THE UNIVERSITY of EDINBURGH

Edinburgh Research Explorer

Financing small and innovative firms during Covid-19

Citation for published version:
Cowling, M, Liu, W, Chen, Y, Calabrese, R & Vorley, T 2023, 'Financing small and innovative firms during Covid-19', *Economics of Innovation and New Technology*. https://doi.org/10.1080/10438599.2023.2297255

Digital Object Identifier (DOI):
10.1080/10438599.2023.2297255

Link:
Link to publication record in Edinburgh Research Explorer

Document Version:
Publisher's PDF, also known as Version of record

Published In:
Economics of Innovation and New Technology

General rights
Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy
The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

OPEN ACCESS

Download date: 12. Jan. 2024

Routledge
Taylor & Francis Group

Economics of Innovation and New Technology

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/gein20

Financing small and innovative firms during COVID-19

Marc Cowling, Weixi Liu, Yujia Chen, Raffaella Calabrese & Tim Vorley

To cite this article: Marc Cowling, Weixi Liu, Yujia Chen, Raffaella Calabrese & Tim Vorley (27 Dec 2023): Financing small and innovative firms during COVID-19, Economics of Innovation and New Technology, DOI: 10.1080/10438599.2023.2297255

To link to this article: https://doi.org/10.1080/10438599.2023.2297255

© 2023 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group

Published online: 27 Dec 2023.

Submit your article to this journal

Article views: 46

View related articles

View Crossmark data

Full Terms & Conditions of access and use can be found at
https://www.tandfonline.com/action/journalInformation?journalCode=gein20

ECONOMICS OF INNOVATION AND NEW TECHNOLOGY
https://doi.org/10.1080/10438599.2023.2297255

OPEN ACCESS Check for updates

Financing small and innovative firms during COVID-19

Marc Cowling[a], Weixi Liu[b], Yujia Chen[c], Raffaella Calabrese[c] and Tim Vorley[a]

[a]Oxford Brookes Business School, Oxford, UK; [b]School of Management, University of Bath Management School, Bath, UK; [c]Business School, University of Edinburgh , Edinburgh, UK

ABSTRACT
Previous research on the financing of smaller innovative firms has established that being small *per se* creates problems in accessing finance, but being small and innovative adds another layer of difficulty. This new research explicitly questions whether the Covid-19 crisis has added to the debt access problems of an already disadvantaged group of firms. Using a unique Covid-19 period dataset of 9000 UK SMEs, we find that the most innovative firms had the highest demand for loans during the Covid-19 crisis and evidence that those firms trying to introduce new products and services faced more severe borrowing constraints. As the vast majority of Covid-19 loans in the UK were government guaranteed, we also find that several classes of innovative firms found it more difficult to access government supported loans. It was also not the case that those most impacted by the crisis had the most privileged access to government loan schemes despite a greater need for liquidity. These findings have potential implications for financing innovative firms in the post-Covid-19 world, such as proposing a specific innovation loan guarantee scheme with higher than conventional guarantee rates.

ARTICLE HISTORY
Received 13 March 2023
Accepted 15 December 2023

KEYWORDS
Innovation; finance gap; small firms; Covid-19

JEL CLASSIFICATION CODE
O31; G21; G32; L26

1. Introduction

The impact of the Covid-19 crisis meant that a much broader swathe of the UK business population faced restricted trading conditions and this caused a general liquidity squeeze that was much more severe than in the Global Financial Crisis period (GFC) (Cowling, Brown, and Rocha 2020). In the light of this much broader and more severe impact on the UK business sector the policy response was similar in that it sought to re-capitalise businesses. Three years on from the UK Covid-19 outbreak, attention is now turning to what the recovery might look like and what role smaller younger firms will play in promoting recovery and economic growth. There is a general acceptance that smaller, but particularly younger, firms play a key role in economic growth (Haltiwanger, Jarmin, and Miranda 2013). The empirical evidence is very clear that the contribution is not equally distributed across the population but more concentrated amongst specific subsets of the smaller business population (Ayyagari, Demirgüç-Kunt, and Maksimovic 2011). It is here that innovative firms play a very prominent and disproportionate role as their contributions to economic growth and productivity are related to their ability to innovate and bring to market new products and services (Balsmeier and Woerter 2019). Innovative firms are also relevant and interesting in respect of their financing behaviours as they have a greater demand for external capital due to their ability to burn internal

CONTACT Marc Cowling mcowling@brookes.ac.uk Oxford Brookes Business School, Headington Rd, Headington, Oxford OX3 0BP, UK

© 2023 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group
This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

cash resources during the process of commercialisation and bringing new offerings to market and due to their inherently risky business models (Akpan, Soopramanien, and Kwak 2020; Hsu et al. 2015; Savignac 2008), but also face thin capital markets (Polzin, Sanders, and Stavlöt 2018). It follows that how capital markets react to their funding applications are of paramount importance (Cowling, Ughetto, and Lee 2018; Magri 2009). On the supply-side of capital markets, the preference financiers have for tangible assets also puts innovative firms in service-based industries at a disadvantage, although Yang, Gu, and Yang (2021) also highlight the potential role of IP as a collateral substitute. This is particularly relevant in an innovation context where risk and uncertainty in terms of the distribution of potential outcomes are heightened compared to more conventional firms (Hottenrott and Peters 2012; Jia 2018) and particularly for new start-ups (Arena et al. 2018).

GFC research suggests that finance problems are magnified for all firms, but particularly innovative firms (Lee, Sameen, and Cowling 2015). It is also of note that there was a general collapse in UK equity provision during this period (Brown, Rocha, and Cowling 2020). We incorporate two novel features into our research and analysis. First is our use of a composite Covid-19-Severity-Index (CSI), which classifies how badly each firm has been affected by the crisis-related trading restrictions along multiple dimensions. Second is a very fine-grained innovation classification that identifies firm's with Intellectual Property on their balance sheets, firms who have developed new products and services, and combinations of the two. These are in addition to being small that form the basis of our investigation.

This paper investigates the financing of innovative firms during Covid-19 using two waves of a bespoke Covid-19 crisis version of the UK SME Finance Monitor – covering over 9000 firms – in 2020 quarter 2 (April-June) and 2020 quarter 3 (July-September). The data set is large enough to consider the early impact of Covid-19 as the first wave corresponds to the formal lockdown of the UK economy and a period when the UK government began to introduce its Covid-19 loan guarantee schemes. Our approach is to use econometric analysis to explore how financing for innovative firms evolved during the Covid-19 crisis, taking account of the firm level severity of the crisis impact and the level of innovativeness of the firm. After our analysis, we draw out the key public policy implications.

The results show that the smallest firms had the highest demand for finance during Covid-19 and medium-sized firms the highest chance of receiving it. The second key finding was that the most innovative firms (those developing new products and services and with IP on their balance sheets) had the highest demand for finance suggesting that if these demands were not met then the 'best' innovators would be at risk of failure due to running out of cash. This would naturally weaken the UK economy's ability to innovate and grow in the post-Covid-19 period. On the supply-side of debt markets, we find that innovators developing new products and services had the highest loan refusal rates and this may constrain future market development and diffusion of innovations. Our results show that the severity of the firm-specific Covid-19 impact was associated with a higher demand for finance and this supports the government response through its' loan guarantee schemes as an appropriate policy instrument. It also confirms that cash-flow problems led directly to firms running out of liquidity. However, the fact that innovative firms with IP on their balance sheets were more likely to be offered conventional loans and less likely to be offered government-guaranteed loans also potentially weakens the argument that financiers prefer tangible assets to lend against and dislike intangible assets. Finally, our results clearly suggest that two of the most commonly identified factors determining loan outcomes, firm age, which is a proxy for lending risk, and geography, which is a strong proxy for local demand conditions, were not important during the Covid-19 pandemic period, suggesting that small business lending fundamentally changes in nature (a) during a severe crisis, and (b) in the presence of a generous loan guarantee scheme.

Our research makes several important contributions to the wider literature on innovation finance, and adds to the body of work that explored this issue in the context of the GFC. It is one of the first papers to empirically investigate how access to finance for innovative firms was shaped by the

Covid-19 crisis. We also considered the uniqueness of the Covid-19 impact on each firm and this was found to be extremely important in increasing the demand for finance. Finally, our measure of innovation is more inclusive, and fine grained, than in most other studies that have commonly used R&D-based measures (Bryan, Lemus, and Marshall 2020) or exclusively focused on newly commercialised products and services.

The rest of this paper is organised as follows. Section reviews the literature on the financing of innovative forms. Section 3 describes the survey data we use for analysis and provides our key definitions for our Covid-19-Severity-Index and our 4-way innovation classification. Section 4 describes the data at a univariate level in respect of loan demand and supply. Section 5 estimates a series of probit models (some with a selection specification) to isolate key differences in loan demand and supply and the use of government-supported loan schemes. Section 6 draws together our key findings and the implications for future research and also for government policy.

2. Literature review

Credit rationing in the small business sector has been extensively examined in a wide body of research (Berger and Udell 1992; 1998; Hall 2012). At the core of this literature is the information asymmetry between SMEs and banks (Behr and Guttler 2007; Berger and Udell 1998; Petersen and Rajan 1994). The adverse selection and moral hazard problems as a result of this agency problem lead to a supply of investment capital below the social optimum (de Meza and Southey 1996; Stiglitz and Weiss 1981). The failure of SMEs to secure the finance needed is caused by lack of asset cover (Coco 2000), poor information flows (Diamond 1984; Myers 1984; Myers and Majluf 1984), non-viable projects, poor management teams, and exogenous factors such as unfavourable economic conditions (Cowling, Liu, and Ledger 2012; Lee, Sameen, and Cowling 2015). The issue of 'unfair' credit rationing, that is not based on firm quality (Stiglitz and Weiss 1981), has been the focus of a large literature (Cowling and Mitchell 2003; Fraser 2009), and has been used to justify government intervention such as loan guarantee programmes (Cowling 2010; Cowling and Siepel 2013; Riding 1997).

2.1. Access to finance for innovative SMEs

There are several unique characteristics of innovative SMEs which suggest that they are more likely to be disadvantaged in the credit market (Carpenter and Petersen 2002). First, the high uncertainty associated with innovation and R&D (Mina, Lahr, and Hughes 2013), as well as the higher transaction costs related to external financing means that banks have to factor in high idiosyncratic risks when making lending decisions to innovative SMEs. Since innovation is more likely to happen in smaller firms (Acs and Audretsch 1987), there are fewer scale economies to investment compared to larger firms (Berger and Udell 1998; Cassar 2004, Freel 2007), which makes the investment returns to innovation significantly and negatively skewed (Coad and Rao 2008). Therefore, financing innovation appears less attractive for banks, who cannot enjoy the upside potential whilst left unprotected from the downside risk of an innovation project due to the nature of debt investment.

Second, innovative SMEs suffer more from the informational opacity in the firm-bank relationship. Because of the high novelty of innovative products/services with little or no track record, banks impose high risk premia to compensate for the difficulties in determining *ex ante* the valuation of the innovation (Akerlof 1970; Hall 2012; Stiglitz and Weiss 1981). Moreover, information asymmetry may pose further difficulties for investors to monitor *ex post* the behaviour of innovative SMEs. As such, investors may require physical assets as collateral to secure their investment but for innovative SMEs whose value relies heavily on growth opportunities and intellectual property, their intangible and highly firm-specific assets have little collateral value (Colombo and Grilli 2007; Mina, Lahr, and Hughes 2013; Revest and Sapio 2012).

Third, generalised investors such as banks have neither the skills nor resources to evaluate the investment potential of highly context-specific innovation projects, particularly when capital requirements are based on innovations yet to be commercialised (Colombo and Grilli 2007; Stiglitz 1993). With the emergence of standardised credit scoring techniques (Cressy 2002; Fraser 2014), banks would prefer to invest in more established businesses or those with lower technological uncertainty (Carpenter and Petersen 2002; Hall 2012).

On the demand side and according to the pecking order theory (Myers 1984; Myers and Majluf 1984), external sources of finance are particularly important for innovative SMEs with limited internal funds (Schneider and Veugelers 2010). The most common source of external funding is the commercial bank loans (de Bettignies and Brander 2007), even for innovative SMEs (Giudici and Paleari 2000). Credit rationing can also arise from the demand side if credit-worthy firms with a latent demand for capital become discouraged because the cost of application is too high (Kon and Storey 2003). A series of recent empirical studies have found that firms may self-select out of the capital market based on their perception of the true capital supply (Cole and Sokolyk 2016; Cowling et al. 2016; Han, Fraser, and Storey 2009; Kon and Storey 2003). Therefore, the considerably higher risks inherent in high-tech, innovative companies are likely to *a priori* lead to higher discouragement (Hutton and Nightingale 2011).

Based on the above discussion, we propose the following hypotheses:

H1: Small, innovative firms have a higher demand for credit.

H2: Small, innovative firms are more likely to experience difficulties in accessing external finance.

2.2. The effect of pandemic and other economic shocks on access to innovation finance

Cowling, Liu, and Ledger (2012), using a large sample of UK SMEs, show that the number of finance-seeking firms dropped by 12% during the GFC, and this depressed demand persists even aftermath the GFC. However, a greater degree of credit rationing in an adverse economic environment is usually observed, following the sudden drying-up of liquidity (Acharya and Viswanathan 2011) or tight monetary conditions (Bougheas, Mizen, and Yalcin 2006). It is found that banks become less capable of evaluating the riskiness of loan applicants during a recession given the increased market noise, and tend to use a smaller set of factors in making their lending decisions (Cowling, Liu, and Ledger 2012).

The demand for finance by innovative SMEs is closely associated with the needs for innovation investment, here specifically related to enhancing the technological content of products and services. The creative destruction theory (Schumpeter 1939) suggests that periods of economic turbulence present a unique opportunity for firms capable of innovation to challenge their incumbent counterparts and take advantage of the increased demand when the market recovers. Therefore, innovation activities and thus the demand for innovation finance appears to be counter-cyclical. The demand-pull theory (Schmookler 1966), on the other hand, argues that the marginal benefit of innovation is maximised when market demand is high. Accordingly, innovation investments are supposed to be pro-cyclical and during an economic downturn, low profit margins (and thus the availability of internal funds) and a general 'pessimistic mood' are likely to depress the external financing needs of innovative firms (Freeman, Clark, and Soete 1982).

We have established why innovative firms are usually considered to be more risky even in a 'business as usual' period (Lee, Sameen, and Cowling 2015; Nanda and Rhodes-Kropf 2017). In a crisis they are considered even more risky and innovation outcomes are more uncertain. It was the case that in the UK during the early Covid-19 period only 8% of total small business loans issued were not under a government guarantee (Calabrese, Cowling, and Liu 2022) which is exceptional and reflects the scale and generosity of the government schemes. The BBL scheme had a 100% guarantee on loans up to a ceiling of £50,000 and a fixed interest rate of 2.5%, and the CBILS scheme with an 80% guarantee and a ceiling of £5 m and guaranteed loan take-up was unprecedented

compared to the entire 40-year history of UK guarantee schemes (Cowling et al. 2022). Further, there is additional evidence that previously scarred and discouraged small business borrowers re-entered the loan market and were routed onto the government schemes (Cowling, Liu, and Calabrese 2022), and that there was a much more equitable regional distribution of loans (Cowling, Nightingale, and Wilson 2023). However, this scale of guaranteed lending did not come without consequences, not only in the UK (Cowling et al. 2022), but in Germany (Dörr, Licht, and Murmann 2022) and other countries including Switzerland (Zoller-Rydzek and Keller 2020) and Italy (Cascarino et al. 2022). It is a likely consequence that even when all small firms are facing liquidity problems, that innovative firms were relatively more disadvantaged and thus more likely to seek out loans, and particularly loans issued under a government guarantee.

Derived from the above review on the relation between economic shocks and capital market, we propose two further hypotheses regarding the effect of COVID-19 pandemic:

H3: The demand for finance by innovative SMEs will increase as the pandemic extends.

H4: Innovative firms more severely affected by the pandemic are more likely to receive government-backed loans.

3. Data and definitions

We collect our data from the SME Finance Monitor (SFM) special Covid-19 survey waves for the period April to September 2020. In total the two survey waves contain a cross-sectional of individual firm responses from 9011 UK SMEs, and after eliminating missing values, we have 7718 valid observations. These special survey waves are unique within the context of the 36 SFM waves that preceded them as they incorporated some specific questions relating to the UK government Covid-19 lending schemes. It is this additional information that we use to tackle our key research questions.

Each respondent firm interviewed per wave (by CATI using the quota sampling method) is allocated a Dun & Bradstreet and Experian credit risk rating and this is added to the data set on a case-by-case basis. Sample weights were applied based on the above three strata – size, sector and region, and then for firms trading for fewer than two years (start-ups). Weights were initially applied separately to each wave and both waves were then combined and grossed to the total of 5,002,010 SMEs, based on the UK business population data. This ensures that each individual wave is representative of all SMEs while the total interviews conducted are weighted to the total of all SMEs.

The key dependent variables that link to our research questions are: (i) *Sought Loan* – coded 1 if firm sought a bank loan and 0 if not; (ii) *Got Loan Offer* – conditional on applying for a loan in the first instance, coded 1 if the firm received an offer from the bank and 0 if refused; and (iii) *Government Backed Loan Offer* – conditional upon applying for a loan and receiving an offer, coded 1 if firms loan offer was through the UK government Covid-19 lending schemes and 0 otherwise (i.e. a conventional bank loan).

It is appropriate here to provide some detail about our key variable – Government Backed Loan Offer. This relates to two Covid-19 specific loan guarantee schemes which replaced the single national Enterprise Finance Guarantee (EFG) scheme which offered bank loans of up to £1.2 m to credit constrained smaller firms with a 75% guarantee and a premium interest rate of 2.5%. The smaller loan guarantee scheme, the Bounce Back Loan Scheme (BBLS) offered loans of £2000 up to £50,000 with a 100% guarantee at a fixed rate of 2.5% and no government premium. More than 1 million BBL loans were issued to small firms in the twelve months since its introduction in March 2020 with an average loan size of £37,000. The larger guarantee scheme, the Coronavirus Business Interruption Scheme (CBILS), offered loans of up to £5 m but allowed the lending bank to determine the interest rate and no government premium was applied. The guarantee level was set at 80%. In its lifetime 76,000 guaranteed loans were issued to smaller businesses with an average loan size of £267,000. Any firm that applied for a loan could potentially access a government

backed loan, but only for 25% of its average sales in a good year (Cowling, Nightingale, and Wilson 2023).

Further variables of interest are measures of innovation (Becker-Blease 2011) and the impact of the pandemic on business operation. We define a four-way classification for the identification of innovation appropriate businesses using two key indicators: (i) the firm has developed a new product or service in the last three years (coded 0 if No and 1 if Yes) and (ii) the business holds IP or other knowledge assets on its' balance sheet (coded 0 if No and 1 if Yes). Both indicators are common measures of innovation output used by relevant literature (Greenhalgh and Rogers 2010; Rogers 2003). Using the combinations of these two key indicators we create the following 4-way classification of innovation (Table 1), which will be used as four binary variables to identify the innovation levels of SMEs:

Such classification addresses the problem that smaller firms are usually excluded from official innovation data sets and better captures the value of innovation through alternative perspectives (Greenhalgh and Rogers 2006 and 2010). Moreover, the use of multiple innovation measures is recommended as it could serve to increase the accuracy and informativeness of measurement (Nelson et al. 2014). Table 2 reports the cross-tabulation of the two innovation identifiers, out of the 22% of SMEs with at least one type of innovation output, less than one in five reports both new product/service development and the possession of IP.

To measure the impact of the pandemic on small businesses, we use a self-reported, ten-point Likert scale variable (CSI) from the question 'to what extent does the impact of the coronavirus pandemic present an obstacle to you running your business as you would want in the next 12 months'. This measure captures SME owner managers' perception of the negative impacts in relation to the pandemic, cited by 68% of SMEs, alongside obstacles such as access to external finance, and legislation/regulation environment (BDRC 2020).

4. Descriptive statistics

Table 3 reports the descriptive statistics for the three dependent variables and all the independent variables. Except for CSI, all the other variables are binary. The weighted figures are reported. It is shown that 18% of SMEs sought bank loans during the initial Covid-19 outbreak (April – September 2020) while banks offered loans to 91% of SMEs who submitted loan applications. Amongst the loans offered by banks, the majority (93%) are government backed. This explains why the loan approval rate (91%) is much higher than it was (70%) during the GFC period (Cowling, Liu, and Ledger 2012): government Covid-19 schemes played an important role in supporting the SMEs during the Covid-19 crisis.

A CSI average of 7.5 out of 10 indicates that SMEs generally perceived the pandemic as a major challenge to business operations. Most firms are non-innovative firms (78%), compared to 18% of firms with either new product/service or IP, and only 4% of firms having both. Regarding credit risk ratings, 70% of SMEs are classed as average or above-average risk and a non-trivial share (10%) have no formal risk classification *per se*. The age of firms is relatively even-distributed, with 37% being older than 15 years, 29% being aged between 6–15 and 33% younger than 6.

We computed some descriptive statistics for the three dependent variables based on the 4-way innovation classification (Table 4). There is a larger proportion of firms in higher innovation classes

Table 1. New product service and IP classification.

	Intellectual property	
New product or service	No	Yes
No	0	1
Yes	2	3

Table 2. Frequency for 4-way classification.

New Product/Service	IP	Firm Shares %
No	No	78.06
No	Yes	3.97
Yes	No	14.13
Yes	Yes	3.84
		100.00

seeking finance during the crisis, with the largest share in dual-innovation class (28%) compared to 17% for non-innovative firms. This finding is consistent with Lee, Sameen, and Cowling (2015) that innovative firms tend to look for more external finance in a crisis. For the outcomes of applications, firms with IP in their balance sheets have the highest chance of getting loan offers (97%) but the lowest share of government-backed loans (75%). Firms in the other innovation classes had similar proportions of (government backed) loan offers.

We also calculated the distribution of the firms across the risk rating scores based on the 4-way innovation classification (Table 5). Overall, it shows that the innovative firms are slightly more likely to be in the 'minimal' and 'low' credit risk rating compared to other firms. And they are slightly less likely to be in the 'average' and 'above average' credit risk, suggesting a lower credit risk level. Within the innovative firms, it seems that firms only with new product/service have a higher credit risk, since they have a higher proportion of 'above average' credit risk and are less likely to be in the 'minimal' risk rating compared to the firms with IP. We also note that credit scoring models typically place greater weight on financial behavioural characteristics than firm characteristics *per se* (Emel et al. 2003; Orgler 1970).

5. Modelling loan demand and supply

Table 6 report the regression results from the probit models, where the dependent variable is whether firms sought a bank loan (Models 1–3),[1] whether they got a loan offer from the bank (Models 4–6) and whether the offer was a government backed loan (Models 7–9).[2] Besides the control variables, Models 1, 4 and 7 include CSI as one of the independent variables, models 2, 5 and 8 further add our 4-way innovation classification as the independent variable, and finally the above two kinds of variables and their interaction terms are all included in models 3, 6 and 9.[3] Sample weights are applied to all the regressions so our discussions on empirical findings represent the entire UK SME population.[4] For all specifications, we report the marginal effects of individual variables to show their economic significance.

5.1. Sought loan

Across all three specifications, SMEs that were more adversely affected by the pandemic had higher demand for finance. Here a one-standard-deviation increase of CSI raises the probability of loan seeking by almost two percent. Compared to non-innovation businesses, innovative firms, especially those with both IP and new product or service, were more likely to apply for finance during the Covid-19 crisis by over eight percentage points. This result is consistent with the analysis of the innovative SMEs during the GFC period (Lee, Sameen, and Cowling 2015; North, Baldock and Ullah 2013), that the demand for external finance is strongly counter-cyclical. The three interaction terms between CSI and innovation classification (model 3) are not significant at 10% level of significance, suggesting that the effect of the pandemic on credit demand is non-differentiating across SMEs with varying levels of innovation.

Besides the two novel features analysed above, we also find a time dynamic as the Covid-19 crisis extended into its second quarter. The proportion of SMEs seeking finance increased by six percentage points as we moved deeper into the crisis from the second to the third quarter. This may

Table 3. Descriptive statistics of dependent and independent variables.

Variable Name	Mean	Std. Dev.	Min	Max	Number of Obs.
Dependent Variables					
Sought loan offer	0.176	0.380	0	1	7718
Received loan offer	0.914	0.278	0	1	1437
Received gov't backed loan offer	0.933	0.253	0	1	1290
Independent Variables					
Covid-19-Severity-Index	7.540	2.821	1	10	7718
Innovation:					
No IP, no new product or service	0.781	0.443	0	1	7718
IP, no new product or service	0.040	0.211	0	1	7718
new product or service, no IP	0.141	0.373	0	1	7718
IP, new product or service	0.038	0.226	0	1	7718
Region:					
Scotland	0.060	0.280	0	1	7718
North East	0.030	0.222	0	1	7718
York & Humber	0.070	0.268	0	1	7718
North West	0.100	0.285	0	1	7718
West Midlands	0.070	0.276	0	1	7718
East Midlands	0.070	0.259	0	1	7718
East of England	0.100	0.285	0	1	7718
Wales	0.040	0.243	0	1	7718
South West	0.100	0.286	0	1	7718
London	0.180	0.328	0	1	7718
South East	0.160	0.329	0	1	7718
Northern Ireland	0.020	0.217	0	1	7718
Risk Rating:					
Minimal	0.057	0.376	0	1	7718
Low	0.131	0.450	0	1	7718
Average	0.269	0.441	0	1	7718
Above Average	0.442	0.403	0	1	7718
Not Known	0.101	0.269	0	1	7718
Employment Size:					
1	0.748	0.400	0	1	7718
2–10	0.205	0.467	0	1	7718
11–50	0.041	0.467	0	1	7718
51–250	0.006	0.315	0	1	7718
Industry Section:					
Agriculture	0.031	0.249	0	1	7718
Manufacturing	0.055	0.282	0	1	7718
Construction	0.191	0.378	0	1	7718
Wholesale/retail	0.104	0.304	0	1	7718
Hotels & catering	0.037	0.255	0	1	7718
Transport & Communications	0.123	0.311	0	1	7718
Real Estate	0.268	0.402	0	1	7718
Health	0.074	0.266	0	1	7718
Other services	0.118	0.317	0	1	7718
Legal Status:					
Sole Proprietor	0.567	0.414	0	1	7718
Partnership	0.034	0.236	0	1	7718
LLP&LLC	0.399	0.116	0	1	7718
Firm Age:					
Less than one year	0.065	0.169	0	1	7718
1–2 years	0.135	0.251	0	1	7718
2–5 years	0.134	0.273	0	1	7718
6–9 years	0.119	0.283	0	1	7718
10–15 years	0.173	0.367	0	1	7718
More than 15 years	0.373	0.495	0	1	7718

indicate that firms had faced more severe liquidity problems due to the restricted trading conditions, which accords with the findings of Cowling, Liu, and Zhang (2021).

At teh sector level, we find that the lowest application rates are in health service sectors, which were able to operate throughout the crisis as a key industry. Size also plays an important role – micro

Table 4. Descriptive statistics based on 4-way innovation classification.

	Sought Loan		Got Loan Offer		Got Gov't Backed Loan Offer	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
No IP, no new product or service	0.166	0.372	0.912	0.284	0.946	0.227
IP, no new product or service	0.187	0.391	0.969	0.174	0.748	0.437
new product or service, no IP	0.192	0.394	0.912	0.283	0.895	0.307
IP, new product or service	0.279	0.449	0.943	0.233	0.947	0.226

Table 5. Distribution of the firms across the risk rating scores based on the 4-way innovation classification.

Credit risk	Share of firms in each category (%):				
	Non-innovator No IP, no new product/ service	Innovator IP, no new product/ service	no IP, new product/ service	IP, new product/ service	All
Minimal	5.4	10.4	5.6	8.0	5.7
Low	12.2	15.9	16.3	15.0	13.1
Average	27.2	25.6	26.2	26.5	26.9
Above average	44.9	39.5	42.8	39.6	44.2
Unknown	10.3	8.6	9.1	10.8	10.1
Total	100.0	100.0	100.0	100.0	100.0

(2–10 employees), small (11–50 employees) and medium (51–250 employees) firms had a significantly higher probability of seeking bank loans. There is also evidence that younger firms (2–5 years) had a higher demand for finance. These results for size and age are in line with the analysis on innovative SMEs in the GFC as stated in Lee, Sameen, and Cowling (2015) and Cowling, Liu, and Zhang (2021). Finally, we find no significant evidence of risk rating of firms influencing financial applications.

5.2. Loan approval

Models 4, 5 and 6 in Table 6 consider whether the bank accepted or refused the loan application. We find that firms exposed to higher pandemic-induced business risks were less likely to get loan offers, where the chance of loan approval will be reduced by around two percentage points when CSI increases by one standard deviation. With respect to the effect of innovation activities, it is shown that firms with IP on their balance sheets had a significantly higher probability of receiving external finance. A close inspection of the interaction terms shows that being innovative helps to alleviate the negative effect of the pandemic on credit supply, especially for firms investing in intellectual property (Model 6). Similar to Lee, Sameen, and Cowling (2015), we document a narrowing of the financing gap between innovation and non-innovation businesses. However, this does not hold for SMEs engaging both IP and product/service innovation, implying that excess risk-taking outweighs the higher resilience and growth perspective in banks' decision-making.

Although loan demand increased the further the UK entered the pandemic, we do not find a similar upward shift in loan approval. Firm size does not have a significant effect on getting loan offers, consistent with the result shown in Lee, Sameen, and Cowling (2015) for the GFC. Finally, we find no significant differences for the different classes of firm age and risk ratings.

5.3. Got government backed loan offer

Models 7, 8 and 9 in Table 6 distinguish loan offers based on whether they belong to the UK Government-backed Covid-19 lending schemes or not. Unlike the sought finance and the got loan offer models, here we find no association between the severity of the firm-specific Covid-19 impact

Table 6. Probit regression results: Finance applications and outcomes, population weighted

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	Sought loan			Got loan offer			Got government backed loan offer		
Covid-19-Severity-Index (CSI)	0.019***	0.018***	0.019***	−0.015***	−0.015***	−0.016***	0.002	0.003	0.001
	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.006)
Innovation (No Innovation)									
IP, no new product service		0.024	0.020		0.052**	0.047*		−0.158*	−0.169**
		(0.040)	(0.038)		(0.026)	(0.026)		(0.081)	(0.076)
new product service, no IP		0.007	0.007		−0.009	−0.009		−0.044	−0.050
		(0.020)	(0.020)		(0.031)	(0.031)		(0.031)	(0.031)
IP, new product service		0.086**	0.083*		0.015	0.015		−0.011	−0.019
		(0.044)	(0.043)		(0.036)	(0.035)		(0.037)	(0.034)
*Interaction (CSI*No Innovation)*									
CSI*(IP, no new product service)			0.046			0.268**			0.188*
			(0.048)			(0.106)			(0.103)
CSI*(new product service, no IP)			0.023			0.134*			0.179*
			(0.033)			(0.077)			(0.099)
CSI*(IP, new product service)			0.071			0.007			−0.418
			(0.052)			(0.168)			(0.294)
Survey Wave (Q2 2020)									
Q3 2020	0.058***	0.059***	0.059***	0.026	0.026	0.025	0.079**	0.087***	0.088***
	(0.015)	(0.015)	(0.015)	(0.029)	(0.028)	(0.028)	(0.032)	(0.031)	(0.031)
Region (Scotland)									
North East	−0.019	−0.019	−0.019	−0.052	−0.048	−0.054	−0.007	−0.005	0.009
	(0.045)	(0.045)	(0.044)	(0.081)	(0.077)	(0.081)	(0.130)	(0.128)	(0.097)
York & Humber	−0.015	−0.014	−0.014	−0.060	−0.068	−0.073	0.064	0.071	0.057
	(0.039)	(0.039)	(0.039)	(0.064)	(0.065)	(0.066)	(0.063)	(0.066)	(0.063)
North West	−0.010	−0.010	−0.009	−0.034	−0.035	−0.036	0.095*	0.100*	0.094*
	(0.040)	(0.040)	(0.040)	(0.069)	(0.069)	(0.069)	(0.052)	(0.055)	(0.050)
West Midlands	0.001	0.002	0.002	−0.019	−0.018	−0.019	0.078	0.072	0.065
	(0.039)	(0.039)	(0.039)	(0.055)	(0.054)	(0.054)	(0.059)	(0.063)	(0.058)
East Midlands	0.010	0.012	0.012	0.023	0.022	0.018	0.123**	0.126**	0.119**
	(0.040)	(0.040)	(0.040)	(0.042)	(0.041)	(0.041)	(0.051)	(0.054)	(0.049)
East England	−0.095***	−0.096***	−0.095***	−0.174*	−0.175*	−0.171*	0.023	0.022	0.013
	(0.034)	(0.034)	(0.034)	(0.094)	(0.093)	(0.090)	(0.066)	(0.069)	(0.066)
Wales	−0.023	−0.022	−0.020	−0.030	−0.028	−0.026	0.046	0.047	0.048
	(0.041)	(0.041)	(0.041)	(0.061)	(0.059)	(0.058)	(0.064)	(0.067)	(0.064)
South West	−0.052	−0.053	−0.053	0.039	0.039	0.037	0.077	0.074	0.072
	(0.038)	(0.037)	(0.037)	(0.039)	(0.039)	(0.039)	(0.060)	(0.063)	(0.059)
London	−0.048	−0.049	−0.049	−0.024	−0.026	−0.027	0.033	0.046	0.040
	(0.035)	(0.035)	(0.035)	(0.050)	(0.050)	(0.051)	(0.058)	(0.063)	(0.056)
South East	−0.028	−0.029	−0.028	−0.050	−0.050	−0.051	0.037	0.033	0.026
	(0.037)	(0.036)	(0.036)	(0.060)	(0.058)	(0.058)	(0.058)	(0.060)	(0.056)

N.Ireland	−0.019	−0.018	−0.017	−0.204*	−0.201*	−0.201*	0.018	0.028	−0.002
	(0.045)	(0.044)	(0.044)	(0.108)	(0.106)	(0.104)	(0.100)	(0.093)	(0.105)
Risk Rating (Minimal)									
Low	0.007	0.009	0.008	−0.003	0.003	0.003	0.130**	0.107**	0.113**
	(0.031)	(0.030)	(0.030)	(0.057)	(0.058)	(0.059)	(0.065)	(0.047)	(0.049)
Average	−0.009	−0.009	−0.009	0.001	0.004	0.004	0.111	0.084*	0.089*
	(0.030)	(0.030)	(0.030)	(0.050)	(0.052)	(0.054)	(0.068)	(0.050)	(0.053)
Above Average	−0.010	−0.009	−0.008	0.061	0.065	0.069	0.071	0.043	0.055
	(0.032)	(0.031)	(0.031)	(0.049)	(0.050)	(0.051)	(0.076)	(0.062)	(0.061)
Not Known	0.023	0.024	0.024	0.031	0.035	0.035	0.150**	0.120**	0.128**
	(0.038)	(0.038)	(0.038)	(0.059)	(0.061)	(0.062)	(0.068)	(0.052)	(0.053)
Employment Size (One)									
2–10	0.061***	0.061***	0.061***	−0.024	−0.024	−0.020	0.054**	0.057**	0.063**
	(0.018)	(0.018)	(0.018)	(0.032)	(0.032)	(0.032)	(0.028)	(0.027)	(0.028)
11–50	0.099***	0.096***	0.097***	0.001	−0.002	0.005	0.045	0.047	0.055*
	(0.025)	(0.025)	(0.025)	(0.036)	(0.036)	(0.036)	(0.033)	(0.032)	(0.032)
51–250	0.064**	0.058**	0.060**	−0.006	−0.008	−0.005	0.047	0.047	0.051
	(0.027)	(0.027)	(0.027)	(0.046)	(0.047)	(0.048)	(0.035)	(0.032)	(0.032)
Industry (Agriculture)									
Manufacturing	−0.028	−0.032	−0.032	−0.121	−0.119	−0.116	−0.019	−0.015	−0.007
	(0.036)	(0.037)	(0.037)	(0.077)	(0.077)	(0.074)	(0.111)	(0.105)	(0.110)
Construction	0.002	0.004	0.003	−0.035	−0.036	−0.037	0.120	0.117	0.120
	(0.035)	(0.035)	(0.035)	(0.036)	(0.036)	(0.036)	(0.082)	(0.073)	(0.075)
Wholesale/retail	0.024	0.023	0.022	−0.062	−0.061	−0.061	0.042	0.039	0.041
	(0.035)	(0.035)	(0.035)	(0.046)	(0.045)	(0.045)	(0.091)	(0.084)	(0.089)
Hotels & catering	0.003	0.005	0.005	−0.007	0.009	−0.010	0.026	0.037	0.032
	(0.034)	(0.034)	(0.034)	(0.036)	(0.036)	(0.037)	(0.093)	(0.083)	(0.087)
Transport & Comms	0.038	0.038	0.039	−0.091*	−0.088*	−0.083	0.029	0.020	0.039
	(0.038)	(0.038)	(0.039)	(0.054)	(0.053)	(0.052)	(0.094)	(0.087)	(0.086)
Real Estate	−0.005	−0.008	−0.008	−0.038	−0.042	−0.044	0.087	0.087	0.093
	(0.033)	(0.033)	(0.033)	(0.035)	(0.037)	(0.037)	(0.082)	(0.073)	(0.075)
Health	−0.058	−0.059*	−0.060*	0.003	0.001	0.003	0.096	0.086	0.095
	(0.036)	(0.036)	(0.036)	(0.030)	(0.030)	(0.030)	(0.084)	(0.076)	(0.079)
Other services	−0.020	−0.020	−0.020	−0.006	−0.008	−0.006	0.065	0.081	0.090
	(0.036)	(0.036)	(0.036)	(0.032)	(0.032)	(0.032)	(0.092)	(0.078)	(0.080)
Legal (Sole Proprietor)									
Partnership	0.010	0.010	0.011	0.050	0.047	0.047	0.008	0.003	0.004
	(0.033)	(0.033)	(0.033)	(0.065)	(0.067)	(0.068)	(0.029)	(0.030)	(0.029)
LLP&LLC	0.067***	0.064***	0.065***	0.055*	0.056*	0.055*	−0.043	−0.041	−0.040
	(0.020)	(0.020)	(0.020)	(0.032)	(0.033)	(0.032)	(0.028)	(0.030)	(0.029)
Firm Age (<1 year)									
1–2 years	0.057	0.057	0.057	0.076	0.079	0.082	−0.047	−0.037	−0.027

(*Continued*)

Table 6. Continued.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	Sought loan			Got loan offer			Got government backed loan offer		
	(0.036)	(0.037)	(0.037)	(0.065)	(0.066)	(0.067)	(0.030)	(0.030)	(0.028)
2–5 years	0.115***	0.113***	0.112***	−0.046	−0.043	−0.041	0.001	0.008	0.009
	(0.037)	(0.037)	(0.038)	(0.082)	(0.085)	(0.085)	(0.025)	(0.027)	(0.030)
6–9 years	0.036	0.034	0.036	0.020	0.021	0.022	−0.032	−0.031	−0.043
	(0.036)	(0.037)	(0.037)	(0.074)	(0.076)	(0.078)	(0.034)	(0.037)	(0.044)
10–15 years	0.018	0.016	0.016	0.044	0.043	0.041	−0.111*	−0.109	−0.110*
	(0.034)	(0.034)	(0.034)	(0.078)	(0.078)	(0.079)	(0.065)	(0.065)	(0.064)
>15 years	−0.001	−0.001	−0.0003	0.060	0.061	0.060	−0.075**	−0.074**	−0.074
	(0.032)	(0.032)	(0.032)	(0.070)	(0.071)	(0.072)	(0.037)	(0.038)	(0.038)
Obs	7718	7718	7718	1437	1437	1437	1290	1290	1290
Pseudo R^2	0.063	0.065	0.065	0.084	0.086	0.090	0.124	0.136	0.144
Log-Likelihood	−3335.989	−3327.989	−3325.206	−358.324	−357.100	−354.006	−230.884	−222.463	−216.176
Wald χ^2	137.888***	153.888***	159.453***	18.817***	21.265***	27.454***	0.707	17.549	30.122**

Marginal effects reported with robust standard errors in parentheses, except for the interactions between CSI and innovation classifications where coefficients estimates are reported. Reference category is given in parentheses. Significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

and the probability of getting a government backed loan offer. Although innovators with IP on their balance sheets had a higher chance of approval, this innovation class was significantly less likely to receive government-backed Covid loans. The interactions between CSI and either IP or product/service innovation are significantly positive, implying that the Covid-specific public support managed to narrow the funding gap for credit-worthy and innovative SMEs most adversely affected by the pandemic, by providing the much-needed guarantee for their financing activities.

As expected, we find that moving deeper into the initial Covid-19 crisis is associated with an increase in the share of loan offers that were routed onto the UK Covid-19 lending schemes. The increase in probability of receiving a government back loan is around eight percentage points between Covid-19 quarter 1 and quarter 2. Compared to firms with minimum and above-average risk rating, firms with low and average risk rated classes were more likely to receive government backed loan offers. A potential explanation to this concentration in the 'middle' segment of risk distribution is that whilst the riskiest firms would have failed the pre-screening loan assessment which is a requirement for government guarantee, banks also wanted to reward its minimal risk customers with lower interest rate loans (below 2.5%) through normal lending channels. The probability of obtaining a government backed loan is higher for micro firms (1-9 employees) and lower for those operating for more than 10 years, significant at the 5% or 10% significance levels, respectively.

5.4. Robustness checks with sample selection

In this section we identify the potential selection bias in Table 6, as only firms seeking finance could receive a loan offer. Similarly, we can only distinguish whether firms received government-backed loans or not among firms whose applications were approved. Given the binary nature of the dependent variables for both selection and outcome equations, instead of the two-step Heckman correction for linear models, we address the selection bias by using the equivalent technique of a bivariate probit model with sample selection, which applies the full maximum likelihood estimation (van de Ven and van Praag 1981). Specifically, we use the probit model of applying for loans as the selection function and the probit model of obtaining loans as the outcome equation to correct the selection bias when estimating the likelihood of SMEs obtaining loans. Similarly, we use the probit model of obtaining loans as the selection equation and the probit model of obtaining government-backed loans as the outcome equation to correct the selection bias when estimating the likelihood of SMEs obtaining government-backed loans. We consider the regional dummies and the legal status identifiers as the exclusion restrictions which are commonly used in similar studies (e.g. Brown, Liñares-Zegarra, and Wilson 2022; Lee, Sameen, and Cowling 2015).

This sample selection method estimates ρ, which represents the covariance between the error of the selection equation and the error of the outcome equation. A significant ρ (Atanh ρ reported in the table) suggests that $\rho \neq 0$ and therefore selection bias is present. A significant Wald test of the independence between the selection and outcome equations can further supports the conclusion. As shown in Table 7, Atanh ρ and Wald test are significant only in Models 1 and 2 at 5% and 10% significance levels respectively, which indicates the presence of selection bias when estimating the likelihood of obtaining loans with CSI and innovation classifications as independent variables. The estimation Atanh ρ and Wald test are insignificant in all other models, which suggests that sample selection bias is not evident. Moreover, for all six models, our headline findings on CSI, innovation classification and their interactions are consistent with the unconditional probit models in Table 6. Overall, we conclude that our findings are robust against sample selection adjustment.

6. Conclusions and implications

We set out to investigate the potential for small and innovative firms faced more acute problems during the Covid-19 crisis. The potentially confounding feature of the capital market in the Covid-19 crisis was the presence of two historically large UK government loan guarantee schemes. Aside

Table 7. Probit regression results, with sample selection: Finance applications and outcomes, population weighted.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Got Loan Offer			Got Government Backed Loan Offer		
Covid-19-Severity-Index (CSI)	−0.021***	−0.022***	−0.025***	0.003	0.003	0.002
	(0.008)	(0.008)	(0.009)	(0.006)	(0.004)	(0.005)
Innovation (No Innovation)						
IP, no new product service		0.050*	0.023		−0.159*	−0.169**
		(0.027)	(0.043)		(0.088)	(0.083)
new product service, no IP		−0.002	−0.020		−0.049	−0.053*
		(0.040)	(0.044)		(0.031)	(0.030)
IP, new product service		0.026	0.028		−0.013	−0.020
		(0.035)	(0.036)		(0.032)	(0.032)
*Interaction (CSI*No Innovation)*						
CSI*(IP, no new product service)			0.215***			0.269***
			(0.044)			(0.100)
CSI*(new product service, no IP)			0.146**			0.135*
			(0.033)			(0.074)
CSI*(IP, new product service)			0.034			0.003
			(0.052)			(0.149)
Survey Wave (Q2 2020)						
Q3 2020	0.031	0.032	0.037	0.076**	0.084***	0.084***
	(0.033)	(0.034)	(0.037)	(0.032)	(0.031)	(0.030)
Region (Scotland)						
North East				0.009	0.007	0.019
				(0.103)	(0.100)	(0.083)
York & Humber				0.063	0.070	0.057
				(0.061)	(0.062)	(0.060)
North West				0.087*	0.090*	0.085*
				(0.053)	(0.054)	(0.050)
West Midlands				0.070	0.063	0.058
				(0.056)	(0.059)	(0.055)
East Midlands				0.117**	0.119**	0.114**
				(0.051)	(0.053)	(0.049)
East England				0.023	0.019	0.012
				(0.069)	(0.071)	(0.068)
Wales				0.052	0.052	0.054
				(0.060)	(0.062)	(0.058)
South West				0.078	0.0715	0.070
				(0.055)	(0.058)	(0.054)
London				0.023	0.034	0.031
				(0.068)	(0.066)	(0.062)
South East				0.029	0.026	0.022
				(0.056)	(0.058)	(0.055)
N.Ireland				0.022	0.029	0.003
				(0.083)	(0.079)	(0.084)
Risk Rating (Minimal)						
Low	0.015	0.021	0.021	0.153**	0.130**	0.135**
	(0.069)	(0.070)	(0.073)	(0.077)	(0.056)	(0.056)
Average	0.0159	0.018	0.023	0.143*	0.113*	0.120**
	(0.0637)	(0.065)	(0.068)	(0.083)	(0.060)	(0.061)
Above Average	0.074	0.077	0.087	0.099	0.070	0.083
	(0.059)	(0.060)	(0.063)	(0.086)	(0.066)	(0.065)
Not Known	0.045	0.049	0.053	0.177**	0.146**	0.154**
	(0.075)	(0.076)	(0.081)	(0.082)	(0.059)	(0.060)
Employment Size (One)						
2–10	0.010	0.006	0.015	0.027	0.031	0.040
	(0.036)	(0.037)	(0.037)	(0.028)	(0.026)	(0.025)
11–50	−0.012	−0.015	−0.008	0.043*	0.045**	0.052**
	(0.032)	(0.033)	(0.034)	(0.022)	(0.021)	(0.021)
51–250	0.012	0.007	0.010	0.031	0.031	0.035
	(0.044)	(0.047)	(0.048)	(0.031)	(0.028)	(0.028)
Industry (Agriculture)						
Manufacturing	−0.132	−0.131	−0.144	−0.045	−0.039	−0.034
	(0.110)	(0.106)	(0.110)	(0.092)	(0.087)	(0.089)
Construction	−0.024	−0.026	−0.032	0.099	0.097*	0.100*

(*Continued*)

Table 7. Continued.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Got Loan Offer			Got Government Backed Loan Offer		
	(0.055)	(0.056)	(0.061)	(0.066)	(0.058)	(0.060)
Wholesale/retail	−0.041	−0.041	−0.041	0.0239	0.021	0.023
	(0.057)	(0.056)	(0.057)	(0.074)	(0.068)	(0.070)
Hotels & catering	0.017	0.017	0.018	0.013	0.020	0.016
	(0.046)	(0.045)	(0.047)	(0.080)	(0.069)	(0.071)
Transport & Comms	−0.059	−0.057	−0.053	0.0030	−0.007	0.014
	(0.066)	(0.065)	(0.065)	(0.077)	(0.070)	(0.069)
Real Estate	−0.018	−0.024	−0.028	0.063	0.064	0.070
	(0.050)	(0.052)	(0.056)	(0.066)	(0.059)	(0.060)
Health	0.023	0.027	0.021	0.077	0.066	0.076
	(0.045)	(0.044)	(0.047)	(0.069)	(0.062)	(0.064)
Other services	0.020	0.018	0.023	0.044	0.059	0.068
	(0.046)	(0.046)	(0.048)	(0.079)	(0.065)	(0.066)
Legal (Sole Proprietor)						
Partnership	0.056*	0.056*	0.060*			
	(0.031)	(0.033)	(0.034)			
LLP&LLC	0.052	0.052	0.053			
	(0.057)	(0.059)	(0.063)			
Firm Age (<1 year)						
1–2 years	0.054	0.055	0.060	−0.054*	−0.042	−0.031
	(0.082)	(0.084)	(0.085)	(0.032)	(0.031)	(0.030)
2–5 years	−0.043	−0.040	−0.043	0.0025	0.010	0.012
	(0.105)	(0.109)	(0.111)	(0.022)	(0.025)	(0.027)
6–9 years	0.0029	0.004	0.0008	−0.030	−0.028	−0.036
	(0.094)	(0.097)	(0.100)	(0.031)	(0.034)	(0.038)
10–15 years	0.035	0.034	0.033	−0.107**	−0.102*	−0.104**
	(0.093)	(0.095)	(0.097)	(0.053)	(0.053)	(0.052)
>15 years	0.039	0.041	0.040	−0.067**	−0.067*	−0.066*
	(0.093)	(0.095)	(0.097)	(0.032)	(0.035)	(0.0345)
Atanh ρ	−3.560**	−3.731*	−4.255	0.571	0.450	0.457
	(1.568)	(2.188)	(4.183)	(0.856)	(0.811)	(0.715)
Obs: Selected	1419	1419	1419	1290	1290	1290
Obs: Nonselected	5.938	5.938	5.938	102	102	102
Log-Likelihood	−329.290	−328.227	−327.676	−47.362	−46.562	−45.801
Wald χ^2	127.720***	129.520***	113.750***	80.840***	94.740***	104.570***
Wald χ^2 of indep. Eqns. ($\rho = 0$)	5.15**	2.91*	1.03	0.44	0.31	0.41

Marginal effects reported with robust standard errors in parentheses, except for interactions between CSI and innovation classifications where coefficients estimates are reported. Outcome equations 1, 2 and 3 relates to the probability of got loan offer conditional on seeking finance. Outcome equations 4, 5 and 6 relates to the probability of got government backed loan offer conditional on got loan offer. Besides the control variables, Models 1 and 4 include CSI as one of the independent variables, models 2 and 5 further add the 4-way innovation classification as the independent variables, and finally the above two kinds of variables and their interaction terms are all included in models 3 and 6. Reference category is given in parentheses. Significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

from their sheer scale (current estimates suggest guaranteed lending in excess of £70bn), the loan guarantee coverage rate at 100% on BBLS and 80% on CBILS, was unprecedented compared to a historical average of 75%. It is apposite to question whether (a) innovative firms had a greater demand for external capital during Covid-19, and (b) whether this level of demand was being met by the capital market. Further, we question whether the presence of these two government guarantee schemes meant that a greater proportion of innovation lending was routed through these schemes which would indicate that banks were trying to de-risk lending to this segment of the business population. Additional nuance and insights were gained by testing for Covid-19 severity in terms of the individual firm effects and also by allowing for a separation of innovative firms into those who had IP on their balance sheets, those who were developing new products & services, and those with both.

Our results show that in general the individual firm-level severity of the Covid-19 impact had a strong and positive effect on the demand for finance. But we also found evidence that the most

severely impacted firms were the least likely to be offered finance, although if they were, they were as likely to access one of the government guarantee schemes. Risk, firm size and firm age were also found to be important with riskier firms having a greater demand for external finance but a lower chance of accessing government Covid-19 guarantee schemes. Micro and small businesses also had a higher demand for finance which is consistent with them having limited cash reserves, but this did not translate into greater success in being able to access finance including government schemes. Finally, we note that firms in their early life-cycle post start-up also had a higher demand for finance. Our findings on this age effect are also consistent with evidence for leverage in private US firms (Dinlersoz et al. 2018).

On innovation, we find that firms with IP were the least likely to access government schemes, although it was firms with IP and developing new products & services that had the highest demand for external finance and a lower probability of receiving government backed guarantee funding. However, we also found that at the individual firm level, when taking into account the relative severity of the Covid-19 impact on each firm, firms either with IP or developing new product & services were more likely to receive loan offers both generally and regarding government support, whilst those with IP and developing new products & services had the least access to government backed guaranteed funding. This confirms our initial contention that the nuance added by a more disaggregated approach to capturing innovation and a better understanding of the firm-specific Covid-19 impact has added greater insight into our general understanding of the financing of innovation during a crisis.

Our specific Covid-19 results show that the most innovative firms still have a higher demand for external finance, so nothing has changed. But the willingness of capital markets to meet these demands is different as innovative firms had more equal access which is unusual. However, they had unequal access to government Covid-19 guarantee schemes unless they were most severely impacted by the crisis itself. This suggests that the key factor driving this relatively favourable position for innovative firms was not really that they were innovative, but that they were more affected by the crisis and it was this that opened up access to public guarantee schemes.

For policymakers, our findings provide the potential implications for resolving the innovation finance gap in a post-Covid-19 world. This evidence opens up the scope for establishing a specific innovation loan guarantee scheme with higher than conventional guarantee rates. As for limitations, we have limited information on the 'quality' of the innovation of the firms and this could be addressed if better data become available. In terms of what a potential innovation loan guarantee scheme might be appropriate for the UK, we suggest that a higher guarantee coverage rate (maybe 5% over the standard guarantee rate) would be appropriate to de-risk lending and lower the average interest rate offered by lenders thus reducing the per period repayments and improving firm's liquidity. In the case of innovation that takes time to commercialise, capital repayment and interest rate holidays early in the life of a loan may also be appropriate and these options were available during the pandemic guarantee schemes and were used widely. Operationally, Innovate UK actually has a 'quality of innovation' measurement procedure that ranks firms' innovation projects and this could be brought into wider use through commercial banks via a referral process. In respect of identifying innovative firms *per se*, standard classifications of knowledge intensive services (KIS) and manufacturing industry sectors could be utilised, but this would exclude the significant innovation carried out in more conventional industry sectors.

Notes

1. We also run a multi nominal probit model with three possible outcomes (not applying finance, applying for normal loan, applying for government backed loan) for SMEs in need of finance. The results are shown in Table A3 in the online appendix.

2. One referee suggests incorporating discouraged borrowers (firms who need finance but not apply) in this analysis to see how this category reacted to the pandemic. We run the probit model with sample selection (van de Ven and van Praag 1981) to evaluate the impact of pandemic and innovation on borrower discouragement and the results are reported in Table A2 in the online appendix. Overall, we find no association between the pandemic-induced business risks and the probability of being a discouraged borrower conditional on needing finance. Being innovators with new product/service increases the likelihood of borrower discouragement, which is in line with the findings of Brown, Liñares-Zegarra, and Wilson (2022).
3. We estimated a model with the squared term of CIS but as the results are not significant at 10% level of significance.
4. The unweighted results are reported in the online appendix (Table A1) for comparison purpose, and it can be seen that the coefficient estimates are not substantially different from the weighted regressions.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This work was supported by Economic and Social Research Council [grant number ES/W010259/1].

References

Acharya, V. V., and S. Viswanathan. 2011. "Leverage, Moral Hazard, and Liquidity." *The Journal of Finance* 66 (1): 99–138. https://doi.org/10.1111/j.1540-6261.2010.01627.x.

Acs, Z. J., and D. B. Audretsch. 1987. "Innovation, Market Structure, and Firm Size." *The Review of Economics and Statistics* 69 (4): 567–574. https://doi.org/10.2307/1935950.

Akerlof, G. A. 1970. "The Market for "Lemons": Quality Uncertainty and the Market Mechanism." *The Quarterly Journal of Economics* 84 (3): 488–500. https://doi.org/10.2307/1879431.

Akpan, I. J., D. Soopramanien, and D.-H. Kwak. 2020. "Cutting-Edge Technologies for Small Business and Innovation in the era of COVID-19 Global Health Pandemic." *Journal of Small Business & Entrepreneurship* 33 (6): 1–11.

Arena, M., I. Bengo, M. Calderini, and V. Chiodo. 2018. "Unlocking Finance for Social Tech Start-Ups: Is There a new Opportunity Space?" *Technological Forecasting and Social Change* 127: 154–165. https://doi.org/10.1016/j.techfore.2017.05.035.

Ayyagari, M., A. Demirgüç-Kunt, and V. Maksimovic. 2011. "Small vs. Young Firms Across the World: Contribution to Employment, job Creation, and Growth." World Bank Policy Research Working Paper (5631).

Balsmeier, B., and M. Woerter. 2019. "Is This Time Different? How Digitalization Influences job Creation and Destruction." *Research Policy* 48 (8): 103765. https://doi.org/10.1016/j.respol.2019.03.010.

Becker-Blease, J. R. 2011. "Governance and Innovation." *Journal of Corporate Finance* 17 (4): 947–958. https://doi.org/10.1016/j.jcorpfin.2011.04.003.

Behr, P., and A. Guttler. 2007. "Credit Risk Assessment and Relationship Lending: An Empirical Analysis of German Small and Medium-Sized Enterprises*." *Journal of Small Business Management* 45 (2): 194–213. https://doi.org/10.1111/j.1540-627X.2007.00209.x.

Berger, A. N., and G. F. Udell. 1992. "Some Evidence on the Empirical Significance of Credit Rationing." *Journal of Political Economy* 100 (5): 1047–1077. https://doi.org/10.1086/261851.

Berger, A. N., and G. F. Udell. 1998. "The Economics of Small Business Finance: The Roles of Private Equity and Debt Markets in the Financial Growth Cycle." *Journal of Banking & Finance* 22 (6-8): 613–673. https://doi.org/10.1016/S0378-4266(98)00038-7.

Bougheas, S., P. Mizen, and C. Yalcin. 2006. "Access to External Finance: Theory and Evidence on the Impact of Monetary Policy and Firm-Specific Characteristics." *Journal of Banking & Finance* 30 (1): 199–227. https://doi.org/10.1016/j.jbankfin.2005.01.002.

Brown, R., J. Liñares-Zegarra, and J. Wilson. 2022. "Innovation and Borrower Discouragement in SMEs." *Small Business Economics* 59: 1489–1517. https://doi.org/10.1007/s11187-021-00587-1.

Brown, R., A. Rocha, and M. Cowling. 2020. "Financing Entrepreneurship in Times of Crisis: Exploring the Impact of COVID-19 on the Market for Entrepreneurial Finance in the United Kingdom." *International Small Business Journal: Researching Entrepreneurship* 38 (5): 380–390. https://doi.org/10.1177/0266242620937464.

Bryan, K., J. Lemus, and G. Marshall. 2020. "Innovation During a Crisis: Evidence from Covid-19." SSRN 3587973.

Calabrese, R., M. Cowling, and W. Liu. 2022. "Understanding the Dynamics of UK Covid-19 SME Financing." *British Journal of Management* 33 (2): 657–677. https://doi.org/10.1111/1467-8551.12576.

Carpenter, R. E., and B. C. Petersen. 2002. "Is the Growth of Small Firms Constrained by Internal Finance?" *Review of Economics and Statistics* 84 (2): 298–309. https://doi.org/10.1162/003465302317411541.

Cascarino, G., R. Gallo, F. Palazzo, and E. Sette. 2022. "Public Guarantees and Credit Additionality During the Covid-19 Pandemic." Bank of Italy Temi di Discussione Working Paper No, 1369.

Cassar, G. 2004. "The Financing of Business Start-ups." *Journal of Business Venturing* 19 (2): 261–283. https://doi.org/10.1016/S0883-9026(03)00029-6.

Coad, A., and R. Rao. 2008. "Innovation and Firm Growth in High-Tech Sectors: A Quantile Regression Approach." *Research Policy* 37 (4): 633–648. https://doi.org/10.1016/j.respol.2008.01.003.

Coco, G. 2000. "On the use of Collateral." *Journal of Economic Surveys* 14 (2): 191–214. https://doi.org/10.1111/1467-6419.00109.

Cole, R., and T. Sokolyk. 2016. "Who Needs Credit and who Gets Credit? Evidence from the Surveys of Small Business Finances." *Journal of Financial Stability* 24: 40–60. https://doi.org/10.1016/j.jfs.2016.04.002.

Colombo, M. G., and L. Grilli. 2007. "Funding Gaps? Access to Bank Loans by High-Tech Start-ups." *Small Business Economics* 29 (1): 25–46. https://doi.org/10.1007/s11187-005-4067-0.

Cowling, M. 2010. "The Role of Loan Guarantee Schemes in Alleviating Credit Rationing in the UK." *Journal of Financial Stability* 6 (1): 36–44. https://doi.org/10.1016/j.jfs.2009.05.007.

Cowling, M., R. Brown, and A. Rocha. 2020. "Did you Save Some Cash for a Rainy COVID-19 d? The Crisis and SMEs." *International Small Business Journal: Researching Entrepreneurship* 38 (7): 593–604. https://doi.org/10.1177/0266242620945102.

Cowling, M., W. Liu, and R. Calabrese. 2022. "Has Previous Loan Rejection Scarred Firms from Applying for Loans During Covid-19?" *Small Business Economics* 59 (4): 1327–1350. https://doi.org/10.1007/s11187-021-00586-2.

Cowling, M., W. Liu, and A. Ledger. 2012. "Small Business Financing in the UK Before and During the Current Financial Crisis." *International Small Business Journal: Researching Entrepreneurship* 30 (7): 778–800. https://doi.org/10.1177/0266242611435516.

Cowling, M., W. Liu, M. Minniti, and N. Zhang. 2016. "UK Credit and Discouragement During the GFC." *Small Business Economics* 47 (4): 1049–1074. https://doi.org/10.1007/s11187-016-9745-6.

Cowling, M., W. Liu, and N. Zhang. 2021. "In the Post-Crisis World, did Debt and Equity Markets Respond Differently to High-Tech Industries and Innovative Firms?" *International Small Business Journal: Researching Entrepreneurship* 39 (3): 247–288. https://doi.org/10.1177/0266242620947281.

Cowling, M., and P. Mitchell. 2003. "Is the Small Firms Loan Guarantee Scheme Hazardous for Banks or Helpful to Small Business?" *Small Business Economics* 21 (1): 63–71. https://doi.org/10.1023/A:1024408932156.

Cowling, M., P. Nightingale, and N. Wilson. 2023. "COVID-19 Lending Support and Regional Levelling up: Evidence from UK Loan Guarantee Schemes." *Regional Studies* 57 (11): 1–16.

Cowling, M., and J. Siepel. 2013. "Public Intervention in UK Small Firm Credit Markets: Value-for-Money or Waste of Scarce Resources?" *Technovation* 33 (8): 265–275. https://doi.org/10.1016/j.technovation.2012.11.002.

Cowling, M., E. Ughetto, and N. Lee. 2018. "The Innovation Debt Penalty: Cost of Debt, Loan Default, and the Effects of a Public Loan Guarantee on High-Tech Firms." *Technological Forecasting and Social Change* 127: 166–176. https://doi.org/10.1016/j.techfore.2017.06.016.

Cowling, M., N. Wilson, P. Nightingale, and M. Kacer. 2022. "Predicting Future Default on the Covid-19 Bounce Back Loan Scheme: The £46.5 Billion Question." *International Small Business Journal: Researching Entrepreneurship* 40 (5): 650–666. https://doi.org/10.1177/02662426211058050.

Cressy, R. 2002. "Introduction: Funding Gaps: A Symposium." *Economic Journal* 112 (477): F1–F16.

de Bettignies, J.-E., and J. A. Brander. 2007. "Financing Entrepreneurship: Bank Finance Versus Venture Capital." *Journal of Business Venturing* 22 (6): 808–832. https://doi.org/10.1016/j.jbusvent.2006.07.005.

de Meza, D., and C. Southey. 1996. "The Borrower's Curse: Optimism, Finance and Entrepreneurship." *The Economic Journal* 106 (435): 375–386. https://doi.org/10.2307/2235253.

Diamond, D. W. 1984. "Financial Intermediation and Delegated Monitoring." *The Review of Economic Studies* 51 (3): 393–414. https://doi.org/10.2307/2297430.

Dinlersoz, E., S. Kalemli-Ozcan, H. Hyatt, and V. Penciakova. 2018. *Leverage Over the Life Cycle and Implications for Firm Growth and Shock Responsiveness* (No. w25226). National Bureau of Economic Research.

Dörr, J. O., G. Licht, and S. Murmann. 2022. "Small Firms and the COVID-19 Insolvency Gap." *Small Business Economics* 58 (2): 887–917. https://doi.org/10.1007/s11187-021-00514-4.

Emel, A. B., M. Oral, A. Reisman, and R. Yolalan. 2003. "A Credit Scoring Approach for the Commercial Banking Sector." *Socio-Economic Planning Sciences* 37 (2): 103–123. https://doi.org/10.1016/S0038-0121(02)00044-7.

Fraser, S. 2009. "Is There Ethnic Discrimination in the UK Market for Small Business Credit?" *International Small Business Journal: Researching Entrepreneurship* 27 (5): 583–607. https://doi.org/10.1177/0266242609338756.

Fraser, S. 2014. *Back to Borrowing? Perspectives on the arc of Discouragement*. Enterprise Research Centre: ERC White Paper. Warwick Business School.

Freel, M. S. 2007. "Are Small Innovators Credit Rationed?." *Small Business Economics* 28 (1): 23–35. https://www.jstor.org/stable/40229516.

Freeman, C., J. Clark, and L. Soete. 1982. *Unemployment and Technical Innovation*. London: Frances Pinter.

Giudici, G., and S. Paleari. 2000. "The Provision of Finance to Innovation: A Survey Conducted among Italian Technology-Based Small Firms." *Small Business Economics* 14 (1): 37–53. https://doi.org/10.1023/A:1008187416389.

Greenhalgh, C., and M. Rogers. 2006. "The Value of Innovation: The Interaction of Competition, R&D and IP." *Research Policy* 35 (4): 562–580. https://doi.org/10.1016/j.respol.2006.02.002.

Greenhalgh, C., and M. Rogers. 2010. *Innovation, Intellectual Property, and Economic Growth*. Princeton: Princeton University Press.

Hall, T. W. 2012. "The Collateral Channel: Evidence on Leverage and Asset Tangibility." *Journal of Corporate Finance* 18 (3): 570–583. https://doi.org/10.1016/j.jcorpfin.2011.12.003.

Haltiwanger, J., R. S. Jarmin, and J. Miranda. 2013. "Who Creates Jobs? Small Versus Large Versus Young." *Review of Economics and Statistics* 95 (2): 347–361. https://doi.org/10.1162/REST_a_00288.

Han, L., S. Fraser, and D. J. Storey. 2009. "Are Good or Bad Borrowers Discouraged from Applying for Loans? Evidence from US Small Business Credit Markets." *Journal of Banking & Finance* 33 (2): 415–424. https://doi.org/10.1016/j.jbankfin.2008.08.014.

Hottenrott, H., and B. Peters. 2012. "Innovative Capability and Financing Constraints for Innovation: More Money, More Innovation?" *Review of Economics and Statistics* 94 (4): 1126–1142. https://doi.org/10.1162/REST_a_00227.

Hsu, P., H. Lee, A. Z. Liu, and Z. Zhang. 2015. "Corporate Innovation, Default Risk, and Bond Pricing." *Journal of Corporate Finance* 35: 329–344. https://doi.org/10.1016/j.jcorpfin.2015.09.005.

Hutton, W., and P. Nightingale. 2011. *The Discouraged Economy*. London: The Work Foundation.

Jia, N. 2018. "Corporate Innovation Strategy and Stock Price Crash Risk." *Journal of Corporate Finance* 53: 155–173. https://doi.org/10.1016/j.jcorpfin.2018.10.006.

Kon, Y., and D. J. Storey. 2003. "A Theory of Discouraged Borrowers." *Small Business Economics* 21 (1): 37–49. https://doi.org/10.1023/A:1024447603600.

Lee, N., H. Sameen, and M. Cowling. 2015. "Access to Finance for Innovative SMEs Since the Financial Crisis." *Research Policy* 44 (2): 370–380. https://doi.org/10.1016/j.respol.2014.09.008.

Magri, S. 2009. "The Financing of Small Innovative Firms: The Italian Case." *Economics of Innovation and New Technology* 18 (2): 181–204. https://doi.org/10.1080/10438590701738016.

Mina, A., H. Lahr, and A. Hughes. 2013. "The Demand and Supply of External Finance for Innovative Firms." *Industrial and Corporate Change* 22 (4): 869–901. https://doi.org/10.1093/icc/dtt020.

Myers, S. C. 1984. "The Capital Structure Puzzle." *The Journal of Finance* 39 (3): 574–592. https://doi.org/10.1111/j.1540-6261.1984.tb03646.x.

Myers, S. C., and N. S. Majluf. 1984. "Corporate Financing and Investment Decisions When Firms Have Information That Investors do not Have." National Bureau of Economic Research Working Paper 1396.

Nanda, R., and M. Rhodes-Kropf. 2017. "Financing Risk and Innovation." *Management Science* 63 (4): 901–918. https://doi.org/10.1287/mnsc.2015.2350.

Nelson, A., A. Earle, J. Howard-Grenville, J. Haack, and D. Young. 2014. "Do Innovation Measures Actually Measure Innovation? Obliteration, Symbolic Adoption, and Other Finicky Challenges in Tracking Innovation Diffusion." *Research Policy* 43 (6): 927–940. https://doi.org/10.1016/j.respol.2014.01.010.

North, D., R. Baldock, and F. Ullah. 2013. "Funding the growth of UK technology-based small firms since the financial crash: are there breakages in the finance escalator?." *Venture Capital* 15 (3): 237–260. https://doi.org/10.1080/13691066.2013.804755.

Orgler, Y. E. 1970. "A Credit Scoring Model for Commercial Loans." *Journal of Money, Credit and Banking* 2 (4): 435–445. https://doi.org/10.2307/1991095.

Petersen, M. A., and R. G. Rajan. 1994. "The Benefits of Lending Relationships: Evidence from Small Business Data." *The Journal of Finance* 49 (1): 3–37. https://doi.org/10.1111/j.1540-6261.1994.tb04418.x.

Polzin, F., M. Sanders, and U. Stavlöt. 2018. "Do Investors and Entrepreneurs Match? – Evidence from The Netherlands and Sweden." *Technological Forecasting and Social Change* 127: 112–126. https://doi.org/10.1016/j.techfore.2017.07.016.

Revest, V., and A. Sapio. 2012. "Financing Technology-Based Small Firms in Europe: What Do We Know?" *Small Business Economics* 39 (1): 179–205. https://doi.org/10.1007/s11187-010-9291-6.

Riding, A. 1997. "On the Care and Nurture of Loan Guarantee Programs." In *Financing Growth in Canada*, edited by P. Halpern. Calgary: University of Calgary Press.

Rogers, E. M. 2003. *Diffusion of Innovations*. 5th ed. Simon and Schuster.

Savignac, F. 2008. "Impact of Financial Constraints on Innovation: What Can be Learned from a Direct Measure?" *Economics of Innovation and New Technology*. 17 (6): 553–569. https://doi.org/10.1080/10438590701538432.

Schmookler, J. 1966. *Invention and Economic Growth*. Cambridge, MA: Harvard University Press.

Schneider, C., and R. Veugelers. 2010. "On Young Highly Innovative Companies: Why They Matter and How (Not) to Policy Support Them." *Industrial and Corporate Change* 19 (4): 969–1007. https://doi.org/10.1093/icc/dtp052.

Schumpeter, J. A. 1939. *Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process*. New York: McGraw-Hill.

BDRC Continental. 2020. *SME Finance Monitor. London: BDRC Continental*.

Stiglitz, J. E. 1993. "Endogenous Growth and Cycles." National Bureau of Economic Research Working Paper Series 4286.

Stiglitz, J. E., and A. Weiss. 1981. "Credit Rationing in Markets with Imperfect Information." *American Economic Review* 71 (3): 393–410.

van de Ven, W. P. M. M., and B. M. S. van Praag. 1981. "The Demand for Deductibles in Private Health Insurance: A Probit Model with Sample Selection." *Journal of Econometrics* 17 (2): 229–252. https://doi.org/10.1016/0304-4076(81)90028-2.

Yang, X., X. Gu, and X. Yang. 2021. "Firm age and Loan Financing with Patents as Collateral of Chinese Startups: The Roles of Innovations and Experience." *Economics of Innovation and New Technology* 32 (3): 1–27.

Zoller-Rydzek, B., and F. Keller. 2020. "COVID-19: Guaranteed Loans and Zombie Firms." *CESifo Economic Studies* 66 (4): 322–364. https://doi.org/10.1093/cesifo/ifaa014.

Appendix

Table A1. Probit regression results: Finance applications and outcomes.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	Sought Loan			Got Loan Offer			Got Government Backed Loan Offer		
Covid-19-Severity-Index (CSI)	0.021***	0.021***	0.021***	−0.005*	−0.004	−0.005	−0.001	−0.0004	−0.002
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Innovation (No Innovation)									
IP, no new product service		0.044*	0.043*		−0.042	−0.057		−0.050	−0.055
		(0.024)	(0.023)		(0.036)	(0.040)		(0.038)	(0.041)
New product service, no IP		0.009	0.009		−0.049**	−0.049**		−0.036*	−0.038*
		(0.013)	(0.013)		(0.021)	(0.021)		(0.021)	(0.021)
IP, new product service		0.066***	0.065***		−0.052	−0.051		−0.067*	−0.060*
		(0.023)	(0.022)		(0.033)	(0.033)		(0.034)	(0.032)
Interaction (CSI*No Innovation)									
CSI*(IP, no new product service)			0.050			0.165**			0.066
			(0.030)			(0.082)			(0.103)
CSI*(new product service, no IP)			0.010			0.010			0.085
			(0.018)			(0.056)			(0.058)
CSI*(IP, new product service)			0.045			−0.008			−0.162
			(0.029)			(0.093)			(0.117)
Survey Wave (Q2 2020)									
Q3 2020	0.034***	0.035***	0.035***	0.030*	0.032**	0.033**	0.032**	0.036**	0.035**
	(0.010)	(0.010)	(0.010)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
Region (Scotland)									
North East	−0.035	−0.034	−0.033	−0.011	−0.010	−0.013	0.034	0.033	0.033
	(0.025)	(0.025)	(0.025)	(0.039)	(0.040)	(0.040)	(0.034)	(0.035)	(0.034)
York & Humber	−0.015	−0.015	−0.015	−0.048	−0.047	−0.050	0.002	−0.001	−0.004
	(0.023)	(0.023)	(0.023)	(0.036)	(0.036)	(0.036)	(0.035)	(0.036)	(0.036)
North West	−0.012	−0.012	−0.012	0.040	0.043	0.042*	0.026	0.028	0.025
	(0.023)	(0.023)	(0.023)	(0.026)	(0.026)	(0.026)	(0.031)	(0.031)	(0.031)
West Midlands	−0.010	−0.010	−0.010	−0.025	−0.024	−0.027	0.039	0.039	0.036
	(0.023)	(0.023)	(0.023)	(0.033)	(0.033)	(0.033)	(0.030)	(0.030)	(0.030)
East Midlands	0.010	0.011	0.010	0.013	0.017	0.015	0.061**	0.062**	0.060**
	(0.024)	(0.024)	(0.024)	(0.029)	(0.029)	(0.029)	(0.027)	(0.027)	(0.026)
East England	−0.044*	−0.044**	−0.044**	−0.006	−0.007	−0.009	−0.003	−0.004	−0.009
	(0.022)	(0.022)	(0.022)	(0.034)	(0.034)	(0.034)	(0.037)	(0.038)	(0.038)
Wales	0.015	0.015	0.015	0.003	0.006	0.004	0.018	0.021	0.022
	(0.025)	(0.025)	(0.025)	(0.033)	(0.033)	(0.032)	(0.035)	(0.034)	(0.033)
South West	−0.016	−0.018	−0.018	0.002	0.008	0.008	−0.008	0.001	−0.004
	(0.023)	(0.022)	(0.022)	(0.031)	(0.031)	(0.030)	(0.035)	(0.034)	(0.034)
London	−0.004	−0.005	−0.005	−0.011	−0.010	−0.009	0.037	0.039	0.039

(*Continued*)

Appendix

Table A1. Continued.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	Sought Loan			Got Loan Offer			Got Government Backed Loan Offer		
	(0.021)	(0.021)	(0.021)	(0.029)	(0.029)	(0.029)	(0.028)	(0.028)	(0.027)
South East	−0.033	−0.034	−0.034	−0.028	−0.025	−0.028	−0.023	−0.023	−0.026
	(0.021)	(0.021)	(0.021)	(0.032)	(0.032)	(0.032)	(0.036)	(0.036)	(0.035)
N.Ireland	0.015	0.016	0.017	0.005	0.005	0.004	−0.003	−0.007	−0.009
	(0.027)	(0.027)	(0.027)	(0.035)	(0.035)	(0.035)	(0.040)	(0.041)	(0.040)
Risk Rating (Minimal)									
Low	0.071***	0.072***	0.072***	0.046*	0.044*	0.044*	0.083***	0.085***	0.088***
	(0.013)	(0.013)	(0.013)	(0.026)	(0.026)	(0.026)	(0.030)	(0.030)	(0.030)
Average	0.094***	0.093***	0.093***	0.019	0.018	0.018	0.081***	0.083***	0.085***
	(0.014)	(0.014)	(0.014)	(0.028)	(0.027)	(0.027)	(0.031)	(0.031)	(0.031)
Above Average	0.069***	0.068***	0.068***	0.049*	0.046	0.049*	0.065*	0.066*	0.070*
	(0.017)	(0.017)	(0.017)	(0.029)	(0.029)	(0.029)	(0.036)	(0.036)	(0.036)
Not Known	0.071***	0.070***	0.069***	0.023	0.021	0.026	0.096***	0.096***	0.098***
	(0.021)	(0.021)	(0.021)	(0.037)	(0.037)	(0.036)	(0.036)	(0.036)	(0.037)
Employment Size (One)									
2–10	0.057***	0.056***	0.056***	−0.001	0.006	0.004	0.046	0.049	0.050
	(0.015)	(0.015)	(0.015)	(0.027)	(0.028)	(0.028)	(0.030)	(0.031)	(0.031)
11–50	0.104***	0.102***	0.103***	0.025	0.032	0.033	0.027	0.033	0.034
	(0.018)	(0.018)	(0.018)	(0.029)	(0.030)	(0.030)	(0.034)	(0.035)	(0.035)
51–250	0.066***	0.061***	0.062***	0.027	0.035	0.032	−0.001	0.008	0.007
	(0.019)	(0.019)	(0.019)	(0.032)	(0.033)	(0.033)	(0.039)	(0.039)	(0.040)
Industry (Agriculture)									
Manufacturing	−0.026	−0.033	−0.032	−0.049	−0.036	−0.038	−0.018	−0.006	−0.006
	(0.025)	(0.025)	(0.025)	(0.043)	(0.042)	(0.041)	(0.039)	(0.038)	(0.038)
Construction	0.015	0.017	0.017	−0.011	−0.013	−0.013	0.013	0.010	0.010
	(0.023)	(0.023)	(0.023)	(0.032)	(0.033)	(0.033)	(0.029)	(0.030)	(0.030)
Wholesale/retail	−0.005	−0.007	−0.008	−0.0002	0.004	0.004	−0.013	−0.007	−0.008
	(0.024)	(0.024)	(0.024)	(0.034)	(0.034)	(0.034)	(0.034)	(0.033)	(0.034)
Hotels & catering	0.012	0.013	0.014	0.021	0.023	0.023	−0.004	−0.008	−0.010
	(0.027)	(0.027)	(0.027)	(0.033)	(0.034)	(0.033)	(0.034)	(0.035)	(0.035)
Transport & Comms	−0.006	−0.006	−0.006	−0.041	−0.041	−0.043	−0.009	−0.009	−0.008
	(0.024)	(0.024)	(0.024)	(0.036)	(0.037)	(0.037)	(0.033)	(0.033)	(0.033)
Real Estate	−0.027	−0.031	−0.031	0.002	0.009	0.008	0.007	0.013	0.015
	(0.022)	(0.022)	(0.022)	(0.032)	(0.032)	(0.032)	(0.029)	(0.029)	(0.029)
Health	−0.078***	−0.079***	−0.080***	−0.021	−0.021	−0.022	−0.001	−0.001	0.005
	(0.025)	(0.025)	(0.025)	(0.043)	(0.044)	(0.044)	(0.040)	(0.041)	(0.039)
Other services	−0.007	−0.008	−0.007	−0.000	0.005	0.004	0.023	0.025	0.024
	(0.024)	(0.024)	(0.024)	(0.032)	(0.033)	(0.034)	(0.029)	(0.030)	(0.030)
Legal (Sole Proprietor)									

Partnership	0.051**	0.052**	0.052**	0.076***	0.079***	0.081***	−0.022	−0.025	−0.026
	(0.023)	(0.023)	(0.023)	(0.029)	(0.030)	(0.030)	(0.038)	(0.039)	(0.039)
LLP&LLC	0.079***	0.077***	0.077***	0.027	0.032	0.034	0.002	0.006	0.006
	(0.014)	(0.014)	(0.014)	(0.027)	(0.028)	(0.028)	(0.024)	(0.025)	(0.025)
Firm Age (<1 year)									
1–2 years	0.060*	0.060*	0.061*	0.036	0.041	0.045	−0.025	−0.017	−0.016
	(0.032)	(0.032)	(0.032)	(0.058)	(0.058)	(0.059)	(0.048)	(0.049)	(0.048)
2–5 years	0.086***	0.083***	0.083***	0.018	0.029	0.033	0.009	0.015	0.016
	(0.031)	(0.031)	(0.031)	(0.058)	(0.058)	(0.059)	(0.044)	(0.045)	(0.044)
6–9 years	0.050	0.049	0.049	0.022	0.027	0.032	−0.021	−0.015	−0.016
	(0.031)	(0.031)	(0.031)	(0.058)	(0.058)	(0.060)	(0.048)	(0.049)	(0.048)
10–15 years	0.026	0.026	0.027	0.059	0.061	0.065	−0.007	−0.007	−0.010
	(0.029)	(0.029)	(0.029)	(0.055)	(0.056)	(0.057)	(0.045)	(0.046)	(0.046)
>15 years	0.014	0.013	0.013	0.039	0.042	0.044	−0.024	−0.021	−0.023
	(0.028)	(0.028)	(0.028)	(0.055)	(0.056)	(0.057)	(0.044)	(0.045)	(0.044)
Obs	7718	7718	7718	1437	1437	1437	1290	1290	1290
Pseudo R^2	0.074	0.077	0.078	0.081	0.098	0.104	0.102	0.121	0.131
Log-Likelihood	−3973.781	−3967.619	−3965.035	−344.338	−339.452	−337.407	−274.921	−270.302	−267.585
Wald χ^2	134.353***	146.677***	151.844***	2.998*	12.771**	16.861**	0.216	9.4531*	14.887**

Marginal effects reported with robust standard errors in parentheses, except for the interactions between CSI and innovation classifications where coefficients estimates are reported. Reference category is given in parentheses. Significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table A2. Probit regression results, with sample selection: Discouraged borrowers, population weighted.

Variables	(1) Selection	(2) Outcome	(3) Selection	(4) Outcome	(5) Selection	(6) Outcome
Covid-19-Severity-Index (CSI)	0.009***	−0.015	0.009***	−0.013	0.009***	−0.014
	(0.002)	(0.023)	(0.002)	(0.031)	(0.002)	(0.026)
Innovation (No Innovation)						
IP, no new product service			−0.015	−0.118	−0.013	−0.082
			(0.016)	(0.178)	(0.017)	(0.129)
New product service, no IP			0.018	0.124*	0.019	0.135*
			(0.014)	(0.069)	(0.014)	(0.081)
IP, new product service			0.132***	−0.075	0.130***	−0.089
			(0.039)	(0.133)	(0.038)	(0.128)
Interaction (CSI*No Innovation)						
CSI*(IP, no new product service)					−0.039	−0.114*
					(0.054)	(0.100)
CSI*(new product service, no IP)					0.020	−0.033
					(0.034)	(0.051)
CSI*(IP, new product service)					0.027	0.070
					(0.052)	(0.156)
Survey Wave (Q2 2020)						
Q3 2020	0.062***	−0.108	0.061***	−0.095	0.061***	−0.097
	(0.010)	(0.067)	(0.010)	(0.063)	(0.010)	(0.079)
Region (Scotland)						
North East	0.006	0.298	0.007	0.275*	0.007	0.269*
	(0.027)	(0.198)	(0.276)	(0.143)	(0.028)	(0.156)
York & Humber	0.027	0.246*	0.028	0.203	0.030	0.179
	(0.026)	(0.147)	(0.025)	(0.178)	(0.026)	(0.160)
North West	−0.003	0.025	−0.002	−0.011	−0.002	0.001
	(0.022)	(0.172)	(0.022)	(0.177)	(0.022)	(0.182)
West Midlands	0.020	0.009	0.019	0.016	0.019	−0.0003
	(0.023)	(0.152)	(0.023)	(0.160)	(0.023)	(0.161)
East Midlands	0.001	0.142	0.003	0.116	0.002	0.130
	(0.023)	(0.188)	(0.023)	(0.184)	(0.023)	(0.189)
East England	−0.008	0.293*	−0.009	0.309**	−0.009	0.283*
	(0.022)	(0.151)	(0.022)	(0.154)	(0.022)	(0.171)
Wales	−0.021	0.040	−0.020	0.039	−0.019	0.031
	(0.019)	(0.166)	(0.020)	(0.170)	(0.019)	(0.169)
South West	0.005	0.425**	0.0003	0.480***	0.001	0.457***
	(0.022)	(0.181)	(0.022)	(0.138)	(0.022)	(0.148)
London	0.013	0.062	0.011	0.041	0.011	0.0543
	(0.021)	(0.153)	(0.021)	(0.151)	(0.021)	(0.155)
South East	−0.003	0.329**	−0.005	0.308**	−0.005	0.284*
	(0.021)	(0.139)	(0.020)	(0.133)	(0.020)	(0.150)
N.Ireland	0.021	0.129	0.023	0.119	0.024	0.112
	(0.030)	(0.191)	(0.031)	(0.188)	(0.031)	(0.197)
Risk Rating (Minimal)						
Low	0.022*	0.105	0.022*	0.0209	0.022*	−0.019
	(0.013)	(0.136)	(0.013)	(0.112)	(0.012)	(0.152)
Average	0.041***	0.213**	0.041***	0.167	0.041***	0.140
	(0.013)	(0.096)	(0.013)	(0.119)	(0.013)	(0.126)
Above Average	0.031***	0.111	0.032***	0.0796	0.032***	0.053
	(0.012)	(0.091)	(0.012)	(0.102)	(0.012)	(0.113)
Not Known	0.040**	0.091	0.041**	0.0940	0.042**	0.023
	(0.018)	(0.133)	(0.017)	(0.145)	(0.017)	(0.145)
Employment Size (One)						
2–10	0.043***	−0.140**	0.039**	−0.172**	0.040***	−0.173**
	(0.015)	(0.069)	(0.015)	(0.072)	(0.015)	(0.073)
11–50	0.009	−0.013	0.009	−0.054	0.009	−0.065
	(0.010)	(0.063)	(0.010)	(0.070)	(0.010)	(0.080)
51–250	0.045**	−0.094	0.034*	−0.055	0.036**	−0.084
	(0.018)	(0.095)	(0.018)	(0.112)	(0.018)	(0.097)
Industry (Agriculture)						
Manufacturing	−0.047	0.179	−0.051*	0.131	−0.051*	0.110

(*Continued*)

Table A2. Continued.

Variables	(1) Selection	(2) Outcome	(3) Selection	(4) Outcome	(5) Selection	(6) Outcome
	(0.030)	(0.126)	(0.030)	(0.120)	(0.030)	(0.135)
Construction	−0.079***	−0.139	−0.077***	−0.128	−0.076***	−0.145
	(0.027)	(0.145)	(0.027)	(0.133)	(0.027)	(0.143)
Wholesale/retail	−0.062**	−0.210	−0.065**	−0.220**	−0.064**	−0.220
	(0.027)	(0.155)	(0.027)	(0.106)	(0.027)	(0.155)
Hotels & catering	−0.078***	0.018	−0.077***	0.029	−0.076***	0.026
	(0.027)	(0.165)	(0.027)	(0.152)	(0.027)	(0.163)
Transport & Comms	−0.021	0.019	−0.023	0.0187	−0.022	−0.011
	(0.031)	(0.140)	(0.031)	(0.125)	(0.031)	(0.135)
Real Estate	−0.066***	−0.080	−0.070***	−0.055	−0.069***	−0.085
	(0.026)	(0.120)	(0.026)	(0.120)	(0.026)	(0.130)
Health	−0.076***	0.142	−0.082***	0.139	−0.081***	0.134
	(0.028)	(0.170)	(0.028)	(0.142)	(0.027)	(0.168)
Other services	−0.056**	0.082	−0.058**	0.0886	−0.057**	0.063
	(0.029)	(0.158)	(0.029)	(0.116)	(0.028)	(0.131)
Legal (Sole Proprietor)						
Partnership	0.019**		0.017*		0.016*	
	(0.009)		(0.009)		(0.009)	
LLP&LLC	0.013		0.014		0.015	
	(0.020)		(0.020)		(0.020)	
Firm Age (<1 year)						
1–2 years	−0.016	−0.248	−0.016	−0.218	−0.016	−0.217
	(0.026)	(0.193)	(0.026)	(0.188)	(0.026)	(0.186)
2–5 years	0.0004	0.112	−0.004	0.126	−0.004	0.139
	(0.026)	(0.167)	(0.026)	(0.151)	(0.026)	(0.166)
6–9 years	0.003	−0.165	−0.002	−0.148	−0.0005	−0.124
	(0.028)	(0.177)	(0.027)	(0.169)	(0.027)	(0.171)
10–15 years	−0.025	−0.092	−0.028	−0.033	−0.028	−0.016
	(0.025)	(0.167)	(0.025)	(0.165)	(0.024)	(0.156)
>15 years	−0.038*	−0.107	−0.038*	−0.051	−0.038*	−0.046
	(0.023)	(0.159)	(0.023)	(0.165)	(0.023)	(0.160)
Atanh ρ	12.514***		15.123***		13.516***	
	(0.013)		(0.138)		(0.279)	
Obs: Selected	744		744		744	
Obs: Nonselected	8057		8057		8057	
Log-Likelihood	−283.593		−279.109		−278.603	
Wald χ^2 of indep. Eqns. ($\rho = 0$)	9.4e+05***		11977.940***		2347.370***	

Marginal effects reported with robust standard errors in parentheses, except for interactions between CSI and innovation classifications where coefficients estimates are reported. The selection equation relates to the probability of needing finance. The outcome equation relates to the probability of being a discouraged borrower conditional on needing finance. The exclusion restriction used in the selection equation is legal status. Besides the control variables, Models 1 and 2 include CSI as one of the independent variables, models 3 and 4 further add the 4-way innovation classification as the independent variables, and finally the above two kinds of variables and their interaction terms are all included in models 5 and 6. Reference category is given in parentheses. Significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table A3. Multinominal probit regression results: Finance applications, population weighted.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	Not applying	Normal loans	Government-backed loans	Not applying	Normal loans	Government-backed loans	Not applying	Normal loans	Government-backed loans
Covid-19-Severity-Index (CSI)	−0.019***	0.005***	0.014***	−0.018***	0.004***	0.014***	−0.019***	0.005***	0.015***
	(0.003)	(0.001)	(0.003)	(0.003)	(0.001)	(0.003)	(0.003)	(0.001)	(0.003)
Innovation (No Innovation)									
IP, no new product service				−0.017	0.047*	−0.0305	−0.014	0.045*	−0.031
				(0.037)	(0.028)	(0.0242)	(0.035)	(0.027)	(0.023)
New product service, no IP				−0.009	0.021*	−0.0120	−0.008	0.020*	−0.012
				(0.020)	(0.011)	(0.0175)	(0.020)	(0.011)	(0.018)
IP, new product service				−0.086**	−0.010	0.0966**	−0.083*	−0.010	0.093**
				(0.044)	(0.008)	(0.0429)	(0.042)	(0.008)	(0.042)
Interaction (CSI*No Innovation)									
CSI*(IP, no new product service)								0.108	0.033
								(0.090)	(0.070)
CSI*(new product service, no IP)								−0.009	0.048
								(0.063)	(0.049)
CSI*(IP, new product service)								0.136	0.100
								(0.136)	(0.076)
Survey Wave (Q2 2020)									
Q3 2020	−0.057***	−0.018**	0.076***	−0.058***	−0.018***	0.076***	−0.059***	−0.018***	0.076***
	(0.015)	(0.007)	(0.014)	(0.015)	(0.007)	(0.014)	(0.015)	(0.007)	(0.014)
Region (Scotland)									
North East	0.021	0.039	−0.060*	0.018	0.040	−0.058	0.018	0.039	−0.058
	(0.044)	(0.028)	(0.036)	(0.044)	(0.029)	(0.036)	(0.044)	(0.028)	(0.036)
York & Humber	0.014	−0.002	−0.012	0.013	−0.004	−0.009	0.012	−0.004	−0.008
	(0.039)	(0.017)	(0.036)	(0.038)	(0.016)	(0.036)	(0.038)	(0.016)	(0.036)
North West	0.012	−0.004	−0.007	0.011	−0.003	−0.007	0.010	−0.004	−0.007
	(0.039)	(0.017)	(0.037)	(0.039)	(0.017)	(0.036)	(0.039)	(0.017)	(0.036)
West Midlands	−0.005	−0.007	0.012	−0.005	−0.007	0.012	−0.006	−0.007	0.012
	(0.039)	(0.017)	(0.037)	(0.039)	(0.016)	(0.037)	(0.039)	(0.017)	(0.037)
East Midlands	−0.010	−0.013	0.023	−0.013	−0.012	0.024	−0.012	−0.012	0.023
	(0.040)	(0.015)	(0.038)	(0.040)	(0.016)	(0.037)	(0.039)	(0.016)	(0.037)
East England	0.094***	−0.005	−0.088***	0.093***	−0.006	−0.088***	0.093***	−0.006	−0.087***
	(0.034)	(0.016)	(0.031)	(0.034)	(0.016)	(0.031)	(0.034)	(0.016)	(0.031)
Wales	0.023	0.003	−0.026	0.020	0.004	−0.024	0.019	0.003	−0.022
	(0.041)	(0.019)	(0.038)	(0.041)	(0.019)	(0.038)	(0.041)	(0.019)	(0.038)
South West	0.052	−0.008	−0.044	0.053	−0.009	−0.044	0.053	−0.009	−0.044
	(0.037)	(0.016)	(0.035)	(0.037)	(0.015)	(0.034)	(0.036)	(0.015)	(0.034)

London	0.049	−0.010	−0.039	0.050	−0.011	−0.039	0.050	−0.011	−0.039
	(0.035)	(0.015)	(0.032)	(0.034)	(0.015)	(0.032)	(0.034)	(0.015)	(0.032)
South East	0.027	0.002	−0.029	0.028	0.003	−0.031	0.027	0.003	−0.030
	(0.036)	(0.016)	(0.034)	(0.036)	(0.016)	(0.033)	(0.036)	(0.016)	(0.033)
N.Ireland	0.021	0.010	−0.031	0.020	0.010	−0.030	0.019	0.011	−0.029
	(0.044)	(0.019)	(0.041)	(0.044)	(0.019)	(0.041)	(0.044)	(0.019)	(0.040)
Risk Rating (Minimal)									
Low	−0.012	−0.022	0.033	−0.014	−0.020	0.034	−0.013	−0.020	0.033
	(0.030)	(0.017)	(0.026)	(0.029)	(0.014)	(0.026)	(0.029)	(0.014)	(0.026)
Average	0.006	−0.013	0.007	0.005	−0.011	0.006	0.005	−0.011	0.005
	(0.029)	(0.018)	(0.024)	(0.028)	(0.015)	(0.024)	(0.028)	(0.015)	(0.024)
Above Average	0.007	−0.013	0.006	0.005	−0.010	0.0049	0.005	−0.010	0.005
	(0.030)	(0.019)	(0.025)	(0.030)	(0.016)	(0.025)	(0.030)	(0.016)	(0.025)
Not Known	−0.025	−0.027	0.052	−0.026	−0.023	0.050	−0.026	−0.023	0.049
	(0.037)	(0.018)	(0.033)	(0.036)	(0.016)	(0.033)	(0.036)	(0.016)	(0.033)
Employment Size (One)									
2−10	−0.104***	0.014	0.090***	−0.103***	0.014	0.089***	−0.104***	0.014	0.090***
	(0.025)	(0.012)	(0.023)	(0.025)	(0.011)	(0.023)	(0.025)	(0.011)	(0.023)
11−50	−0.065***	0.009	0.056***	−0.065***	0.009	0.057***	−0.066***	0.009	0.057***
	(0.018)	(0.008)	(0.016)	(0.018)	(0.008)	(0.016)	(0.018)	(0.008)	(0.016)
51−250	−0.066**	0.013	0.053**	−0.062**	0.014	0.048**	−0.064**	0.014	0.050**
	(0.027)	(0.013)	(0.024)	(0.026)	(0.012)	(0.024)	(0.026)	(0.013)	(0.024)
Industry (Agriculture)									
Manufacturing	0.027	0.007	−0.034	0.031	0.006	−0.037	0.031	0.006	−0.038
	(0.036)	(0.018)	(0.032)	(0.036)	(0.018)	(0.032)	(0.036)	(0.018)	(0.032)
Construction	−0.000	−0.001	0.001	−0.002	−0.0005	0.003	−0.002	−0.0005	0.002
	(0.034)	(0.016)	(0.031)	(0.034)	(0.015)	(0.031)	(0.034)	(0.015)	(0.031)
Wholesale/retail	−0.023	−0.0002	0.023	−0.022	−0.0005	0.023	−0.021	−0.0004	0.022
	(0.035)	(0.016)	(0.032)	(0.035)	(0.016)	(0.032)	(0.035)	(0.016)	(0.032)
Hotels & catering	−0.006	−0.010	0.016	−0.008	−0.010	0.019	−0.008	−0.010	0.018
	(0.034)	(0.015)	(0.032)	(0.034)	(0.015)	(0.032)	(0.034)	(0.015)	(0.032)
Transport & Comms	−0.040	−0.012	0.051	−0.040	−0.010	0.049	−0.040	−0.010	0.049
	(0.037)	(0.015)	(0.035)	(0.037)	(0.015)	(0.035)	(0.037)	(0.015)	(0.035)
Real Estate	0.005	−0.006	0.0006	0.007	−0.007	0.0004	0.008	−0.008	−0.0002
	(0.032)	(0.014)	(0.030)	(0.032)	(0.014)	(0.029)	(0.032)	(0.014)	(0.029)
Health	0.058	−0.010	−0.047	0.060*	−0.012	−0.048	0.060*	−0.011	−0.049
	(0.035)	(0.017)	(0.032)	(0.035)	(0.016)	(0.032)	(0.035)	(0.016)	(0.032)
Other services	0.019	0.009	−0.028	0.019	0.008	−0.027	0.018	0.009	−0.026
	(0.035)	(0.018)	(0.031)	(0.035)	(0.018)	(0.031)	(0.035)	(0.018)	(0.031)
Legal (Sole Proprietor)									
Partnership	−0.066***	0.018*	0.048***	−0.063***	0.017*	0.047***	−0.065***	0.017*	0.047***
	(0.020)	(0.009)	(0.018)	(0.020)	(0.009)	(0.018)	(0.020)	(0.009)	(0.018)
LLP&LLC	−0.009	0.0003	0.009	−0.009	0.003	0.006	0.010	0.003	0.007

(*Continued*)

Table A3. Continued.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Variables	Not applying	Normal loans	Government-backed loans	Not applying	Normal loans	Government-backed loans	Not applying	Normal loans	Government-backed loans
	(0.031)	(0.010)	(0.030)	(0.032)	(0.011)	(0.030)	(0.032)	(0.010)	(0.030)
Firm Age (<1 year)									
1–2 years	−0.056	0.008	0.048	−0.056	0.008	0.048	−0.056	0.008	0.049
	(0.036)	(0.013)	(0.034)	(0.036)	(0.013)	(0.034)	(0.036)	(0.013)	(0.034)
2–5 years	−0.111***	0.023	0.088***	−0.110***	0.024	0.086**	−0.109***	0.023	0.086**
	(0.037)	(0.016)	(0.034)	(0.037)	(0.016)	(0.034)	(0.037)	(0.016)	(0.034)
6–9 years	−0.034	0.007	0.028	−0.032	0.007	0.025	−0.033	0.007	0.026
	(0.036)	(0.014)	(0.034)	(0.036)	(0.013)	(0.034)	(0.036)	(0.013)	(0.034)
10–15 years	−0.016	0.005	0.011	−0.014	0.006	0.008	−0.014	0.006	0.008
	(0.033)	(0.012)	(0.031)	(0.033)	(0.012)	(0.031)	(0.033)	(0.012)	(0.031)
>15 years	0.003	0.008	−0.011	0.003	0.009	−0.012	0.002	0.009	−0.011
	(0.031)	(0.012)	(0.029)	(0.031)	(0.012)	(0.029)	(0.031)	(0.012)	(0.029)
Obs		7718			7718			7718	
Log-Likelihood		−414.260			−411.358			−410.913	
Wald χ^2		266.040***			344.450***			359.220***	

Marginal effects reported with robust standard errors in parentheses, except for the interactions between CSI and innovation classifications where coefficients estimates are reported (Base outcome – Not applying does not have coefficients of interactions). Reference category is given in parentheses. Significance: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.