{TA_{i,t-1}}^{*} = \begin{cases} 1 & \text{if } \frac{I^A_{i,t}}{TA_{i,t-1}}^{*} > 0 \\ 0 & \text{if } \frac{I^A_{i,t}}{TA_{i,t-1}}^{*} = 0 \end{cases} \tag{2}$$

Investment in asset type A is scaled by firm total assets. In our analysis, we distinguish between three asset types: tangible fixed capital, intangible capital, and digital expenditures. Tangible fixed capital includes expenditure on buildings, vehicles, and other machinery and equipment. For firms for which investment is positive (depending on the specific asset), our binary

Figure 9: Digital investments quartiles by firm size and age



Only firms with digital investments.
Source: DoF Credit Demand Survey 2021 and 2022.

model takes the value of 1 and 0 otherwise. With this latent binary model, we can apply a simple logit model to the cross sectional data to test the impact of various factors on the probability of investing.

For the second model, the latent process is similar except we have both a clustering of the distribution at 0 (for the non-investors) and positive values for the other investors as represented by the following:

$$\frac{I^A_{i,t}}{TA_{i,t-1}}^* = \begin{cases} \frac{I^A_{i,t}}{TA_{i,t-1}} & \text{if } \frac{I^A_{i,t}}{TA_{i,t-1}}^* > 0 \\ 0 & \text{if } \frac{I^A_{i,t}}{TA_{i,t-1}}^* = 0 \end{cases} \tag{3}$$

To estimate the above equation, a number of different approaches are possible. We follow Martinez-Cillero et al. (2020) and Martinez-Cillero et al. (2023) and use a tobit model approach.[3]

For both models, we include the same set of covariates to determine what factors impact investment by enterprises in digitalisation. To capture the performance, quality and fundamentals of the firm we include an indicator for the marginal value product of capital which is often approximated by Tobin's Q in analytical studies. As we do not have listed firms, we cannot construct Q from market data so instead include a proxy which is the sales to capital ratio ($\frac{Y_{i,t}}{TA_{i,t-1}}$). This variable approximates the additional revenue that is received from an additional unit of assets. We expect a positive relationship with investment. The conditions under which the sales to capital ratio can proxy the marginal value product of capital are discussed in Galindo et al. (2007). In addition, we include indicator variables for firm turnover growth (declining turnover, remaining the same, increasing turnover) as well as an indicator of profitability (profit making, loss making, break even). In all models, dummies for firm size groups, sector, age categories and exporting status are included. As we are using repeated cross sectional data, it is not possible to undertake a specific transformation to remove firm-level unobserved heterogeneity such as a fixed or random effects approach.

In terms of the financial factors controlled for in the regression, we include the debt to asset ratio, an interest rate and a series of credit access dummies which distinguish between the following groups of firms: 1) those that applied for finance and were successful; 2) those that applied for finance and were rejected; 3) those that did not apply for finance and indicated they did not need it; and 4) and those that did not apply but indicated they would like credit. Groups 1 and 4 above proxy credit constrained firms, picking up credit rationed and discouraged borrowers as in Casey & O'Toole (2014). The other two groups are unconstrained; 1) received the credit they need and 3) have no demand for credit thus are unconstrained by definition. Our model can be depicted as follows:

$$\frac{I^A_{i,t}}{TA_{i,t-1}}^{*} = \alpha_0 + \beta_1 \frac{Y_{i,t}}{TA_{i,t-1}} + \beta_2 \pi_i + \beta_3 \Delta Y_i + \beta_4 \left(\frac{D^A_{i,t-1}}{TA_{i,t-1}} \right)_i + \boldsymbol{\tau}\mathbf{C} + \boldsymbol{\gamma}\mathbf{Z} + \epsilon_{i,t} \quad (4)$$

[3] While Martinez-Cillero et al. (2020) use a Heckman in their main specification, we do not use this approach due to the absence of an appropriate selection variable.

where **C** is a vector that includes the credit constraint indicators, and **Z** is a vector of indicator variables for size, age, sector and exporting status. π is a series of dummies for profitability and ΔY are the dummies for firm growth. Our expectations for the key variables in the regressions are presented in the table below:

Table 1: Variable definitions & expected regression coefficients

Variable		Exp. coef.
Sales-to-Total Asset Ratio	$\frac{Y_{i,t}}{TA_{i,t-1}}$	$\beta_1 > 0$
Firm has operating profits=1	π_i	$\beta_2 > 0$
Change in turnover	ΔT_i	$\beta_3 > 0$
Debt-to-Total Asset Ratio	$\frac{D^A_{i,t-1}}{TA_{i,t-1}}$	$\beta_4 < 0$

3.1 Regression sample

In addition to the general data preparation discussed in section 2.1.2, we perform additional data cleaning to maximise the number of observations in our regression models.

The primary issue concerns the large number of missing values for assets, particularly in 2021. To address this we first augment data from the Spring 2021 and Spring 2022 surveys with data from the Autumn 2021 survey[4]. This gives information for 106 firms which otherwise had missing values. Secondly, we use multiple imputation on 20 samples to fill-in the remaining missing values of assets. The log of assets is fitted as a function of firm employment, employment-squared, firm age, age-squared, as well as sector and year fixed effects. Finally, we use two approaches to obtain the level of assets at the start of the period rather than the level at the end of the period as reported in the survey. For the subsample of firms that either report the previous year's assets or appear in the previous year's survey, we use the actual data available. For the remaining firms, we calculate the start-of-the-year assets using end-of-the-year assets, deduct the investments and increase the value to account for depreciation with assumed 5% depreciation rate.

One of the key explanatory variables are interest rates. However, interest rate data are only reported for those firms that received the loan in the previous 6 months. It is highly likely that the investments of many firms are

[4] This survey did not include any questions on investments and therefore we do not use it elsewhere in the paper.

impacted by interest rates (or the perception of what the cost of capital would be), even if they dont have loan finance in place at present. We therefore need to establish an interest rate that could apply to each firm if they were to seek credit access. We again use the Autumn 2021 Credit Demand Survey for additional information, but for other observations we calculate mean within size-age-sector-year category values and apply the mean to all the remaining firms.

Finally, all continuous variables are winsorised at 5th and 95th percentile to address the problem of outliers. This includes both investment variables and explanatory variables. The Turnover/Assets variable had more extreme value and is winsorised at the 10th and 90th percentile. Summary statistics for the regression sample after winsorsing are shown in table 5.

4 Results

In this section, we present the results of the econometric assessment of what drives digitalisation. The results are presented in two separate sub-sections, with the determinants of the decision to invest and the determinants of the level of investment. All results are presented as marginal effects of the respective logit and tobit models.

4.1 Determinants of Decision to Invest

4.1.1 Overall Findings

The results for the logit model on the decision to invest (do firms invest?) are presented in table 2. In the table, regressions are presented in four columns relating to different types of capital asset: in column (1) the dependent variable is invest in any assets; in column (2) the dependent variable is any fixed asset; in column (3) investment in intangibles is presented; and in column (4) we presented the main digitalisation results. The juxtaposition of these variables allows us to compare and contrast which factors matter across the types of capital and whether there are differences in the relative magnitude of the effects. All results are presented as marginal effects at the mean; a one per cent change in the variable has the presented impact for continuous variables while for binary indicators the coefficient presents the percentage difference in the mean compared to the reference group.

In each of the regressions, we present the following explanatory variables: **fundamentals** (sales to assets, profitability indicators and turnover growth

indicators); **credit market variables** (debt-to-asset ratio, interest rate, credit constraints indicator); **firm specific variables** (age dummies, size dummies, sector dummies, exporting status, year dummy). The results for the sector dummies are not presented for brevity but their results are discussed and are available on request.

Considering firstly the effects of the fundamental variables, we do not find an effect of the turnover/assets ratios on any of the investment asset types. However, we find a very clear effect of profitability status; being a profitable firm relative to a loss making firm increases the probability of investing by 18 per cent for all assets, and 16 per cent for fixed assets. The magnitude is somewhat smaller for digital investments, with being profitable associated with a 4.4 per cent higher investment likelihood. Firm growth, as measured by the turnover change variable, has less of an impact on most investment assets types with the exception of digitalisation. For firms investing in digitalisation, growing firms have a near 6 per cent higher investment probability than shrinking firms, controlling for the other fundamentals.

Focusing on the credit market variables, we do not find a statistically significant link between the likelihood of investing in any assets and the debt-to-asset ratio. This indicates that indebtedness is unlikely to be acting as a drag on investment. Given the drop in leverage levels in Ireland since the financial crisis in 2008, this is not a surprising finding as many firms have maintained a low-debt funding structure. We do find a negative and statistically significant effect of the interest rate i.e. as interest rates increase, this dampens investment demand. This applies across all asset types but the magnitude of the effects differs; for all assets, a one percent increase in the interest rate leads to a 3 per cent drop in the probability of investing. The magnitude is smaller for intangible assets and digital assets but the effect remains. The final credit variables are a set of dummies that distinguish between firms who received financing (unconstrained), firms who were rejected from financing applications or did not apply due to possible rejection (constrained), and firms who did not want financing. We find a clear negative association between the unconstrained firms and those that did not want credit but no difference between constrained and unconstrained firms. This potentially indicates a clear distinction between those firms with an investment appetite and those without. It may suggest that firms are self financing investments as the constrained firms continued to invest (as there is no statistical difference between constrained and unconstrained) regardless of their credit market access.

Table 2: Marginal effects of logistic regression on probability of investing by type of investment

	(1) Total	(2) Fixed	(3) Intangible	(4) Digital
	Fundamentals			
Turnover/Assets	0.003	0.003	−0.001	0.003
	(0.003)	(0.003)	(0.002)	(0.003)
Profit: Break-even	0.113***	0.091**	0.005	0.030
	(0.035)	(0.035)	(0.015)	(0.028)
Profit: Profitable	0.181***	0.163***	0.008	0.044*
	(0.033)	(0.033)	(0.014)	(0.026)
Turnover: No change	0.013	0.017	0.010	0.039*
	(0.029)	(0.029)	(0.015)	(0.023)
Turnover: Increasing	0.036	0.042	−0.010	0.059***
	(0.027)	(0.027)	(0.012)	(0.022)
	Credit Variables			
Debt/Assets	−0.005	−0.003	−0.003	−0.005
	(0.014)	(0.014)	(0.007)	(0.011)
Interest rate	−0.028***	−0.026***	−0.006*	−0.010*
	(0.008)	(0.008)	(0.003)	(0.006)
Credit: Constrained	−0.099	−0.084	0.017	−0.045
	(0.064)	(0.064)	(0.035)	(0.059)
Credit: No need	−0.165***	−0.164***	−0.036**	−0.109***
	(0.030)	(0.030)	(0.016)	(0.027)
	Firm Characteristics			
Exporter dummy	0.061**	0.052*	0.055***	0.077***
	(0.030)	(0.030)	(0.012)	(0.022)
Size: Small	0.125***	0.117***	0.008	0.073***
	(0.024)	(0.024)	(0.012)	(0.020)
Size: Medium	0.127**	0.135**	−0.031*	0.160***
	(0.058)	(0.056)	(0.017)	(0.053)
Age: 10-19 yrs	−0.043	−0.045	−0.027	−0.044
	(0.038)	(0.038)	(0.021)	(0.031)
Age: 20-29 yrs	−0.037	−0.020	−0.060***	−0.057*
	(0.038)	(0.038)	(0.020)	(0.031)
Age: 30+ yrs	−0.002	0.014	−0.069***	−0.031
	(0.038)	(0.038)	(0.020)	(0.031)
Sector and Year fixed effects	Yes	Yes	Yes	Yes
Observations	1,995	2,020	2,043	2,023
Mean pseudo R-sq.	0.0629	0.0608	0.125	0.0599

Size-category effect compared to micro firms, Age compared to firms younger than 10 years, Credit access compared to firms that got loans, Profit indicator compared to break-even firms, Turnover growth indicator compared to no-change.
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The final set of factors that we consider are the firm characteristics: size, age and exporting status. We find a clear positive effect of exporting status - likely linked to the higher productivity, better quality firms that become exporters (this is endogenous in our research). We also find clear firm size differences with larger firms (small and medium, relative to micro) more likely to invest across all assets but in particular digital assets. Medium sized firm are 16 per cent more likely to invest than micro firms and small firms are 7 per cent more likely to invest in digital assets. The difference between medium and small firms is much greater for digital assets than overall investments; this indicates a clear size gradient in the investment in digitalisation that applies over and above the controls for firm quality and other factors. This may be due to issues like economies of scale for digital absorption. In terms of firm age, the omitted group are the youngest firms (less than 10 years). We not not find a consistent effect of age on any of the investment areas other than intangibles where investment in this asset type is negatively associated with age.

4.1.2 Exploring Heterogeneous Effects

While the aggregate effects above provide insight into the market wide determinants of investment across all firms, it is highly likely that given the diffuse and heterogeneous nature of the SME sector, differences in the relative magnitudes across firms are likely to occur. To explore this in more detail, we run the baseline regression specification for difference sub-samples of the data by age, size, and sector to test whether the coefficients are different across groups of firms. We estimate the results for all investments and for digital investments. We use a sub-sample approach as this allows all variables to have a separate effect that varies by group rather than an interaction effects model that might allow only specific variable to differ and hold all others at the mean. However, one limitation of this is we are running the regressions on smaller samples and this may lead to challenges in estimation.

The results of the logit model are presented for age and size in table 6. Given the volume of results presented in these regressions, the key themes of the findings are summarised. In terms of the interest rates effect on overall investment, this appears to have a stronger impact on micro firms and older firms. However, this does not hold for digital investments. The impact of profitability is greatest for micro and older firms for overall investment but again this does not hold through for digital investment. For both digital investments and overall investments, there is a strong effect for older, larger firms towards higher investment levels. A clear effect for micro firms is evi-

dent in terms of the turnover growth indicator; this is positive and significant for both investment types indicating that growing, micro firms have a higher propensity to invest that other micro firms.

In table 7, the results for the different sub-sectors are presented for both overall investment and for digital investment. A number of findings are worth noting. First, in terms of interest rate effects on overall investment, these are particularly strong for construction firms but also affect business services and other firms. Profitability has a strong effect on investment for manufacturing firms but it matters for most sectors. Credit constraints appear to notably lower investment for manufacturing firms. In terms of digitalisation, very strong size effects are evident for manufacturing and hotels and restaurants; firms in these sectors have a large difference between micro and other firms. Older manufacturing firms also appear to have notably lower investment likelihoods for digital assets.

4.2 Determinants of the level of investment

4.2.1 Overall Findings

In this section, we present the results of the findings on the investment to assets ratio i.e. the level of investment. As noted above, the model used in these estimations is a tobit model which deals with the left censoring of the truncated dependent variable. Standard errors are robust. The estimates (as marginal effects) are presented in table 3.

A number of findings emerge. First, the turnover to assets ratio (the main indicator of the marginal value product of capital ratio) is positive and highly significant for all investment, fixed assets and for digital assets. It is not statistically significant for intangible assets. This suggests that for digital and fixed assets, firms invest in line with the underlying profitability of capital. The size of the marginal effect is much larger for the fixed investments than for digital investments which may reflect the smaller nature of digital investments as a per cent of assets (thus the reaction is less per increase in unit profitability). In terms of the profitability indicators to distinguish loss making, break even and profit making firms, they are positive and significant for break even and profit making firms for all investments and fixed tangible capital. They are not significant for intangible or digital assets. In terms of the turnover change variables, we find a positive and significant effect for growing firms relative to shrinking firms for digital assets which may indicate that firms with a positive growth trajectory are committed to the digital transformation.

Table 3: Tobit regression on investments-to-assets ratio

	(1) Total	(2) Fixed	(3) Intangible	(4) Digital
	Fundamentals			
Turnover/Assets	0.027***	0.025***	0.000	0.001***
	(0.003)	(0.003)	(0.000)	(0.000)
Profit: Break-even	0.070**	0.058**	0.000	0.003
	(0.031)	(0.028)	(0.000)	(0.004)
Profit: Profitable	0.125***	0.115***	0.000	0.004
	(0.028)	(0.025)	(0.000)	(0.004)
Turnover: No change	−0.011	−0.008	0.000	0.005
	(0.023)	(0.022)	(0.000)	(0.003)
Turnover: Increasing	0.002	0.000	0.000	0.007***
	(0.021)	(0.020)	(0.000)	(0.003)
	Credit Variables			
Debt/Assets	0.012	0.013	0.000	0.000
	(0.013)	(0.012)	(0.000)	(0.001)
Interest rate	−0.012**	−0.010	0.000*	−0.001
	(0.006)	(0.006)	(0.000)	(0.001)
Credit: Constrained	−0.057	−0.042	0.000	−0.005
	(0.053)	(0.051)	(0.000)	(0.006)
Credit: No need	−0.124***	−0.113***	−0.001***	−0.013***
	(0.024)	(0.022)	(0.000)	(0.003)
	Firm Characteristics			
Exporter dummy	0.023	0.020	0.001***	0.010***
	(0.023)	(0.021)	(0.000)	(0.003)
Size: Small	0.018	0.015	0.000	0.006***
	(0.018)	(0.017)	(0.000)	(0.002)
Size: Medium	0.011	0.025	−0.001	0.011***
	(0.036)	(0.035)	(0.001)	(0.004)
Age: 10-19 yrs	−0.079**	−0.060*	0.000	−0.008**
	(0.033)	(0.031)	(0.000)	(0.004)
Age: 20-29 yrs	−0.091***	−0.066**	−0.001***	−0.010**
	(0.033)	(0.030)	(0.000)	(0.004)
Age: 30+ yrs	−0.087***	−0.061**	−0.001***	−0.007**
	(0.032)	(0.030)	(0.000)	(0.004)
Sector and Year fixed effects	Yes	Yes	Yes	Yes
Observations	1,995	2,020	2,043	2,023
Mean pseudo R-sq.	0.131	0.133	-0.241	-0.438

Size-category effect compared to micro firms, Age compared to firms younger than 10 years, Credit access compared to firms that got loans, Profit indicator compared to break-even firms, Turnover growth indicator compared to no-change.
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Focusing on the credit variables, we find no impact of the debt to asset ratio on investment levels. As with the findings for the propensity to invest, it is likely the very conservative path of borrowing behaviour by Irish enterprises since the financial crisis as well as the extensive deleveraging that has taken place has left firms with well balanced debt structures and these are not limiting investment. We find a negative effect of the interest rate for overall investment but not for the other sub groups. In terms of direct credit constraints, we find no effect for rejected (or constrained firms), however, we find a strong negative effect for those firms with no demand for any credit. These firms are clearly committing less investment capital.

Across the firm characteristics, some very clear patterns emerge. Exporters are much more likely to invest in intangible and digital assets while considerable size effects are evident for digital assets (micro firms have much lower investment than small and medium sized firms). There are also strong age effects across all asset classes; older firms have lower levels of investment relative to younger firms. As younger firms are more likely to be in the establishment and growth phase of their operations it is not unsurprising that their levels of investment are larger as a share of assets.

In terms of the sector dummies (which are not in the table but available on request), a number of findings emerge. Relative to the base sectoral group of food manufacturing, firms in non-motor retail, transport and communications, wholesale, manufacturing other and general construction had a negative and significant effect. The level of investment in digital assets was much lower for this group.

4.2.2 Exploring Heterogeneous Effects

The heterogeneous effects for the tobit estimates across size, age and sector are presented in tables 8 and 9. It must be noted that many of these regressions are being estimated on very small sub-samples and in many cases this can lead to few positive investment values in the data on which the tobit models will be estimated. While these sub-samples do provide estimation results, a degree of caution is advised given the low level of variation. However, as noted in the above heterogeneous effects section, the benefit of this approach is that it allows all variables to differ across the groups rather than holding some constant at the mean as would be the case with an interactions effects model. In these regressions, we only provide analysis for two investment types: a) overall; and b) digital. The aim with this approach is to narrow in

on the impact of digitalisation and to provide a comparison to the effects in that asset class with the overall findings.

A number of findings emerge from the heterogeneity exploration. First, the estimated effect on the relationship between the proxy for the marginal value product of capital (the sales to capital ratio) and investment is negative and declining with age. This is the case for overall investments. In terms of digital investments, the relationship between the sales to capital ratio and investment is only positive and significant for the smaller and younger firms. For overall investment, the interest rate is significant for micro firms and the oldest firms. No clear patterns emerge across firm size except for older firms investing in digital assets where a positive effect is found. For micro firms, a negative relationship exists across firm age for both digital and all investments; as micro firms age, the level of investment in digital (and all assets) declines.

Across sectors, investment is significantly determined by the sales to capital ratio for most groups but it is particularly strong for hotels and restaurants. For digitalisation, construction and retail firms are found to have a positive relationship between the sales to capital ratio and investment indicating that these firms choose their digitalisation strategies closely considering their added profitability. Investment by manufacturing firms appears to fall with age for all investments, with some evidence of the same pattern for digital investments. No clear size effects are evident on a cross sectoral basis. Across nearly all sectors, the no credit demand group has lower investment levels. Profitability matters strongly for manufacturing, construction and wholesale and retail sectors in driving their overall investments.

5 Exploring Investment Financing

A final element that we consider briefly in this paper is the extent to financing structures differ for digital assets as compared to other asset types. A traditional argument in the literature is that investments which are difficult to collateralise or are non-standard capital expenditures can be more difficult to obtain financing for. The typical example provided is research and development or intangible assets. To understand the degree to which financing is a barrier to investment, it is important to explore how firms finance different assets.

In this section, we document the financing structure of the investments across different types of financing and different assets for which we have data in our survey. We present three indicators as follows:

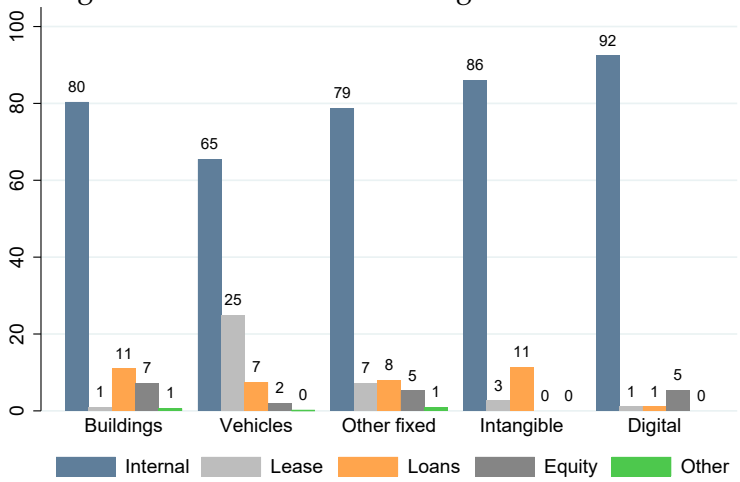
- The average investment financing share - what proportion of investment is funded on average by difference financing types;
- The average share of the value of investment - if a type of financing is used, what is the average usage amount; and
- the ”plain vanilla” usage proportions - shares of how many times a firm used each type (this can sum to greater to 100).

For these indicators, we present data across the following investment assets: buildings, vehicles, other fixed, intangible, digital. Our financing type groups are as follows: internal financing, leasing, loan finance, equity finance and other.

Figure 10 presents the average share of financing in 2021. Across all asset types, internal financing is the preferred mechanism with over 65 per cent average usage across all groups. It is lowest for vehicle purchases and highest for digital assets. Loan financing is used on average to finance 11 per cent of buildings and intangible assets but is extremely low for other fixed and digital assets. Leasing is used to finance 25 per cent of vehicle purchases and 7 per cent of other fixed assets but is not used for other assets in any meaningful quantity. Equity financing usage is low across the board but is the only other financing type used for digital assets.

The second metric that we present is the average share of the value of investment by each financing type if it is used. The data are presented in figure 11. A couple of findings emerge. First, for buildings the average size of loan financing increases is just under 50 per cent i.e. if a firm uses loan finance for building investments, the loan to investment ratio is approximately 50

Figure 10: Investments financing structure in 2021

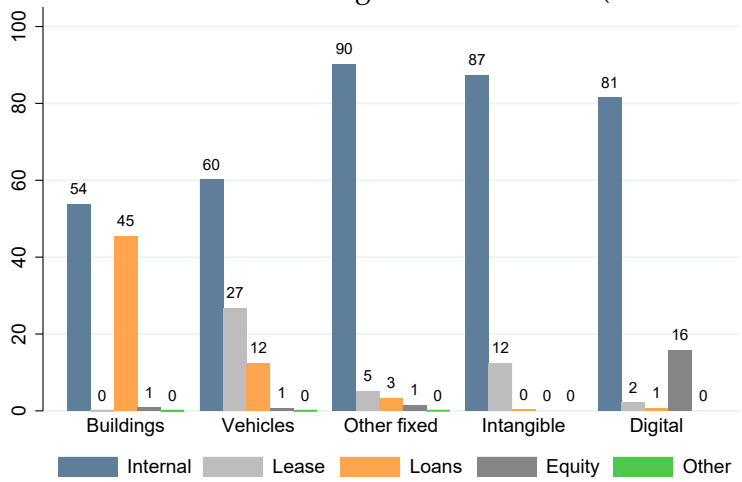


Source: DoF Credit Demand Survey 2022.

per cent. The share of the other financing types for building assets are very small except for internal funds. For vehicles, if leasing is used it typically accounts for 27 per cent of the value while loans make up 12 per cent. For other fixed and tangible capital, the other elements outside internal funds do not make up a notable part of the investment financing structure. For digital assets, the only stand out finding is that when equity is used, it finances approximately 20 per cent of the asset; this is the highest across all the asset types.

The final figure presented covers the proportion of times each financing type was used across the asset structures. Internal financing was used most frequently with 94 per cent for digital assets down to 70 per cent for vehicles. Equity was used by 6 per cent of firms who invested in digital assets.

Figure 11: Investments financing structure in 2021 (share of value)



Source: DoF Credit Demand Survey 2022.

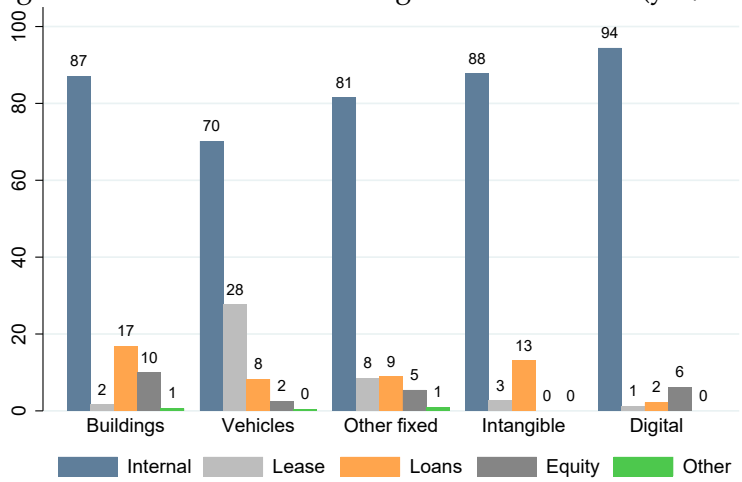
6 Conclusions and Policy Implications

In this paper, we have undertaken a detailed analysis of the factors (both fundamental and related to the credit market) that drive digitalisation investment. We have explored these relationships across a larger group of investment assets as comparisons and using a larger group of firm types than has been completed to date in the literature.

While a range of results are evidence from our research, a number of cross cutting themes can be summarised in terms of the main findings. First, firm performance and quality matter. We find a strong relationship between profitability and whether a firm invests in digital assets and we find a strong link between the return on additional capital and the level of investment. Both of these findings clearly point towards better performing firms being first to invest and adopt digital technologies. If policymakers are aiming for a broad based conversion of firms across the digital agenda, then a focus on poorer performing firms is likely to be required. In this regard, firm growth is also a factor which is critically important. Growing firms appear more likely to be investing in digitalisation.

Second, we find some effects of credit market variables on investment in digitalisation. However, it appears these effects are greater for the types of assets that may be larger in nature such as machinery and equipment or buildings. While interest rates have a negative effect on the level of investment in digital assets, we do not find any effect of over indebtedness or

Figure 12: Investments financing structure in 2021 (yes/no)



Source: DoF Credit Demand Survey 2022.

credit constraints. This suggests that the barriers to digital investment may be less sensitive to credit supports than other types of investment but a lower cost of credit would likely be supportive in terms of the digital transition. On the other hand, the descriptive analysis across the financing structure shows a high share of digital activity is financed by internal funds with little to no usage of loan or lease finance. Understanding better what is holding back the non-investing firms from a financing perspective (be it risk aversion, information asymmetries or other barriers to investment such as education and training) might help to understand whether additional digital transition financing instruments may be necessary.

Thirdly, we find very specific patterns across firms and sectors. These findings hold when controlling for the firm profitability and other fundamental variables thus the effects are not driven by observable differences in firm performance across these groupings. It is clear in terms of the level of investment in digital assets that micro firms and older firms have the lowest activity. For older firms, it could be the case that their capital stock is less digitised or more traditional in nature and therefore the cost of retrofitting that stock in a digitalisation sense is more difficult. Indeed, younger firms who are in the growth or establishment phase are likely to be purchasing new capital which is digital ready. Targeting this group of firms in terms of supports is likely to be required to ensure that all enterprises can see a digital pathway for their enterprise, even if its not part of their current operating capital stock.

From a policy perspective, there are a number of implications which arise from our analysis. Firstly, from a broad perspective, few firms in Ireland invest in digitalisation in a given year; indeed, more than 75 per cent do not invest in digital technologies. Furthermore, noticeable differences exists within sectors such as construction and retail between investment activities of firms. This highlights the fact that the digital gaps likely to be associated with very specific sub-sectors or groups of firms. From a policy formation perspective, it is therefore critical that bespoke digitalisation strategies are deployed that are unique and specific to sub-sectors and sub-groups of firms. If these strategies can draw on the experience of leading firms in these sectors, and provide the enabling factors, supporting instruments and information for laggard firms in these sectors to move along the digital journal this is likely to have spillover effects and improve overall digitalisation. Targeting older firms is also likely to be important, specifically if those firms have older capital stocks which may need upgrading. In this regard, credit and financing instruments may be worth deploying for these firms.

One final element that would certainly help to better target policy making is a greater level of information and stylised facts on how firms use digital technologies at a disaggregated level. Ciarli et al. (2021) note that better information is critical to map the main future trajectories of technologies, their use and recombination in organisations to understand their impact on productivity, technology and inequality. Mattsson & Reshid (2023) note that policies designed to promote the absorptive capabilities, firm dynamics and knowledge diffusion can be effective tools to promote strong catch-up of laggard firms as well as productivity growth in general.

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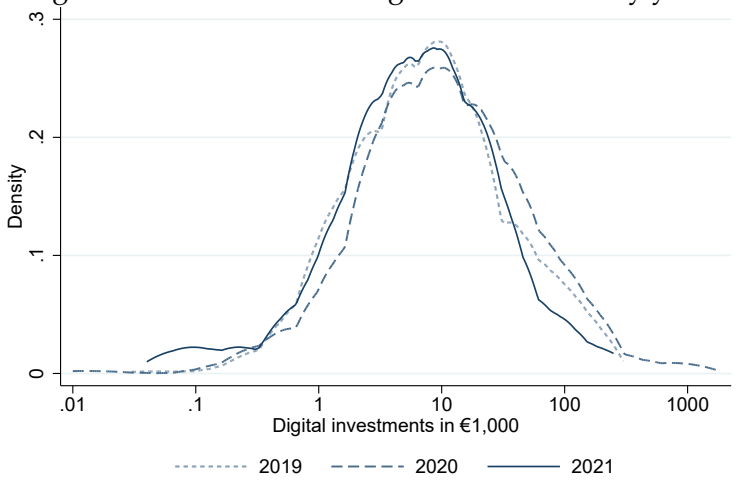
A Appendix: Additional Statistics

Figure 13: Distribution of digital investments by year



Source: DoF Credit Demand Survey 2021 and 2022.

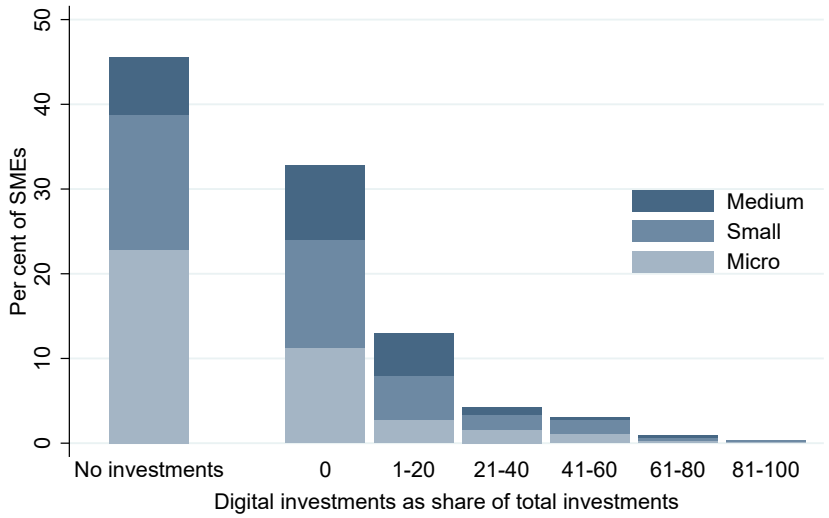
Table 4: Credit constrained firms in 2020 and 2021- summary statistics

	2020				2021			
	Got loan	Cons-trained	No need	Total	Got loan	Con-strained	No need	Total
Manufacturing	22	2	76	100	22	0	78	100
Construction	25	6	69	100	18	2	80	100
Wholesale	14	5	81	100	14	3	83	100
Hotels & restaurants	25	3	72	100	6	11	82	100
Business services	13	7	80	100	16	2	83	100
Other	17	3	80	100	12	5	82	100
Micro	13	6	81	100	11	4	86	100
Small	20	4	76	100	17	3	80	100
Medium	20	5	75	100	18	5	78	100
Total	17	5	78	100	15	4	82	100

Table 5: Regression sample summary statistics

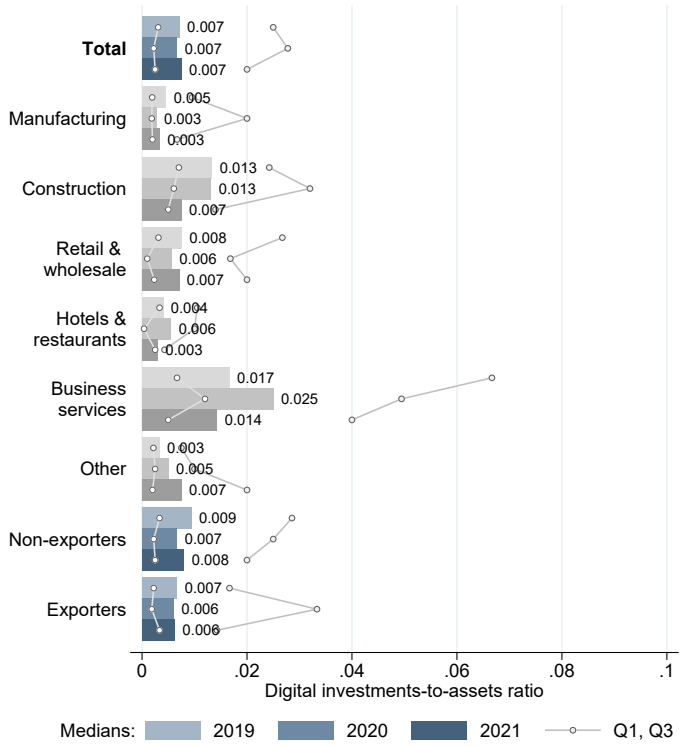
Variable	Obs	Mean	Std. dev.	Min	Max
Investment indicator					
Total	2247	0.504	0.500	0	1
Fixed	2280	0.499	0.500	0	1
Intangible	2307	0.052	0.222	0	1
Digital	2283	0.180	0.384	0	1
Investments-to-assets ratio					
Total	2154	0.108	0.230	0	0.900
Fixed	2185	0.098	0.214	0	0.846
Intangible	2209	0.000	0.000	0	0.001
Digital	2186	0.004	0.010	0	0.042
ln(Value)* of investments					
Total	2247	5.053	5.147	0	12.308
Fixed	2280	4.929	5.091	0	12.301
Intangible	2307	0.302	1.292	0	5.858
Digital	2283	1.494	3.232	0	9.473
Other variables					
Turnover/Assets	2,225	3.418	3.867	0.17	12.33
Debt/Assets	2,323	0.611	1.041	0	3
Interest rate	2,271	4.715	1.552	0	10
Exporter dummy	2,323	0.186	0.389	0	1
Size category	2,323	1.455	0.603	1	3
Age category	2,313	2.864	1.056	1	4
Credit indicator	2,323	2.664	0.722	1	3
Profit indicator	2,274	0.414	0.762	-1	1
ΔTurnover indicator	2,214	-0.051	0.853	-1	1
2021 Dummy	2,323	0.376	0.484	0	1
Sector FE	2,323	9.569	3.854	2	16

Figure 14: Digital investments as a per cent of total



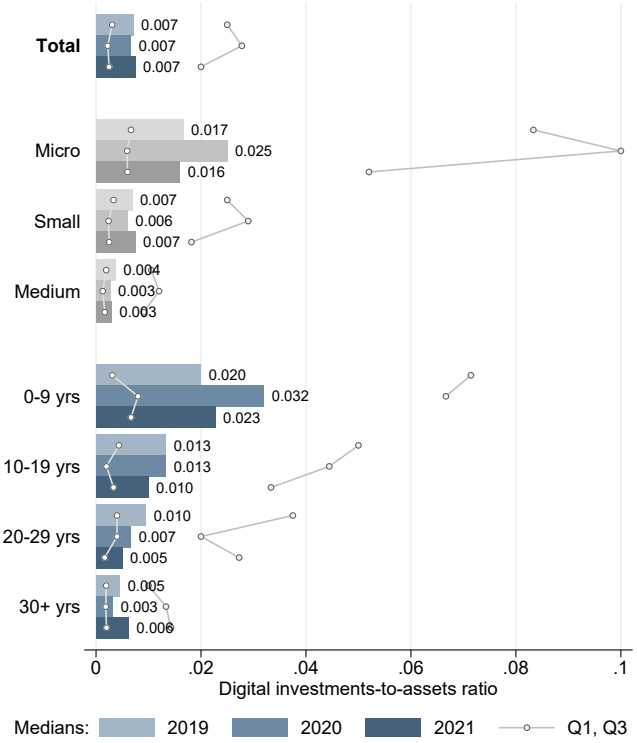
Source: DoF Credit Demand Survey 2021 and 2022.

Figure 15: Digital investments ratio quartiles by sector and export status



Only firms with digital investments.
Source: DoF Credit Demand Survey 2021 and 2022.

Figure 16: Digital investments ratio quartiles by firm size and age



Only firms with digital investments.
Source: DoF Credit Demand Survey 2021 and 2022.

Figure 17: Inv/Assets ratio distribution

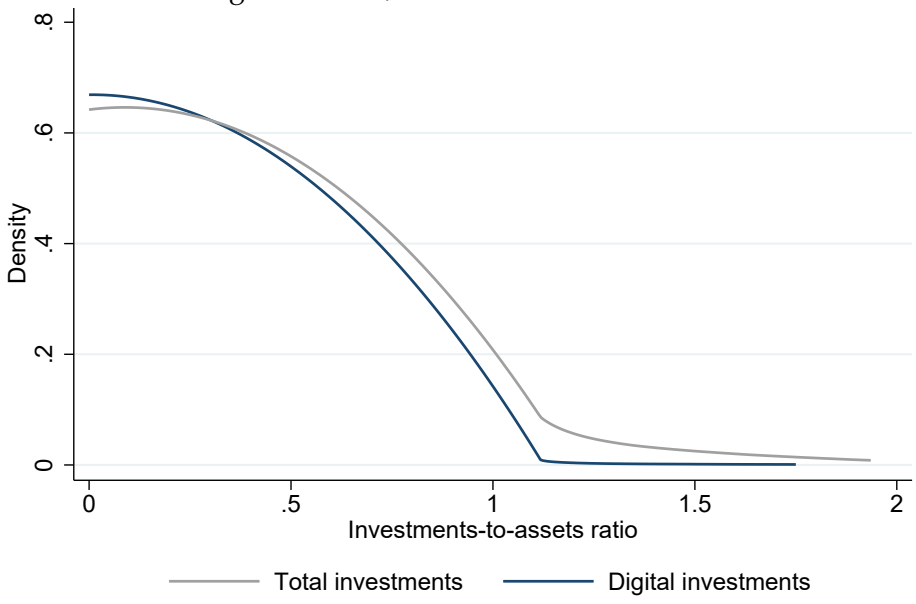


Table 6: Marginal effects of logistic regression on probability of investing by size and age category

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	All investments							Digital investments						
	Micro	Small	Medium	0-10 yrs	10-19 yrs	20-29 yrs	30+ yrs	Micro	Small	Medium	0-10 yrs	10-19 yrs	20-29 yrs	30+ yrs
Turnover/Assets	0.005	0.000	0.008	0.020**	0.003	0.001	−0.005	0.002	0.002	0.006	0.013*	0.002	0.001	−0.003
	(0.004)	(0.006)	(0.019)	(0.009)	(0.007)	(0.006)	(0.007)	(0.003)	(0.005)	(0.019)	(0.007)	(0.005)	(0.005)	(0.005)
Debt/Assets	0.000	−0.022	0.044	−0.032	0.016	0.047	−0.031	−0.001	−0.016	0.022	−0.028	0.021	−0.003	0.000
	(0.019)	(0.021)	(0.056)	(0.040)	(0.026)	(0.029)	(0.024)	(0.014)	(0.019)	(0.066)	(0.034)	(0.020)	(0.020)	(0.018)
Interest rate	−0.032***	−0.023	0.004	−0.001	−0.007	−0.039**	−0.043***	−0.005	−0.031**	0.037	−0.021	−0.016	−0.014	0.001
	(0.010)	(0.016)	(0.044)	(0.024)	(0.016)	(0.020)	(0.015)	(0.007)	(0.015)	(0.037)	(0.022)	(0.011)	(0.013)	(0.011)
Exporter dummy	0.033	0.105**	0.164	−0.026	0.149**	−0.006	0.053	0.073***	0.109***	−0.104	0.136**	0.144***	0.041	0.044
	(0.040)	(0.051)	(0.162)	(0.077)	(0.065)	(0.061)	(0.047)	(0.027)	(0.039)	(0.152)	(0.063)	(0.046)	(0.048)	(0.036)
Size: Small				0.192***	0.059	0.134***	0.142***				0.084	0.006	0.101***	0.105***
				(0.069)	(0.051)	(0.047)	(0.037)				(0.056)	(0.039)	(0.037)	(0.030)
Size: Medium				−0.053	−0.062	0.195	0.167**				0.431*	−0.031	0.205***	0.194***
				(0.348)	(0.124)	(0.139)	(0.082)				(0.239)	(0.112)	(0.072)	(0.051)
Age: 10-19 yrs	−0.035	−0.070	−0.186					−0.029	−0.015	−0.219				
	(0.045)	(0.074)	(0.290)					(0.030)	(0.061)	(0.334)				
Age: 20-29 yrs	−0.052	−0.028	0.158					−0.073**	0.010	−0.042				
	(0.047)	(0.073)	(0.286)					(0.032)	(0.060)	(0.303)				
Age: 30+ yrs	−0.019	0.012	0.013					−0.056*	0.051	0.078				
	(0.048)	(0.071)	(0.278)					(0.032)	(0.059)	(0.308)				
Credit: Constrained	−0.093	−0.132		0.285	−0.028	−0.526***	−0.058	−0.033	−0.097	−0.063	0.276**	−0.226	−0.186	0.007
	(0.078)	(0.113)		(0.193)	(0.109)	(0.163)	(0.113)	(0.053)	(0.104)	(0.309)	(0.135)	(0.142)	(0.164)	(0.077)
Credit: No need	−0.176***	−0.155***	−0.126	−0.055	−0.103*	−0.230***	−0.207***	−0.094***	−0.108***	−0.232**	−0.025	−0.079*	−0.076	−0.146***
	(0.041)	(0.051)	(0.111)	(0.087)	(0.062)	(0.062)	(0.053)	(0.027)	(0.038)	(0.110)	(0.079)	(0.043)	(0.047)	(0.033)
Profit: Break-even	0.161***	0.025	−0.142	−0.024	0.162**	0.063	0.172***	0.022	0.058	0.213	−0.154**	0.128*	0.062	0.045
	(0.044)	(0.066)	(0.255)	(0.087)	(0.077)	(0.066)	(0.061)	(0.037)	(0.059)	(0.251)	(0.078)	(0.076)	(0.057)	(0.055)
Profit: Profitable	0.212***	0.126**	0.012	0.019	0.262***	0.162***	0.211***	0.054	0.038	0.108	−0.096	0.145**	0.040	0.077
	(0.042)	(0.060)	(0.215)	(0.084)	(0.069)	(0.059)	(0.058)	(0.034)	(0.054)	(0.186)	(0.071)	(0.068)	(0.053)	(0.050)
Turnover: No change	0.049	−0.019	−0.250*	−0.092	0.099*	−0.028	0.010	0.036	0.065	0.017	−0.104	0.090**	0.051	0.053
	(0.036)	(0.050)	(0.138)	(0.092)	(0.059)	(0.055)	(0.045)	(0.028)	(0.045)	(0.184)	(0.081)	(0.046)	(0.042)	(0.038)
Turnover: Increasing	0.070**	−0.031	0.035	−0.003	0.088	−0.029	0.045	0.057**	0.061	0.165	−0.018	0.098**	−0.003	0.096***
	(0.034)	(0.047)	(0.130)	(0.074)	(0.055)	(0.051)	(0.044)	(0.025)	(0.042)	(0.132)	(0.061)	(0.042)	(0.043)	(0.036)
2021 dummy	−0.009	0.078*	−0.245*	0.014	−0.127***	0.088*	0.015	0.052**	0.107***	−0.036	0.170**	0.005	0.091***	0.047
	(0.030)	(0.041)	(0.132)	(0.085)	(0.047)	(0.046)	(0.037)	(0.021)	(0.035)	(0.149)	(0.069)	(0.037)	(0.033)	(0.029)
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,230	675	85	249	494	514	738	1,242	688	91	249	500	498	748
Mean pseudo R-sq.	0.058	0.053	0.217	0.114	0.077	0.113	0.097	0.058	0.060	0.122	0.136	0.105	0.105	0.112

Table 7: Marginal effects of logistic regression on probability of investing by sector

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	All investments						Digital investments					
	Manuf.	Construct.	Retail&W.	Hotel&R.	B. serv.	Other	Manuf.	Construct.	Retail&W.	Hotel&R.	B. serv.	Other
Turnover/Assets	−0.011	−0.001	0.008	0.018	−0.004	0.010	−0.023	0.011**	0.003	0.009	−0.002	0.003
	(0.013)	(0.009)	(0.006)	(0.015)	(0.007)	(0.008)	(0.016)	(0.005)	(0.005)	(0.011)	(0.005)	(0.006)
Debt/Assets	0.009	0.010	−0.027	0.057	−0.006	0.022	0.052	0.018	−0.010	−0.030	−0.032	0.014
	(0.048)	(0.047)	(0.023)	(0.045)	(0.032)	(0.033)	(0.038)	(0.024)	(0.018)	(0.032)	(0.029)	(0.027)
Interest rate	−0.032	−0.060**	−0.013	−0.030	−0.036*	−0.044**	−0.028	−0.011	−0.010	0.007	0.010	−0.041**
	(0.027)	(0.027)	(0.016)	(0.031)	(0.021)	(0.018)	(0.018)	(0.018)	(0.013)	(0.022)	(0.016)	(0.016)
Exporter dummy	0.084	0.114	0.061	0.296	0.037	−0.100	0.082	0.017	0.080**	0.123	0.062	0.110
	(0.068)	(0.105)	(0.052)	(0.221)	(0.059)	(0.096)	(0.055)	(0.074)	(0.038)	(0.130)	(0.048)	(0.073)
Size: Small	0.180*	0.081	0.038	0.290***	0.158***	0.221***	0.143**	0.067	0.042	0.326***	0.121**	0.049
	(0.093)	(0.071)	(0.045)	(0.103)	(0.052)	(0.059)	(0.067)	(0.048)	(0.033)	(0.112)	(0.049)	(0.046)
Size: Medium	0.087	−0.108	0.172**	0.236	−0.254*	0.208	0.312**	0.143	0.162**	0.340***	0.077	0.108
	(0.169)	(0.162)	(0.084)	(0.150)	(0.140)	(0.152)	(0.150)	(0.130)	(0.080)	(0.128)	(0.194)	(0.128)
Age: 10-19 yrs	−0.118	−0.039	−0.049	0.061	−0.038	−0.007	−0.056	−0.036	−0.010	−0.145	−0.042	−0.017
	(0.105)	(0.131)	(0.075)	(0.130)	(0.074)	(0.098)	(0.109)	(0.101)	(0.051)	(0.098)	(0.065)	(0.069)
Age: 20-29 yrs	−0.223**	0.010	0.046	0.053	−0.091	−0.012	−0.296***	−0.013	0.005	−0.022	−0.068	0.023
	(0.109)	(0.120)	(0.077)	(0.117)	(0.078)	(0.096)	(0.095)	(0.098)	(0.053)	(0.076)	(0.069)	(0.069)
Age: 30+ yrs	−0.143	0.116	0.040	0.243**	−0.068	0.003	−0.175*	−0.052	0.086*	−0.008	−0.133*	0.053
	(0.101)	(0.144)	(0.073)	(0.119)	(0.081)	(0.100)	(0.098)	(0.104)	(0.051)	(0.075)	(0.068)	(0.072)
Credit: Constrained	0.063	−0.374**	−0.120	0.064	−0.011	−0.180		−0.109	0.056	−0.117	−0.092	−0.110
	(0.163)	(0.165)	(0.105)	(0.199)	(0.136)	(0.257)		(0.142)	(0.112)	(0.160)	(0.122)	(0.167)
Credit: No need	−0.137	−0.243***	−0.203***	−0.104	−0.085	−0.202**		−0.205***	−0.146***	−0.074	−0.032	−0.124*
	(0.089)	(0.071)	(0.053)	(0.105)	(0.070)	(0.079)		(0.067)	(0.052)	(0.073)	(0.063)	(0.069)
Profit: Break-even	0.141	0.191**	0.162**	0.162*	0.012	0.028	0.114	0.054	0.066	0.008	−0.020	−0.007
	(0.106)	(0.092)	(0.075)	(0.094)	(0.081)	(0.084)	(0.076)	(0.067)	(0.055)	(0.065)	(0.068)	(0.071)
Profit: Profitable	0.337***	0.215**	0.222***	0.219**	0.127*	0.049	0.138*	0.092	0.070	−0.081	0.037	−0.013
	(0.103)	(0.092)	(0.068)	(0.093)	(0.072)	(0.080)	(0.077)	(0.064)	(0.046)	(0.071)	(0.061)	(0.071)
Turnover: No change	−0.133	−0.159**	0.046	0.140	0.079	0.074	0.019	0.077	0.058	0.101	0.008	0.060
	(0.090)	(0.074)	(0.053)	(0.138)	(0.061)	(0.064)	(0.070)	(0.056)	(0.043)	(0.088)	(0.049)	(0.053)
Turnover: Increasing	−0.099	−0.019	0.061	0.119	0.024	0.124*	0.071	0.044	0.038	−0.033	0.070	0.102*
	(0.082)	(0.077)	(0.047)	(0.091)	(0.060)	(0.068)	(0.071)	(0.057)	(0.035)	(0.069)	(0.049)	(0.060)
2021 dummy	0.099	−0.019	−0.046	0.045	0.063	0.033	0.032	0.023	0.041	0.253**	0.091**	0.095**
	(0.072)	(0.063)	(0.042)	(0.114)	(0.052)	(0.057)	(0.052)	(0.050)	(0.031)	(0.119)	(0.042)	(0.046)
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	211	260	590	153	454	327	212	267	596	156	461	331
Mean pseudo R-sq.	0.108	0.122	0.074	0.136	0.053	0.099	0.190	0.135	0.075	0.201	0.061	0.090

Credit access indicator omitted from regression (7), because all SMEs marked as credit constrained in the manufacturing sector group sample had no digital investments.

Table 8: Tobit regression on investments-to-assets ratio by size and age category

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	All investments							Digital investments						
	Micro	Small	Medium	0-10 yrs	10-19 yrs	20-29 yrs	30+ yrs	Micro	Small	Medium	0-10 yrs	10-19 yrs	20-29 yrs	30+ yrs
Turnover/Assets	0.030***	0.023***	0.032**	0.043***	0.028***	0.027***	0.017***	0.001**	0.001**	0.001	0.003***	0.001	0.001	0.000
	(0.005)	(0.005)	(0.013)	(0.010)	(0.007)	(0.006)	(0.006)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Debt/Assets	0.014	0.006	0.011	−0.037	0.024	0.046*	0.013	0.000	−0.001	0.001	−0.004	0.002	0.000	0.000
	(0.021)	(0.016)	(0.031)	(0.044)	(0.026)	(0.024)	(0.020)	(0.003)	(0.002)	(0.002)	(0.005)	(0.003)	(0.003)	(0.002)
Interest rate	−0.021**	−0.001	0.018	0.013	0.005	−0.018	−0.016*	−0.001	−0.003**	0.001	−0.002	−0.002	−0.003	0.000
	(0.009)	(0.010)	(0.023)	(0.024)	(0.013)	(0.013)	(0.009)	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)	(0.001)
Exporter dummy	0.014	0.018	0.197**	−0.062	0.098*	−0.042	0.017	0.013***	0.009**	−0.005	0.020**	0.017***	0.006	0.003
	(0.037)	(0.030)	(0.076)	(0.077)	(0.052)	(0.046)	(0.030)	(0.005)	(0.003)	(0.005)	(0.009)	(0.006)	(0.007)	(0.004)
Size: Small				0.078	−0.035	0.063*	0.012				0.009	−0.002	0.009*	0.008***
				(0.069)	(0.039)	(0.036)	(0.025)				(0.008)	(0.005)	(0.005)	(0.003)
Size: Medium				−0.207	−0.111	0.036	0.034				0.040	−0.001	0.016*	0.013***
				(0.282)	(0.094)	(0.069)	(0.047)				(0.025)	(0.014)	(0.008)	(0.005)
Age: 10-19 yrs	−0.076*	−0.106**	−0.001					−0.009*	−0.005	0.001				
	(0.044)	(0.052)	(0.147)					(0.005)	(0.006)	(0.012)				
Age: 20-29 yrs	−0.115**	−0.076	0.101					−0.015***	−0.002	0.000				
	(0.045)	(0.052)	(0.142)					(0.006)	(0.006)	(0.010)				
Age: 30+ yrs	−0.102**	−0.093*	0.095					−0.015***	0.002	0.007				
	(0.044)	(0.050)	(0.142)					(0.006)	(0.006)	(0.011)				
Credit: Constrained	−0.110	0.006	−0.200***	0.205	0.020	−0.356***	−0.086	−0.009	−0.004	−0.009	0.037**	−0.034**	−0.024	0.002
	(0.071)	(0.091)	(0.074)	(0.153)	(0.093)	(0.111)	(0.077)	(0.009)	(0.010)	(0.010)	(0.017)	(0.014)	(0.019)	(0.008)
Credit: No need	−0.178***	−0.064**	0.009	−0.076	−0.061	−0.143***	−0.158***	−0.018***	−0.009***	−0.010**	−0.005	−0.011**	−0.012*	−0.016***
	(0.038)	(0.029)	(0.061)	(0.090)	(0.047)	(0.041)	(0.036)	(0.005)	(0.003)	(0.005)	(0.010)	(0.005)	(0.006)	(0.004)
Profit: Break-even	0.113**	0.006	−0.037	−0.127	0.085	0.100*	0.095**	0.003	0.004	0.009	−0.024**	0.013	0.009	0.003
	(0.044)	(0.044)	(0.127)	(0.088)	(0.069)	(0.056)	(0.044)	(0.006)	(0.005)	(0.009)	(0.010)	(0.009)	(0.008)	(0.005)
Profit: Profitable	0.167***	0.067*	0.096	−0.069	0.179***	0.170***	0.122***	0.008	0.001	0.005	−0.018*	0.013	0.007	0.006
	(0.040)	(0.040)	(0.111)	(0.081)	(0.059)	(0.049)	(0.042)	(0.006)	(0.005)	(0.007)	(0.009)	(0.008)	(0.008)	(0.005)
Turnover: No change	0.015	−0.029	−0.174**	−0.129	0.090*	−0.080*	0.007	0.005	0.008**	−0.003	−0.012	0.012**	0.004	0.007*
	(0.034)	(0.031)	(0.080)	(0.088)	(0.049)	(0.045)	(0.031)	(0.005)	(0.004)	(0.006)	(0.011)	(0.006)	(0.006)	(0.004)
Turnover: Increasing	0.030	−0.041	0.033	−0.057	0.093**	−0.094**	0.018	0.009**	0.006*	0.008*	−0.004	0.013**	−0.001	0.011***
	(0.031)	(0.029)	(0.051)	(0.074)	(0.046)	(0.040)	(0.029)	(0.004)	(0.004)	(0.005)	(0.008)	(0.005)	(0.006)	(0.004)
2021 dummy	0.009	0.057**	−0.122**	−0.012	−0.066	0.080**	0.006	0.009**	0.008***	0.000	0.022**	0.001	0.013***	0.003
	(0.028)	(0.027)	(0.060)	(0.079)	(0.040)	(0.036)	(0.025)	(0.004)	(0.003)	(0.006)	(0.009)	(0.005)	(0.005)	(0.003)
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,230	675	90	249	494	514	738	1,242	688	93	255	500	520	748
Mean pseudo R-sq.	0.127	0.207	1.082	0.186	0.154	0.214	0.167	12.62	-0.225	-0.246	-1.424	-0.849	-1.514	-0.407

Table 9: Tobit regression on investments-to-assets ratio by sector

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	All investments						Digital investments					
	Manuf.	Construct.	Retail&W.	Hotel&R.	B. serv.	Other	Manuf.	Construct.	Retail&W.	Hotel&R.	B. serv.	Other
Turnover/Assets	0.021*	0.025***	0.023***	0.056***	0.021***	0.040***	−0.001	0.002**	0.001**	0.002	0.001	0.001*
	(0.013)	(0.009)	(0.005)	(0.013)	(0.006)	(0.009)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Debt/Assets	0.064	0.021	0.005	0.021	0.003	0.030	0.007	0.004	−0.001	−0.004	−0.005	0.002
	(0.049)	(0.041)	(0.020)	(0.029)	(0.031)	(0.034)	(0.005)	(0.003)	(0.002)	(0.004)	(0.004)	(0.004)
Interest rate	−0.008	−0.017	−0.006	−0.014	−0.019	−0.021	−0.003	−0.001	0.000	0.000	0.000	−0.004**
	(0.018)	(0.022)	(0.012)	(0.019)	(0.018)	(0.017)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Exporter dummy	0.046	0.083	−0.007	0.035	0.017	−0.096	0.013**	0.004	0.007	0.029*	0.009	0.013
	(0.050)	(0.077)	(0.036)	(0.087)	(0.047)	(0.103)	(0.006)	(0.009)	(0.005)	(0.016)	(0.006)	(0.008)
Size: Small	0.003	−0.006	−0.058*	0.115	0.049	0.158***	0.009	0.004	0.002	0.043***	0.012**	0.004
	(0.061)	(0.057)	(0.032)	(0.074)	(0.040)	(0.055)	(0.007)	(0.006)	(0.004)	(0.012)	(0.005)	(0.005)
Size: Medium	0.029	−0.195*	−0.020	0.073	−0.283*	0.178	0.020*	0.006	0.010	0.037***	−0.002	0.008
	(0.137)	(0.101)	(0.046)	(0.084)	(0.152)	(0.126)	(0.010)	(0.010)	(0.006)	(0.013)	(0.019)	(0.011)
Age: 10-19 yrs	−0.166*	−0.033	−0.098	−0.137	−0.058	−0.028	−0.004	−0.007	−0.003	−0.025**	−0.008	−0.005
	(0.088)	(0.107)	(0.064)	(0.091)	(0.065)	(0.093)	(0.009)	(0.010)	(0.008)	(0.012)	(0.008)	(0.009)
Age: 20-29 yrs	−0.253**	0.018	−0.081	−0.036	−0.119*	−0.072	−0.038***	−0.002	−0.004	−0.004	−0.009	−0.001
	(0.097)	(0.098)	(0.063)	(0.078)	(0.068)	(0.091)	(0.011)	(0.010)	(0.008)	(0.010)	(0.008)	(0.009)
Age: 30+ yrs	−0.150*	−0.008	−0.080	0.066	−0.128*	−0.117	−0.012	−0.007	0.004	−0.007	−0.018**	−0.002
	(0.089)	(0.117)	(0.061)	(0.075)	(0.070)	(0.092)	(0.009)	(0.011)	(0.007)	(0.008)	(0.009)	(0.009)
Credit: Constrained	0.038	−0.213	−0.070	−0.174	0.023	−0.027	−0.123***	−0.008	0.006	−0.026	−0.011	−0.015
	(0.121)	(0.159)	(0.078)	(0.142)	(0.122)	(0.258)	(0.017)	(0.014)	(0.009)	(0.018)	(0.018)	(0.017)
Credit: No need	−0.094	−0.164**	−0.118***	−0.175**	−0.111**	−0.120*	−0.009	−0.024***	−0.014***	−0.015*	−0.005	−0.010
	(0.064)	(0.066)	(0.038)	(0.084)	(0.054)	(0.064)	(0.007)	(0.006)	(0.005)	(0.009)	(0.007)	(0.006)
Profit: Break-even	0.133	0.108	0.105*	0.091	−0.033	−0.002	0.019	0.004	0.008	0.001	−0.002	−0.006
	(0.087)	(0.086)	(0.061)	(0.067)	(0.068)	(0.084)	(0.012)	(0.010)	(0.008)	(0.008)	(0.010)	(0.008)
Profit: Profitable	0.260***	0.189**	0.139**	0.083	0.087	0.009	0.012	0.010	0.008	−0.012	0.004	−0.006
	(0.085)	(0.086)	(0.055)	(0.060)	(0.059)	(0.079)	(0.011)	(0.010)	(0.007)	(0.009)	(0.008)	(0.008)
Turnover: No change	−0.137**	−0.111*	0.032	−0.036	0.040	0.026	0.002	0.007	0.008	0.009	0.002	0.006
	(0.066)	(0.066)	(0.039)	(0.086)	(0.050)	(0.058)	(0.008)	(0.006)	(0.005)	(0.011)	(0.007)	(0.007)
Turnover: Increasing	−0.085	−0.046	0.026	0.019	−0.013	0.094	0.006	0.004	0.006	−0.007	0.010	0.010
	(0.065)	(0.066)	(0.033)	(0.056)	(0.049)	(0.061)	(0.007)	(0.007)	(0.004)	(0.009)	(0.006)	(0.007)
2021 dummy	0.062	−0.036	−0.032	0.068	0.075*	0.045	0.004	0.001	0.006	0.040***	0.012**	0.011**
	(0.056)	(0.058)	(0.029)	(0.079)	(0.042)	(0.051)	(0.006)	(0.006)	(0.004)	(0.014)	(0.005)	(0.005)
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	211	260	590	153	454	327	212	267	596	156	461	331
Mean pseudo R-sq.	0.186	0.151	0.140	0.433	0.129	0.189	-0.830	-1.325	-0.388	-3.011	-0.385	-0.573