

WORKING  
PAPERS IN  
RESPONSIBLE  
BANKING &  
FINANCE

**Innovation and Borrower  
Discouragement in SMEs**

By *Ross Brown, Jose M. Liñares-Zegarra, John O.S. Wilson*

**Abstract:** Innovative small and medium enterprises (SMEs) play a crucial role in driving technological change and productivity growth. In this paper, we investigate whether innovative SMEs are more likely to be discouraged from applying for external finance than other SMEs. Utilising a major longitudinal dataset covering over 10,000 UK SMEs, we find that SMEs undertaking both product and process innovation have a significantly higher incidence of borrower discouragement than their non-innovative counterparts. Radical innovators (those producing significant advances in product or process technologies) have the strongest propensity to be discouraged. The results of a longitudinal analysis suggest that transitions from non-discouraged to discouraged borrower status are also associated with innovative activity. Overall, the results suggest the need for a greater policy emphasis on alleviating borrower discouragement within innovative SMEs and a closer alignment between innovation and SME finance policy initiatives.

**WP N° 20-014**

3<sup>rd</sup> Quarter 2020



# **Innovation and Borrower Discouragement in SMEs**

Ross Brown\*

Centre for Responsible Banking & Finance, School of Management,

University of St Andrews

[Ross.Brown@st-andrews.ac.uk](mailto:Ross.Brown@st-andrews.ac.uk)

Jose M. Liñares-Zegarra

Essex Business School, University of Essex and Centre for Responsible Banking & Finance, School of Management, University of St Andrews

[jmlina@essex.ac.uk](mailto:jmlina@essex.ac.uk)

John O.S. Wilson

Centre for Responsible Banking & Finance, School of Management,

University of St Andrews

[jsw7@st-andrews.ac.uk](mailto:jsw7@st-andrews.ac.uk)

## **Acknowledgments**

We gratefully acknowledge the ESRC-funded Enterprise Research Centre for funding for this study. We wish to pay special thanks to Sumit Rahman and Frances Pottier (from the Department for Business, Energy and Industrial Strategy) for providing access to the Longitudinal Small Business Survey. We are also grateful to Steve Roper, Phil Molyneux and Jerry Coakley for valuable comments and suggestions on previous versions of the manuscript. The usual disclaimer applies.

---

\* Corresponding author: Ross Brown, Centre for Responsible Banking & Finance, School of Management, Gateway Building, University of St Andrews, St Andrews, Fife, KY16 9RJ, UK.

# **Innovation and Borrower Discouragement in SMEs**

## **Abstract**

Innovative small and medium enterprises (SMEs) play a crucial role in driving technological change and productivity growth. In this paper, we investigate whether innovative SMEs are more likely to be discouraged from applying for external finance than other SMEs. Utilising a major longitudinal dataset covering over 10,000 UK SMEs, we find that SMEs undertaking both product and process innovation have a significantly higher incidence of borrower discouragement than their non-innovative counterparts. Radical innovators (those producing significant advances in product or process technologies) have the strongest propensity to be discouraged. The results of a longitudinal analysis suggest that transitions from non-discouraged to discouraged borrower status are also associated with innovative activity. Overall, the results suggest the need for a greater policy emphasis on alleviating borrower discouragement within innovative SMEs and a closer alignment between innovation and SME finance policy initiatives.

**Key Words: Innovation, SMEs, Discouraged Borrowers, Access to Finance, Public Policy**

## 1. Introduction

Innovative small and medium enterprises (SMEs) are crucial for job creation, innovation and productivity growth (Audretsch, 1995; Lee et al, 2015). The dynamic, risky and short-lived nature of many innovative young firms has led some to label them the '*fruit flies*' of innovation (De Jong and Marsili, 2006). As a consequence, understanding the barriers and impediments confronting these small innovative firms has received widespread attention in academic and policy circles in recent years (Schneider and Veugelers, 2010; Czarnitzki and Delanote, 2013; Wilson, 2015).

Access to external finance is a fundamental pre-requisite driving firm-level innovation (Kerr et al, 2014; Kerr and Nanda, 2015). However, there are key structural impediments facing small innovative firms seeking access to external finance, which arise from informational asymmetries, asset intangibility and skewed returns (Lee et al, 2015). Given limited collateral and unstable cash flows (Hall and Lerner, 2010), obtaining access to external finance is extremely challenging for innovative SMEs (Cowling et al, 2012; Lee et al, 2015; Giraud et al, 2019). Indeed, expectations regarding the likely success in obtaining external finance can be so acute that some SMEs refrain from applying altogether.<sup>1</sup> These so-called *discouraged borrowers* are firms that choose not to apply for external finance because they expect their applications will be rejected (Kon and Storey, 2003). In this paper, we investigate the novel issue of whether innovative SMEs are more likely to be discouraged from applying for external finance than less innovative SMEs.

Until recently, discouraged borrowers have been a relatively under researched cohort of SMEs (Cowling et al, 2016). This is somewhat surprising given these firms significantly outnumber firms that actually apply, but are subsequently denied credit (Levenson and Willard, 2000; Freel et al, 2012; Cole and Sokolyk, 2016). Recent evidence suggests that over half of discouraged borrowers (55%) would secure external finance if they had applied for a loan (Cowling et al, 2016). Prior research finds that borrower discouragement is driven by a variety of entrepreneurial and firm-level characteristics. However, to date the literature has neglected the impact of innovation on borrow discouragement, despite a priori expectations that borrower discouragement is likely to be higher among innovative SMEs, given their informational opacity, inherent risk and

---

<sup>1</sup> The phrase '*why even bother trying*' is used to depict this cognitive mind-set (Neville et al, 2018).

the uncertainty of outcomes associated with innovation activity (Hutton and Nightingale, 2011; BEIS, 2017).

Borrower discouragement is also vitally important from a public policy perspective (Hutton and Nightingale, 2011). For example, the state-owned British Business Bank and new Scottish National Investment Bank have recently conveyed a desire to tackle borrower discouragement among SMEs (British Business Bank, 2020; Scottish Government, 2019). The European Central Bank has similarly identified borrower discouragement as a problem facing many SMEs operating across the European Union (Ferrando and Mulier, 2015). Therefore, the results of an investigation of innovative SME borrower discouragement is likely to be of considerable relevance for policymakers tasked with alleviating the funding gaps confronting innovative SMEs.

In this paper we investigate the incidence and dynamics of borrower discouragement for innovative SMEs using the Longitudinal Small Business Survey (LSBS). The LSBS is a large-scale representative survey of UK SME owners and managers, which covers over 10,000 UK SMEs. The LSBS survey provides extensive data on firm characteristics such as: borrower discouragement (whether SMEs had a need for finance, but did not apply); and detailed information on a wide range of measures regarding the type (product and process innovation) and novelty (radical, new to the market or incremental, new to the business) of innovative activity.

We conduct an econometric analysis (using probit models) to investigate the association between innovation and borrower discouragement. Firm-level characteristics are incorporated into our estimable models in order to control for other factors that are likely to affect borrower discouragement. The longitudinal nature of the data (which covers the period 2015-2017) allows us to examine the nature of borrower discouragement in the cross-section and over time. By exploiting the longitudinal nature of the data, our methodology departs from the static, cross-sectional methodologies prevalent in most of the literature on borrower discouragement (reviewed in Section 2).

By way of preview, the results of our econometric analysis suggest that innovative SMEs have a significantly higher incidence of borrower discouragement than non-innovative counterparts. These findings hold after accounting for any possible selection bias (via an additional propensity score matching analysis) arising from SME decisions to

innovate. The type of innovation affects the incidence of borrower discouragement across SMEs. Specifically, a combination of product and process innovation has a stronger effect on the likelihood of SME borrower discouragement than any separate effect of product or process innovation. Our results also suggest that radical innovators are more likely to be discouraged borrowers than incremental innovators.

We provide new insights to the literature on borrower discouragement by answering calls for more research to verify *'the existence, extent and characteristics'* of this phenomenon (Fraser, 2014, p. 85). Due to the nature of many survey questionnaires, studies of borrower discouragement adopt (by necessity) rather restrictive definitions of borrower discouragement focusing purely on the fear a loan application is rejected (Neville et al, 2018; Nguyen et al, 2020). This is likely to underestimate significantly the true extent of borrower discouragement across SMEs. By contrast, the rich nature of the LSBS dataset allows us to construct a multi-faceted measure of borrower discouragement encompassing whether an SME had a need for finance in the last 12 months, but did not apply for any of the following reasons: fear of rejection; cost of credit; additional risk-taking; poor credit history; prevailing economic conditions; knowledge of financial sources; and the time and hassle associated with applying.<sup>2</sup>

We also contribute to the understanding of the dynamics of borrower discouragement. The level of borrower discouragement reported in prior studies is based on a snapshot taken at one particular point in time and does little to explain the dynamics of borrower discouragement. In this context, (and for the first time in the literature), we examine the dynamics of borrower discouragement and provide evidence regarding the probability of switching from non-discouraged to discouraged borrower status over time. The results suggest that innovation influences the propensity to switch from non-discouraged to discouraged borrower status.

The remainder of this paper is structured as follows. In section 2, we review relevant literature. Section 3 outlines the data, definitions and methods. In Section 4, we

---

<sup>2</sup> Most empirical studies define borrower discouragement as the fear of being rejected for bank funding. However, the factors shaping discouragement are likely to be heterogeneous and complex. A substantial proportion of SMEs state that they *'don't want to take on additional risk'* as a main reason for being discouraged (27.3% in 2017 and 29.8% in 2015), followed by *'it would be too expensive'* (14.3%) and *'you thought you would be rejected'* (16.2%) in 2017. Figure A1 in the appendix provides a full summary.

present and discuss the main results. Section 5 summarises the results and discusses the policy implications emerging from the study.

## **2. Relevant Literature**

To examine the interconnections between finance, innovation and borrower discouragement, we examine literature related to the structural issues that typically confront innovative SMEs seeking access to external finance. We then review the literature on borrower discouragement.

### *2.1 The Supply of Finance for Innovative SMEs*

Schumpeter (1934) was the first to draw connections between innovation and finance. An integral part of the Schumpeterian story is that financial institutions play an essential role as facilitators of the innovative efforts undertaken by entrepreneurs (King and Levine, 1993; Revest and Sapio, 2012). In contemporary circumstances this translates to the role innovative SMEs play in the innovation process, and the complementarities between SMEs and banks (Mazzucato, 2013; Block et al, 2017).

Lee et al (2015) claim there are three key reasons regarding why access to finance is problematic for innovative SMEs. First, the returns from innovation are highly skewed with only a small number of innovations generating significant revenues, while the remainder yield little or no returns. While increased innovative activity may raise the probability of superior performance, it cannot guarantee it (Coad and Roa, 2008). Second, given that SMEs have more information regarding the likely success of innovation investments, banks cannot accurately estimate the likely returns to innovative investments (Berger and Udell, 1998; Hall and Lerner, 2010). These asymmetric information issues tend to be most severe for SMEs with higher levels of intangible capital (Mina et al, 2013). Consequently, many innovative firms seek finance from specialised financial intermediaries such as business angels and venture capitalists that address asymmetric information issues by *ex-ante* soft information collection and *ex-post* performance monitoring (Robb and Robinson, 2014; Liberti and Petersen, 2019). Finally, intangible assets produced by the innovation process may be difficult to value or transfer beyond an individual firm. Consequently, innovative SMEs without significant tangible or re-deployable assets have insufficient collateral to obtain external finance (Williamson, 1988; Cosh et al, 2009; Hall and Lerner, 2010).

Extant prior literature provides evidence to support the view that innovative SMEs have difficulties obtaining bank finance (Hall and Lerner, 2010). Freel (2007) finds that innovative UK SMEs were less likely to receive bank finance. Schneider and Veugelers (2010) find that German innovative SMEs view external financing constraints as an important factor hampering innovation. Whereas large firms can fund innovation via internal cash flows (Ughetto, 2008), smaller firms seeking finance for innovation activity often have insufficient or unpredictable cash flows to service bank loans adequately (Hall and Lerner, 2010). Recent evidence also suggests that innovative SMEs can be penalised in other ways, for example being charged higher interest rates for loans than counterparts not engaging in innovative activities (Rostamkalaei and Freel, 2016). In continental Europe and the US, there is similarly evidence to suggest that firms engaged in innovative activities often face substantial external financing constraints (Kerr and Nanda, 2015; Hall et al, 2016). Innovative SMEs also appear to be more affected by exogenous liquidity shocks. For example, Lee et al (2015) find that innovative UK SMEs were more likely to be turned down for finance in the aftermath the global financial crisis (corroborating earlier evidence produced for Latin America; Paunov, 2012).<sup>3</sup>

## *2.2 Borrower Discouragement*

In a seminal contribution, Kon and Storey (2003) outline how actual or perceived barriers to accessing external finance may discourage SMEs from applying for credit. Prior evidence suggests that there are significant variations in borrower discouragement across countries (Mac an Bhaird et al, 2016; Lim and Nguyen, 2020). Rostamkalaei et al (2018) find that the incidence of SME borrower discouragement varies between 0.51% and 45%. In most developed economies, borrower discouragement affects between 10% and 20% of SMEs (Freel et al, 2012; Christensen and Hain, 2014; Cowling et al, 2016; Mac an Bhaird et al, 2016; Rostamkalaei et al 2018). The incidence of borrower discouragement is significantly higher in developing countries (Chakravarty and Xiang 2013). Intra-country variations in borrower discouragement are also prevalent. For example, in the UK, Fraser (2004) and Freel et al (2012) find that approximately 8% of

---

<sup>3</sup> Similarly, recent research suggests that while innovative SMEs were penalised during the post global financial crisis period, this do not apply to high-tech SMEs (Cowling and Liu, 2020).



SMEs are discouraged borrowers, while Cowling et al (2016) and Rostamkalaei (2017) find a prevalence of borrower discouragement of 2.7% and 2.1% respectively.

The results of previous research suggest that borrower discouragement is associated with various entrepreneurial and SME-level traits. Table 1 provides a summary. The entrepreneurial characteristics associated with a higher incidence of borrower discouragement include: ethnic minorities (Cavalluzzo et al, 2002; Fraser, 2009; Wiersch et al, 2016; Neville et al 2017); female-led (Freel et al, 2012; Mijid, 2014; Cowling et al, 2016; Moro et al, 2017); older (Cole and Sokolyk, 2016); less well-educated (Cole and Sokolyk, 2016; Nguyen et al, 2020) and less wealthy (Han et al, 2009). Serial entrepreneurs are also much more likely to be discouraged borrowers (Freel et al, 2012). Han et al (2009) find that riskier individuals have a higher incidence of borrower discouragement. Cowling et al (2016) find that since the global financial crisis, experienced entrepreneurs are more likely to be discouraged borrowers.

[Insert Table 1 about here]

In terms of the firm-level characteristics, smaller and younger SMEs are significantly more likely to be discouraged borrowers (Han, et al, 2009; Freel et al, 2012; Chakravarty and Xiang 2013; Cowling et al, 2016; Mac an Bhaird et al, 2016; Rostamkalaei, 2017). Therefore, in line with theoretical a priori expectations, the smallest most informationally opaque SMEs encounter the greater levels of borrower discouragement (Berger and Udell, 1998; Cowling et al, 2016). Such SMEs are less likely to have established relationships and informal interactions with lenders (Rostamkalaei et al, 2018). SMEs that undertake relationship banking are less likely to be discouraged borrowers (Chandler, 2010; Freel et al, 2012). This suggests that good firm-bank relationships substantially facilitate information exchange between borrowers and lenders (Cowling et al, 2016). In a recent contribution, Lim and Nguyen (2020) find that SMEs with political connections are significantly less likely to be discouraged from applying for bank finance relative to SMEs without political connections.

Product and process innovations are important strategies used by many SMEs seeking to improve efficiency in production and distribution or increase revenues by stimulating demand for products and services. A high proportion of innovation tends to be self-financed. However, many SMEs rely on external finance to fund the development

costs associated with new product and process innovation. Given the risk and uncertainty of outcome associated with innovation activity (Coad and Rao 2008; Mazzucato 2013), compared to typical SMEs, innovative SMEs are more likely to encounter significant barriers to accessing finance. This could manifest in the shape of: funding application rejections (Freel, 2007; Lee et al., 2015); higher interest rates on bank loans; more onerous collateral requirement and covenants; or ultimately discouragement to even apply.

To date, there is a paucity of evidence regarding the potential effects of innovation on the demand-side constraints to accessing finance, self-rationing and borrower discouragement. This is partially explained by the absence or limited availability of nationally representative longitudinal information regarding the innovation activities undertaken by SMEs and corresponding levels of borrower discouragement. A notable exception is a study by Rostamkalaei et al (2018) who utilise cross-sectional data to examine the underlying characteristics associated with different types of borrower discouragement measured by informal turndowns (when lenders verbally inform an SME owner that a loan application is likely be denied) and fear of rejection. While innovation is not the focus of the study, the authors find that (product and process) innovative activity is not associated with a specific type of borrower discouragement. The approach adopted in the present study deviates significantly from this in that we examine the impact of (product, process, incremental and radical) innovation activities on the likelihood of borrower discouragement.<sup>4</sup>

Innovation has been traditionally modelled as a binary choice capturing whether a firm innovates or not. However, innovation can take many forms and include activities such as product, process, radical and incremental innovations. In the present study, we posit that the type, nature and scope of innovation is likely to have a differential impact on borrower discouragement, given variations in the risk and uncertainty associated with different forms of innovation (Teece et al, 2016; Roca et al, 2017). There is no certainty that process innovation will lead to lowering the average cost function, or that a product innovation will shift the demand curve to the right. Moreover, radical innovation (which

---

<sup>4</sup> It is worth noting the work by Freel et al (2012), the authors adopt a behavioural approach to quantify how SME owners perceive innovation (measured as a combination of R&D innovation, specialised expertise or products and flair, design and creativity) as a business strength and find no evidence of a significant effect of perceived innovation on discouragement.

implies advancements in knowledge due to the development of new products and processes that are new to the market) is likely to be characterised by higher levels of unknown unknowns due to both 'high technical and market uncertainty' (O'Connor and Rice, 2013, p. 3) than incremental innovations (which merely modify existing products and processes).

Overall, prior evidence suggests that a multitude of factors are likely to determine the incidence of borrower discouragement. However, the role of innovation has for the most part been overlooked. This is surprising given the growing literature that investigates the financing constraints facing innovative firms (Freel 2007; Lee et al, 2015). Moreover, most prior evidence is based upon cross-sectional analyses, and consequently provides only a snapshot of borrower discouragement. The paucity of evidence regarding whether borrower discouragement is a dynamic phenomenon is clearly a compelling issue for further investigation for academics and policy makers alike, and indeed the present study.

### **3. Data, Definitions and Methodology**

#### *3.1 Data*

For the purposes of our empirical analysis, we utilise the Longitudinal Small Business Survey (LSBS) produced by the Department for Business, Energy and Industrial Strategy (BEIS). The LSBS is a large-scale representative survey of UK small business owners and managers. The survey is telephone-based and constructed using a stratified sample of owner-managers of SMEs with less than 250 employees across the four constituent parts of the UK (England, Northern Ireland, Scotland and Wales). The data available for use in the present study comprises a balanced panel of 4,165 businesses that were interviewed in 2015, and then re-interviewed in 2016 and 2017. The survey collects detailed information relating the financial and non-financial activities of SMEs, including the nature of their firm-level innovative activities and their attitudes toward accessing external finance.

#### *3.2 Identifying Innovative SMEs*

Firm-level innovation is a multifaceted concept, which can be defined in various ways. Product innovation involves the introduction of a new product, while process innovation normally involves the introduction of a cost-saving technologies. The

distinction between product and process innovation is not always clear cut. New products often require new methods of production, while new production processes often alter the characteristics of the final product. Innovation is also differentiated by the degree of novelty (Beck et al, 2016; Bouncken et al, 2018; Freel et al, 2019). Radical innovations represent significant advances or new forms of knowledge occurring primarily through the creation of new products and processes (Zhou and Li, 2012). Incremental innovations involve the continuous improvement to existing products, processes or services that are new to the firm (Beck et al, 2016). While incremental innovation can produce competitive advantages to SMEs by making them more efficient, radical innovation can lead to substantive improved growth and returns to SMEs (Love et al, 2016; Saridakis et al, 2019; Freel et al, 2019). Given the inherent lack of resources to undertake radical innovation, incremental innovation is often the most common form of innovation for SMEs.

In the present study, we measure innovation as the introduction of new goods, services and processes. The LSBS asks SMEs a series of questions related to their innovative activity over the past three years as follows:

- (i) Goods innovation: *'Has your [business] introduced any new or significantly improved goods in the last three years? This excludes the resale of goods purchased from other businesses, or changes of a solely aesthetic nature.'* This group of SMEs represent 16.5% of our sample (Table 2).
- (ii) Service innovation: *'Has your [business] introduced any new or significantly improved services in the last three years?'* Figures reported in Table 2 suggest that 28.1% of SMEs in our sample have introduced new services innovations in the last three years.
- (iii) Product innovation is not directly measured in the survey, but can be approximated by measuring companies that introduced goods and/or services innovations, which represent 34% of our sample.
- (iv) Process innovation: *'Has your [business] introduced any new or significantly improved processes for producing or supplying goods or services in the last three years?'* We find that 17.9% of SMEs in our sample has introduced process innovation in the last three years.

[Insert Table 2 about here]

Using the classification above, we classify innovative SMEs into three mutually exclusive groups comprising: pure product innovators (21.9% of SMEs); pure process innovators (5.8% of SMEs); and SMEs that innovate both in terms of product and process simultaneously (12.1%). The detailed nature of the data enables us to delineate between radical and incremental innovators (Beck et al, 2016; Saridakis et al, 2019). The data also allows us to explore the degree of novelty of innovative activity by examining responses to the question: *'Were any of these new or significantly improved goods and services innovations new to the market, or were they all just new to your [business]?'* The responses to this question allow us to create a categorical variable that classifies the product innovation as radical (new to the market), or incremental (new to the business). A similar approach is used to capture radical and incremental process innovations, based on responses to the following question: *'Were any of these new or significantly improved processes new to your industry, or were they all just new to your [business].'*

The data reported in Table 2 suggests that around 9.7% of SMEs in our sample have introduced a radical product innovation in the last three years. We also find that 24% of SMEs introduced incremental product innovations. The percentage of SMEs undertaking radical and incremental process innovations is generally lower than for product innovation accounting for 3.8% and 14% respectively.

### *3.3 Identifying Discouraged SMEs*

The considerable variation in the aggregate level of borrower discouragement reported in prior literature (reviewed in Section 2) is likely to stem from differences in the definitions used. This suggests that considerable caution should be exercised when drawing direct comparisons across studies regarding the incidence of borrower discouragement. Most previous studies typically view borrower discouragement as a binary choice between borrowers who fear rejection and those who do not, and consequently have failed to assess the strength or depth of borrower discouragement. This is a rather surprising omission given the multi-dimensional nature of borrower discouragement. Table 3 highlights the various definitions used in prior studies of borrower discouragement. In most surveys, questions relate to whether SMEs enact self-imposed credit constraints for fear of rejection. However, in some surveys, the terms and conditions (collateral and covenants) are also included as reasons for borrower discouragement (Chakravarty and Xiang 2013; Cowling et al, 2016). Borrowing costs

(interest rates, overdraft charges) are also likely to play a role in mediating the demand for finance. A formal loan application can also be costly in time and human resources (Rostamkalaei et al 2018) inhibiting SMEs from applying for finance given the opportunity cost and *hassle* of applying (Chandler, 2010; Chakravarty and Xiang 2013; Rostamkalaei et al, 2018).<sup>5</sup>

[Insert Table 3 about here]

The definition of borrower discouragement used in the present study is whether SMEs had a need for finance in the last 12 months, but did not apply because of the following reasons: *fear of rejection; cost of credit; additional risk-taking; poor credit history; prevailing economic conditions; knowledge of financial sources; and the time & hassle associated with applying*. In order to assess the myriad of factors underlying borrower discouragement, we use an empirical model, which incorporates a wide range of covariates. To the best of our knowledge, this is the first study to investigate explicitly the role of innovation in borrower discouragement, while incorporating a raft of covariates used in prior literature to explain borrower discouragement.

Table 2 reveals that 9% of SMEs surveyed are discouraged borrowers. The characteristics of these discouraged borrowers is presented in Figures 1-3. Innovative SMEs (in particular, goods innovators) are more likely to be discouraged borrowers than non-innovators (Figure 1). Figure 2 shows that SMEs undertaking both product and process innovations have the highest incidence of borrower discouragement (14.31%). This is followed by pure product innovators (11.1%) and process innovators (10%). Figure 3 shows that a relatively large proportion of discouraged borrowers are radical product (13.5%) and process innovators (11.6%).

[Insert Figure 1 here]

[Insert Figure 2 here]

[Insert Figure 3 here]

---

<sup>5</sup> The issue of cost and hassle of applying for finance is consistent with the original concept of borrower discouragement which contends that application costs can be “considered as financial, in-kind or psychic” (Kon and Storey, 2003, p. 37).

### 3.4 Control variables

We control for several variables that are likely to affect borrower discouragement. These include growth intentions, size, firm age, location, profitability, change in turnover, gender, ethnicity, family ownership, legal structure, region and sector.<sup>6</sup> Growth-oriented SMEs are more likely to require external funding, and thus more likely to be discouraged borrowers. These SMEs represent 51.8% of our sample. SME size is measured by total employment according to one of four size categories: 0 employees (66.1% of SMEs); 1–9 employees (28.9% of SMEs); 10–49 employees (4.4% of SMEs); and 50–249 employees (0.6% of SMEs). Our sample of SMEs are: predominantly mature (20+ years old, 44.1%) and located in urban areas (71.1%). Profitability is measured using an indicator variable that captures whether a SME made a profit (83.9% of SMEs) in the last financial year. Turnover (sales revenue) remained constant or increased in around 80% of the sample.

We also control for cases where the owner is either a female (21.2%), ethnic minority-led (3.8%) and family owned (84.7%). We also differentiate between proprietorships, partnerships, and companies in order to control for differences in legal form. Companies and sole proprietorship constitute around 88.6% of our sample. The majority of SMEs are located in England (87.5%) and are equally distributed across economic sectors. Detailed definitions for all variables are available in Table A1 in the appendix.

### 3.5 Methodology

We conduct probit regressions to examine the potential relationship between borrower discouragement and innovation. The probit model is the most appropriate method for undertaking the empirical analysis given the binary nature of the dependent variable (Cameron & Trivedi, 2005).

A latent variable that represents the propensity of a SME to be a discouraged borrower is defined ( $D_i^*$ ). We cannot observe the latent variable, but we are able to observe whether SME  $i$  is a discouraged borrower as follows:

$$D_j^* = \begin{cases} 0 & \text{if } D_j^* \leq 0 \\ 1 & \text{if } D_j^* > 0 \end{cases} \quad (1)$$

---

<sup>6</sup> Pairwise correlations are reported in Table A2 in the Appendix.

If the latent function is of the form:

$$D_j^* = \beta_i X_i + \gamma_i I_i + \varepsilon_i, \varepsilon \sim N(0, \sigma^2) \quad (2)$$

with an unobservable component ( $\varepsilon$ ) that follows a normal distribution ( $\Phi(\varepsilon)$ ),  $X$  is the vector of SME-level observable characteristics.  $I$  is an indicator variable which captures whether the SME has introduced a specific type of innovation (as described in Section 3.3). The probability that the SME is discouraged in applying for bank finance is:

$$Pr(D_i = 1|X_i, I_i) = Pr(D_j^* > 0|X_i, I_i) = Pr(\varepsilon_i > -\beta_i X_i - \gamma_i I_i) = \Phi(\beta_i X_i + \gamma_i I_i) \quad (3)$$

This equation is estimated using maximum-likelihood techniques. The empirical results are reported in terms of average marginal effects of the explanatory variables on the probabilities of the occurrence that:  $D_i = 1$ . The average marginal effects indicate the change in probability when the independent variable switches from the reference category to the category of interest. In order to account for the correlation of errors over time, we estimate the probit model with standard errors clustered at SME level

#### 4. Results

Table 4 present our main results. We find that innovative SMEs (that introduce either product or process innovations) have a higher incidence of borrower discouragement. The results for Model 1 indicate that being an innovative SME increases the likelihood of borrower discouragement by 2.4 percentage points compared to a non-innovative counterpart. Results derived from estimating Model 2 suggest that SMEs introducing goods and service innovations have a higher likelihood of exporting compared to their non-innovative counterparts.<sup>7</sup> According to the results, goods innovation has a stronger impact on the incidence of borrower discouragement than service innovation. Service innovation increases the likelihood of borrower discouragement, but the magnitude of this effect is approximately half of that obtained for goods innovation. This finding is consistent with the view that services have an orientation towards innovation, which entails organisational change, while product innovation is typically more capital intensive and more expensive (Freel, 2006).

---

<sup>7</sup> This is in line with other recent research examining the connection between firm-level innovation and the internationalisation of SMEs (Saridakis et al, 2019).



[Insert Table 4 about here]

The results obtained from estimating Model 3 suggest that SMEs which introduce product and process innovations are more likely to be discouraged borrowers. Specifically, we find that SMEs engaging in both product and process innovation are two percentage points more likely to be discouraged borrowers relative to SMEs that have not introduced a product or process innovation during the past three years.

In Table 5, we examine the association between the scope of innovation and the incidence of borrower discouragement. We classify SMEs into three mutually exclusive categories based on the type of innovation: pure product innovation; pure process innovation; and product and process innovation. The results suggest that SMEs that have innovated both products and processes simultaneously were 4.5% more likely to be discouraged borrowers relative to non-innovating counterparts. In this model, the pure process innovation coefficient loses statistical significance, and the coefficient of interest for pure product innovation is marginally significant. Overall, the results suggest that introducing a combination of product and process innovation has a stronger impact on borrower discouragement compared to other types of innovation.

[Insert Table 5 about here]

Table 5 also presents the association between the degree of novelty of innovative activity and borrower discouragement. The results suggest that introducing radical product or process innovation increases the SME's propensity of being discouraged by 3.6 % and 4.1% respectively compared to SMEs that did not introduce innovations. However, our results suggest that incremental product innovation and incremental process innovation only increase the probability of being a discouraged borrower by 2.3% and 2.4% respectively. These results imply that the positive effect of innovation on borrower discouragement is stronger for SMEs undertaking radical innovations. In other words, the most innovative SMEs are typically those exhibiting the greatest levels of borrower discouragement.

Turning to the control variables in Tables 4 and 5, we can also observe which business-related characteristics are more likely to increase borrower discouragement. The results suggest that growth-oriented SMEs are 3.3% to 3.6% more likely to be discouraged borrowers than non-growth-oriented counterparts. Mature, profitable SMEs

and SMEs with increased turnover during the past year are less likely to be discouraged borrowers. Increased turnover and profitability tend to improve the cash position of SMEs, and hence makes them more confident that any funding application is likely to be accepted. SMEs led by entrepreneurs belonging to an ethnic minority are 8% more likely to be discouraged borrowers, again aligning with previous literature (Neville et al, 2018). Finally, Scottish SMEs are more likely to be discouraged borrowers relative to counterparts located elsewhere in the UK. This provides some tentative evidence that innovative SMEs based in a peripheral location are more likely to be discouraged borrowers.

We exploit the longitudinal dimension of our database to assess if our key results remain unchanged from a dynamic perspective. Due to the nature of the data used in previous studies this intertemporal perspective has gone unexplored. Tables 6 and 7 summarise the factors affecting the probability of switching from non-discouraged to discouraged borrower status from one period to the next.<sup>8</sup> The results in Table 6 remain largely unchanged and suggest that innovation increases borrower discouragement. In particular, we find that product and process innovators are 1.5% more likely to switch from non-discouraged to discouraged borrower status in the next period. The effect is even larger for goods innovators, which are 2.5% more likely to become discouraged borrowers in the next period. We also find that process innovators are slightly more likely to switch from non-discouraged to discouraged borrower status in the next period (1.5%) compared to product innovating counterparts (1.2%).

[Insert Table 6 about here]

The results in Table 7 focus on the scope of the innovation. SMEs that are involved in both product and process innovation simultaneously are 3% more likely to become discouraged borrowers than non-innovator counterparts. We also find that incremental innovators are slightly more likely to become discouraged borrowers compared to radical innovators. In other words, as well as reporting a higher incidence of borrower

---

<sup>8</sup> We also explore the effect of innovation on the probability of switching from discouraged to non-discouraged borrower status rather than staying in the discouraged borrower status. Results are reported in Table A2 in the Appendix and do not suggest that innovation affects the probability of switching from discouraged to non-discouraged borrower status.

discouragement overall, innovative SMEs also more likely to be discouraged borrowers over time.

[Insert Table 7 about here]

### *Propensity Score Matching Exercise*

The results of the empirical analysis could be biased if ex ante innovators (product or process) are more likely to be discouraged borrowers than non-innovators (product or process) with comparable characteristics. In order to explore this possibility, we follow Rosenbaum and Rubin (1983) and use Propensity Score Matching (PSM) as a means of addressing such concerns. Matching restricts inference to the sample of innovators (the treatment group) and non-innovators (the control group). The treatment group is matched with the control group on the basis of a propensity score which is a function of SME's observable characteristics. We match the SMEs based on the nearest-neighbour with replacement. Propensity scores are estimated via a probit model utilizing SME characteristics described in Section 3.4 (aims to grow, size, business age, urban location, profits, turnover change, legal status, region and sector) as independent variables. We match innovative SMEs with one, four and eight corresponding (nearest neighbour) non-innovative SMEs.<sup>9</sup> If this model is well specified, it should balance the covariates.<sup>10</sup>

We present the average treatment effect on the treated (ATET) in Table 8. We observe that for the whole sample ATET is significant. In other words, for a SME, on average, the effect of being innovative (product or process) increases the likelihood of being a discouraged borrower in around 4.4% to 4.8% compared with what would have

---

<sup>9</sup> Stata 16's 'teffects overlap' routine was used to produce density plots. The graph displays the estimated density of the predicted probabilities that an untreated SME is assigned to treatment and the estimated density of the predicted probabilities that a treated SME is assigned to treatment. Consistent with the overlap assumption, the estimated density plots have considerable mass in the regions where they overlap, little mass around 0, and little mass around 1. Thus there is no evidence that the overlap assumption is violated.

<sup>10</sup> For example, reviewing the covariate balance summary in Table A4 corresponding to the results reported in Panel A (1 match per observation) for the whole sample in Table 8, we see that the weighted standardized differences are all close to zero and the variance ratios are all close to one, which suggest that our model balances the covariates. The raw columns show where we started, and, before weighting, differences were large. Covariate balance summaries for the rest of models reported in Table 8 offer similar results and are available upon request. To further verify the quality of matching, Figure A3 shows the distribution of the propensity score for both groups before and after matching and suggests that the matches are appropriate.

occurred if none of these firms had been innovative. In addition, we repeat the analysis for each survey wave. The results are consistent with those obtained previously.

[Insert Table 8 about here]

## 5. Discussion and Conclusions

This study provides important insights into the incidence of borrower discouragement across UK SMEs. It adds an important new dimension to the growing literature on innovative SMEs by examining the problem of credit self-rationing. According to Schumpeter, entrepreneurship consists of “*getting things done*” (Schumpeter, 1934, p.93). If borrower discouragement prevents entrepreneurs from undertaking growth-oriented activities (i.e. ‘*getting things done*’) there could be strong grounds for much greater academic attention towards understanding both the causes and consequences of this phenomenon.

We augment prior literature by adopting a more expansive definition of borrower discouragement than previous studies which typically adopt a narrow definition and as a consequence potentially underestimating the true extent of borrower discouragement. As such, we find that the overall incidence of borrower discouragement across SMEs is much higher than the levels reported in some previous UK studies (Cowling et al, 2016; Rostamkalaei, 2017). The rich nature of the LSBS dataset used in this study revealed that discouragement is a multi-faceted phenomenon with multiple underlying determinants.

Another novel aspect is our use of a longitudinal dataset, which allowed for a dynamic analysis of borrower discouragement. Owing to the cross-sectional nature of previous survey data analysed, prior studies have been unable to capture the full temporal dynamics of borrower discouragement. For example, an innovative SME that is a discouraged borrower in one period, may cease to be a discouraged in a subsequent period and vice versa. Consequently, results obtained from cross-sectional analysis are unlikely to contain sufficiently nuanced information on which to base reliable policy decisions designed to tackle the underlying demand- and supply-side issues leading to borrower discouragement. By contrast, our results show that transitions from non-discouraged to discouraged borrower status are also associated with innovative activity. The fact innovative firms are more likely to become discouraged over time suggests borrower discouragement is dynamic phenomenon.

To the best of our knowledge, this is the first in-depth empirical study to examine the issue of borrower discouragement across SMEs by the type and novelty of innovative activity. In this regard, the results of our analysis suggest that SMEs engaging in both product and process innovation, and especially those engaging in radical innovative activity are much more likely to be discouraged borrowers. As such, we augment and complement evidence highlighting the structural problems impacting the supply and demand of finance for innovative SMEs (Lee et al, 2015) with new evidence suggesting these radically innovative firms are also those most likely to self-impose credit constraints by refraining from external finance applications.

From a theoretical perspective, our findings are largely consistent with informational theories of firm-level borrowing discussed earlier. These theories suggest that SMEs firms are likely to encounter credit restrictions, and that these will be amplified for the most informationally opaque firms (with limited collateral, erratic cash flows and higher proportions of intangible assets). It may be the case that innovative SMEs are aware of such issues and as a consequence self-ration debt finance. Indeed, this is often an explanation provided in policy reports (BEIS, 2017)<sup>11</sup>. Also in line with the theoretical expectations discussed earlier, one plausible explanation for the higher incidence of borrower discouragement across radical innovators owes to the greater levels of absolute uncertainty associated with those types of innovations (O’Conner and Rice, 2013). Incremental innovations on the other hand are associated with lower levels of certainty, and consequently are easier to assess *ex ante*.

While problems accessing finance are often used as a rationale for government intervention towards small innovative firms (Schneider and Veugelers, 2010; Bloom et al, 2019), frequently these policy efforts focus upon the provision of supply-side measures such as credit guarantee schemes, grants and public equity finance instruments (Wilson, 2015 Giraudo et al, 2019). By comparison, the issue of discouraged borrowers is rarely discussed in policy documents or addressed via policy instruments. Our findings suggest this appears a crucial oversight. Given the potential sub-optimal economic outcomes resulting from discouragement (Hutton and Nightingale, 2011; Cowling et al,

---

<sup>11</sup> Indeed, a study by the UK Department for Business Energy and Industrial Strategy claims *the main reason for borrower discouragement amongst innovative firms was “because of recognition of the risk involved which they [SMEs] believed potential investors would often not be prepared to take on”* (BEIS, 2017, p. 133).

2016), more concerted policy efforts to alleviate borrower discouragement appear appropriate.

Fittingly, there seems some indicative evidence that the traditional supply-side approach to policy may be gradually shifting in focus. Indeed, in light of the recent declining levels of demand for bank finance in SMEs, the British Business Bank has recently launched a Demand Development Unit to help smaller businesses better understand and identify suitable sources of finance (British Business Bank, 2020). This seems desirable step as a lack of awareness of different funding options together with an over-reliance on their main bank may explain why SMEs become discouraged borrowers (Dimitriu and Salter, 2020).<sup>12</sup> Another approach would be to offer SMEs free financial advice on different funding sources and financial products which are often difficult to comprehend by time-constrained entrepreneurs.<sup>13</sup> Access to information regarding external sources of finance for start-ups and SMEs can be helpful for enabling entrepreneurs to access the right type of financing for their ventures (Wilson, 2015). An additional benefit of such informational support is its inexpensive nature and ease of operation.

Overall, our results suggest that going forward, the British Business Bank and other state-owned banks could pro-actively target these initiatives towards the types of innovative SMEs examined herein. State-owned banks should monitor borrower discouragement on a regular on-going basis to assess how these types of policies are performing over time. Given the high levels of borrower discouragement observed in other European and OECD countries, such recommendations may have equal traction elsewhere.<sup>14</sup>

---

<sup>12</sup> Given approximately one in ten SMEs in our sample were affected this could infer as many as 500,000 UK SMEs fall into the category of discouraged borrowers.

<sup>13</sup> This suggestion would help address the 13% of discouraged borrowers in 2017 who claimed they had too little time or thought it involved “too much hassle” to consider bank borrowing (see A1).

<sup>14</sup> Mac an Bhaird et al (2016) discovered that discouraged borrowers during the period 2009-2011 constituted as much as 44% and 23% of all SMEs in Ireland and Germany respectively.

## References

- Audretsch, D. B. (1995). *Innovation and Industry Evolution*. MIT Press, Cambridge, MA.
- Beck, M., Lopes-Bento, C., & Schenker-Wicki, A. (2016). Radical or incremental: Where does R&D policy hit? *Research Policy*, 45(4), 869-883.
- Berger, A. N., & Udell, G. F. (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.
- BEIS (2017) The Innovative Firm's Journey to Finance, *BEIS Research Paper* Number 23.
- Block, J. H., Fisch, C. O., & Van Praag, M. (2017). The Schumpeterian entrepreneur: a review of the empirical evidence on the antecedents, behaviour and consequences of innovative entrepreneurship. *Industry and Innovation*, 24(1), 61-95.
- Bloom, N., Van Reenen, J., & Williams, H. (2019). A toolkit of policies to promote innovation. *Journal of Economic Perspectives*, 33(3), 163-84.
- Bouncken, R. B., Fredrich, V., Ritala, P., & Kraus, S. (2018). Coopetition in new product development alliances: advantages and tensions for incremental and radical innovation. *British Journal of Management*, 29(3), 391-410.
- British Business Bank (2020) Small Business Finance Markets 2019/20. <https://www.british-business-bank.co.uk/wp-content/uploads/2020/02/Small-Business-Finance-Markets-2019-20-report-FINAL.pdf>
- Cameron, A. C., & Trivedi, K. P. (2005). *Microeconometrics: Methods and applications*. Cambridge University Press, New York.
- Cavalluzzo, K. S., Cavalluzzo, L. C., & Wolken, J. D. (2002). Competition, small business financing, and discrimination: Evidence from a new survey. *Journal of Business*, 75(4), 641-679.
- Christensen, J. L., & Hain, D. S. (2014). Scared away? Discouraged borrowers and capital market information. In *ISBE Conference 2014: Inspire, share, learn*.
- Coad, A., & Rao, R. (2008). Innovation and firm growth in high-tech sectors: A quantile regression approach. *Research Policy*, 37(4), 633-648.

- Cole, R., & Sokolyk, T. (2016). Who needs credit and who gets credit? Evidence from the surveys of small business finances. *Journal of Financial Stability*, 24, 40-60.
- Cowling, M., Liu, W., & Ledger, A. (2012). Small business financing in the UK before and during the current financial crisis. *International Small Business Journal*, 30(7), 778-800.
- Cowling, M., Liu, W., Minniti, M., & Zhang, N. (2016). UK credit and discouragement during the GFC. *Small Business Economics*, 47(4), 1049-1074.
- Cowling, M. and Liu, W. (2020) In the post crisis world, did debt and equity markets respond differently to high-tech industries and innovative firms, Mimeo Derby College of Business, Law and Social Sciences, University of Derby.
- Czarnitzki, D., & Delanote, J. (2013). Young innovative companies: the new high-growth firms?. *Industrial and Corporate Change*, 22(5), 1315-1340.
- De Jong, J. P., & Marsili, O. (2006). The fruit flies of innovations: A taxonomy of innovative small firms. *Research Policy*, 35(2), 213-229.
- Dimitriu, S., and Salter, P. (2020). Unlocking Growth: How to Expand Access to Capital, A Report by The Entrepreneurs Network. [https://static1.squarespace.com/static/5e37fd531ca58730c0ed9ed7/t/5e66b86f7633b2769e222766/1583790311734/TEN6810\\_AccessToCapital\\_PRF4.pdf](https://static1.squarespace.com/static/5e37fd531ca58730c0ed9ed7/t/5e66b86f7633b2769e222766/1583790311734/TEN6810_AccessToCapital_PRF4.pdf)
- Ferrando, A., & Mulier, K. (2015). The real effects of credit constraints: evidence from discouraged borrowers in the euro area. European Central Bank Working Paper, 1842.
- Fraser, S. (2004) *Finance for Small and Medium-Sized Enterprises: A Report on the 2004 UK Survey of SME Finances*, Centre for Small and Medium-Sized Enterprises. Warwick Business School, Warwick.
- Fraser, S. (2009). Is there ethnic discrimination in the UK market for small business credit? *International Small Business Journal*, 27(5), 583-607.
- Fraser, S. (2014). Back to borrowing? Perspectives on the arc of discouragement. *Enterprise Research Centre, White Paper*, 8.
- Fraser, S., Bhaumik, S. K., & Wright, M. (2015). What do we know about entrepreneurial finance and its relationship with growth? *International Small Business Journal*, 33(1), 70-88.



- Freel, M. (2006). Patterns of technological innovation in knowledge-intensive business services. *Industry and Innovation*, 13(3), 335-358.
- Freel, M. S. (2007). Are small innovators credit rationed? *Small Business Economics*, 28(1), 23-35.
- Freel, M., Carter, S., Tagg, S., & Mason, C. (2012). The latent demand for bank debt: characterizing “discouraged borrowers”. *Small Business Economics*, 38(4), 399-418.
- Freel, M., Liu, R., & Rammer, C. (2019). The export additionality of innovation policy. *Industrial and Corporate Change*, 28(5), 1257–1277.
- Ghosal, V., & Ye, Y. (2015). Uncertainty and the employment dynamics of small and large businesses. *Small Business Economics*, 44(3), 529-558.
- Giraud, E., Giudici, G., & Grilli, L. (2019). Entrepreneurship policy and the financing of young innovative companies: Evidence from the Italian Startup Act. *Research Policy*, <https://doi.org/10.1016/j.respol.2019.05.010>.
- Grilli, L., & Murtinu, S. (2014). Government, venture capital and the growth of European high-tech entrepreneurial firms. *Research Policy*, 43(9), 1523-1543.
- Hall, B. H., & Lerner, J. (2010). The financing of R&D and innovation. In *Handbook of the Economics of Innovation* (Vol. 1, pp. 609-639). North-Holland, Amsterdam.
- Hall, B. H., Moncada-Paternò-Castello, P., Montresor, S., & Vezzani, A. (2016). Financing constraints, R&D investments and innovative performances: new empirical evidence at the firm level for Europe. *Journal of Innovation and New Technology*, 25 (3), 183-196.
- Han, L., Fraser, S., & Storey, D. J. (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.
- Hutton, W., & Nightingale, P. (2011). *The Discouraged Economy*. Big Innovation Centre, London.
- Kerr, W. R., Nanda, R., & Rhodes-Kropf, M. (2014). Entrepreneurship as experimentation. *Journal of Economic Perspectives*, 28(3), 25-48.

- Kerr, W. R., & Nanda, R. (2015). Financing innovation. *Annual Review of Financial Economics*, 7, 445-462.
- King, R. G., & Levine, R. (1993). Finance and growth: Schumpeter might be right. *Quarterly Journal of Economics*, 108(3), 717-737.
- Kon, Y., & Storey, D. J. (2003). A theory of discouraged borrowers. *Small Business Economics*, 21(1), 37-49.
- Knight, F.H. (1921). Risk, uncertainty and profit. New York: Hart, Schaffner and Marx.
- Lee, N., Sameen, H., & Cowling, M. (2015). Access to finance for innovative SMEs since the financial crisis. *Research Policy*, 44(2), 370-380.
- Levenson, A. R., & Willard, K. L. (2000). Do firms get the financing they want? Measuring credit rationing experienced by small businesses in the US. *Small Business Economics*, 14(2), 83-94.
- Liberti, J. M. & Petersen, M. A. (2019). Information: Hard and soft. *Review of Corporate Finance Studies*, 8(1), 1-41.
- Lim, I. & Nguyen, D-D. (2020) Political connections and access to finance for SMEs around the world: The role of discouraged borrowers, *Journal of International Business Studies*, forthcoming.
- Loch, C. H., Solt, M. E., & Bailey, E. M. (2008). Diagnosing unforeseeable uncertainty in a new venture. *Journal of Product Innovation Management*, 25(1), 28-46.
- Love, J. H., & Roper, S. (2015). SME innovation, exporting and growth: A review of existing evidence. *International Small Business Journal*, 33(1), 28-48.
- Love, J. H., Roper, S., & Zhou, Y. (2016). Experience, age and exporting performance in UK SMEs. *International Business Review*, 25(4), 806-819.
- Mac an Bhaird, C., Vidal, J. S., & Lucey, B. (2016). Discouraged borrowers: evidence for Eurozone SMEs. *Journal of International Financial Markets, Institutions and Money*, 44, 46-55.
- Mazzucato, M. (2013). Financing innovation: Creative destruction vs. destructive creation. *Industrial and Corporate Change*, 22(4), 851-867.

- Mijid, N. (2014). Why are female small business owners in the United States less likely to apply for bank loans than their male counterparts? *Journal of Small Business & Entrepreneurship*, 27(2), 229-249.
- Mina, A., Lahr, H., & Hughes, A. (2013). The demand and supply of external finance for innovative firms. *Industrial and Corporate Change*, 22(4), 869-901.
- Moro, A., Wisniewski, T. P., & Mantovani, G. M. (2017). Does a manager's gender matter when accessing credit? Evidence from European data. *Journal of Banking & Finance*, 80, 119-134.
- Myers, S., & Majluf, N. (1984). Corporate financing decisions when firms have investment information that investors do not. *Journal of Financial Economics*, 13(2), 187-221.
- Neville, F., Forrester, J. K., O'Toole, J., & Riding, A. (2018). Why Even Bother Trying? Examining Discouragement among Racial-Minority Entrepreneurs. *Journal of Management Studies*, 55(3), 424-456.
- Nguyen, H. T., Nguyen, H. M., Troege, M., & Nguyen, A. T. (2020). Debt aversion, education, and credit self-rationing in SMEs. *Small Business Economics*, 1-19.
- O'Connor, G. C., & Rice, M. P. (2013). A comprehensive model of uncertainty associated with radical innovation. *Journal of Product Innovation Management*, 30, 2-18.
- Paunov, C. (2012). The global crisis and firms' investments in innovation. *Research Policy*, 41(1), 24-35.
- Revest, V., & Sapio, A. (2012). Financing technology-based small firms in Europe: what do we know? *Small Business Economics*, 39(1), 179-205.
- Robb, A. M., & Robinson, D. T. (2014). The capital structure decisions of new firms. *Review of Financial Studies*, 27(1), 153-179.
- Roca, J. B., Vaishnav, P., Morgan, M. G., Mendonça, J., & Fuchs, E. (2017). When risks cannot be seen: Regulating uncertainty in emerging technologies. *Research Policy*, 46(7), 1215-1233.
- Rosenbaum, P. R., & Rubin DB. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika* 70, 41-55

Rostamkalaei, A., & Freel, M. (2016). The cost of growth: small firms and the pricing of bank loans. *Small Business Economics*, 46(2), 255-272.

Rostamkalaei, A. (2017). Discouraged borrowers aftermath of financial crisis: a UK study. *Journal of Small Business and Enterprise Development*, 24(2), 394-410.

Rostamkalaei, A., Nitani, M., & Riding, A. (2018). Borrower discouragement: the role of informal turndowns. *Small Business Economics*, 1-16.

Saridakis, G., Idris, B., Hansen, J. M., & Dana, L. P. (2019). SMEs' internationalisation: When does innovation matter? *Journal of Business Research*, 96, 250-263.

Schneider, C., & Veugelers, R. (2010). On young highly innovative companies: why they matter and how (not) to policy support them. *Industrial and Corporate Change*, 19(4), 969-1007.

Schumpeter, J. (1934). *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest and the Business Cycle*, Transaction Publishers, London.

Scottish Government (2019) Scottish National Investment Bank: Fairer Scotland Duty Assessment. Scottish Government, Edinburgh.

Teece, D., Peteraf, M., & Leih, S. (2016). Dynamic capabilities and organizational agility: Risk, uncertainty, and strategy in the innovation economy. *California Management Review*, 58(4), 13-35.

Ughetto, E. (2008). Does internal finance matter for R&D? New evidence from a panel of Italian firms. *Cambridge Journal of Economics*, 32(6), 907-925.

Wiersch, A, Lipman, B, Barclay, B. (2016). *Click, Submit: New Insights on Online Lender Applicants from the Small Business Credit Survey*. Federal Reserve Bank of Cleveland, Cleveland.

Williamson, O. E. (1988). Corporate finance and corporate governance. *Journal of Finance*, 43(3), 567-591.

Wilson, K. E. (2015), "Policy Lessons from Financing Innovative Firms", OECD Science, Technology and Industry Policy Papers, No. 24, OECD Publishing, Paris.

Xiang, D., Worthington, A. C., & Higgs, H. (2015). Discouraged finance seekers: An analysis of Australian small and medium-sized enterprises. *International Small Business Journal*, 33(7), 689-707.

Zhou, K. Z., & Li, C. B. (2012). How knowledge affects radical innovation: Knowledge base, market knowledge acquisition, and internal knowledge sharing. *Strategic Management Journal*, 33(9), 1090-1102.

**Table 1: Entrepreneurial and Firm-Level Drivers of Borrower Discouragement**

<b>Entrepreneurial Characteristics</b>	<b>Firm-Level Characteristics</b>
Older	Young
Female	Small
Ethnic minorities	Knowledge-intensive/service-sector
Low levels of human capital	Non-family-owned firms
Low levels of personal wealth	Exporter
Serial Entrepreneurs	Planning rapid growth
Experienced entrepreneurs	Fewer sources of banking relationships
No formal business plan	Non-relational banking relationship
Poor credit history	Non-urban or peripheral location

Notes: This table provides a summary of firm-level and entrepreneurial characteristics which are thought to be associated to borrower discouragement.

**Table 2 Summary Statistics**

	Mean	Std. Dev.	Observations
<b>DISCOURAGED BORROWER</b>			
Discouraged SME	0.090	0.286	12,382
<b>INNOVATION</b>			
Innovator (product or process)	0.398	0.490	12,495
Product innovator (goods and/or service)	0.340	0.474	12,495
<i>Goods innovator</i>	0.165	0.372	12,440
<i>Service innovator</i>	0.281	0.449	12,455
Process innovator	0.179	0.383	12,442
<b><i>Innovation types</i></b>			
Non-innovator (base category)	0.602	0.489	12,442
Pure product innovator	0.219	0.414	12,442
Pure process innovator	0.058	0.234	12,442
Product and process innovator	0.121	0.326	12,442
<b><i>Scope of product innovation</i></b>			
Non-product innovator (base category)	0.663	0.473	12,426
At least some new to the market (radical)	0.097	0.295	12,426
All just new to the business (incremental)	0.240	0.427	12,426
<b><i>Scope of process innovation</i></b>			
Non-process innovator (base category)	0.823	0.382	12,413
At least some new to the industry (radical)	0.038	0.190	12,413
All just new to the business (incremental)	0.140	0.347	12,413
<b>CONTROL VARIABLES</b>			
Aims to grow	0.518	0.500	12,495
<b><i>Size</i></b>			
Zero employees (base category)	0.661	0.473	12,460
Micro (1-9)	0.289	0.453	12,460
Small (10-49)	0.044	0.204	12,460
Medium (50-249)	0.006	0.078	12,460
<b><i>Business age</i></b>			
0 – 5 years (base category)	0.118	0.323	12,470
6 – 10 years	0.178	0.383	12,470
11 – 20 years	0.263	0.440	12,470
20+ years	0.441	0.497	12,470
<b><i>Turnover change</i></b>			
Decreased (base category)	0.197	0.398	12,240
Stayed the same	0.483	0.500	12,240
Increased	0.319	0.466	12,240
<b><i>Business characteristics</i></b>			
Urban area	0.711	0.453	12,473
Profit	0.839	0.368	12,143

Female led	0.212	0.408	12,056
Minority Ethnic Led	0.038	0.190	11,757
Family owned	0.847	0.360	12,367
<b>Legal status</b>			
Other (base category)	0.035	0.183	12,495
Sole proprietorship	0.486	0.500	12,495
Company	0.401	0.490	12,495
Partnership	0.078	0.268	12,495
<b>Region</b>			
England (base category)	0.875	0.331	12,495
Scotland	0.069	0.254	12,495
Wales	0.030	0.171	12,495
Northern Ireland	0.026	0.158	12,495
<b>Sector</b>			
ABCDEF (base category)	0.263	0.440	12,495
GHI	0.182	0.386	12,495
JKLMN	0.327	0.469	12,495
PQRS	0.228	0.420	12,495

Notes: This table reports the summary statistics using data from the Longitudinal Small Business Survey, 2015-2017. All variables are binary measures. Survey weights applied to represent the population of SMEs in the UK. Variable definitions are reported in Table A1 in the Appendix.



**Table 3: Definitions of Borrower Discouragement Used in Previous Studies**

<b>Study</b>	<b>Data Source</b>	<b>Technical Definition of a Discouraged Borrower</b>
Nguyen et al (2020)	Survey of Small and Medium-Sized Enterprises in Vietnam	<i>'the process is too difficult or don't want to incur debt'</i> (p. 5-6)
Rostamkalaei et al (2018)	UK SME Finance Monitor	<i>'they would be turned down, that it was not the right time to borrow, or that banks were not lending'</i> (p.398)
Gama et al (2017)	EDRB and World Bank Group's Business Environment and Enterprise Performance Survey (2008/09 BEEPS)	<i>'if it does not apply for a loan for different reasons, such as tough loan prices or loan contract procedures or fear of rationing, that is, the scale of discouragement as a function of bank screening errors, application costs, and the difference in interest rates between the bank and other money lenders'</i> (p. 35)
Moro et al (2017)	ECB Survey on the access to Finance of SMES (SAFE)	<i>"did not apply due to anticipated rejection"</i> (p. 122)
Neville et al (2017)	US Federal Reserve Board's Survey of Small Business Finances (SSBF)	<i>'During the last three years, were there times when the firm needed credit, but did not apply because it thought the application would be turned down'</i> (p. 21)
Tang et al (2017)	Bespoke Survey in Hanan and Guangdong province, China	<i>'Have you decided not to apply for a loan anticipating a bank rejection'</i> (p. 529)
Cole and Sokolyk (2016)	US Federal Reserve Board's Survey of Small Business Finances (SSBF)	<i>'is a firm that did not apply for a loan during the previous 3 years because the firm feared rejection, even though it needed credit'</i> (p. 47)
Cowling et al (2016)	UK SME Business Barometer Surveys	<i>'demand for but not applying for any finance either because the firm feared rejection or the owner thought the finance was too expensive'</i> (p. 1054)
Mac an Bhaird et al (2016)	ECB Survey on the access to Finance of SMES (SAFE)	<i>'With respect to banks' loans (either new or renewal): did you apply for them over the past 6 months, or not? 1. Applied. 2: No, because of possible rejection'</i> (p. 49)
Christensen and Hain (2014)	Bespoke panel sample of SMEs in North Jutland, Denmark	<i>'Did expectations of rejection make you abstain from applying for external finance for either development activities or working capital during the past year'</i> (p.14)
Chakravarty and Xiang (2013)	World Bank Enterprise Surveys	<i>'as firms with a need for a loan who nevertheless choose to not apply for a bank loan because (1) the loan procedure was too</i>

*complicated; (2) interest rates were too high; (3) collateral requirement were too high; and (4) there was corruption in allocation' (p. 67)*

Freel et al (2012)	UK biennial survey by the Federation of Small Businesses	<i>'in the past two years has the fear of rejection stopped you from seeking a bank loan for your business' (p. 407)</i>
Chandler (2010)	Statistic Canada's Survey on Financing of Small and Medium Enterprises, 2004	<i>'fear of being turned down, difficulty of applying and the length of the application procedure'</i>
Han et al (2009)	US Survey of Small Business Finances	<i>'all businesses (both high and low risk) with capital demands, but which did not apply because of fear of rejection' (p.416)</i>

Notes: This table outlines the technical definitions used within a selection of empirical studies examining discouraged borrowers, which have been published since 2009. This variation hinges on the different definitional issues utilised within surveys that have investigated borrower discouragement.

**Table 4 Probit Estimation Results: Product and Process Innovation & Borrower Discouragement**

	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>
Innovator (product or process) t-1	0.024*** (3.60)		
Innovator (goods) t-1		0.031*** (3.38)	
Innovator (services) t-1		0.016** (2.12)	
Product innovator (good and/or services) t-1			0.021*** (2.97)
Process innovator t-1			0.020** (2.46)
Aims to grow t-1	0.034*** (4.68)	0.034*** (4.74)	0.033*** (4.54)
Size t-1: Micro	0.013 (1.42)	0.014 (1.47)	0.012 (1.25)
Size t-1: Small	0.018* (1.66)	0.020* (1.80)	0.017 (1.50)
Size t-1: Medium	-0.006 (-0.52)	-0.005 (-0.40)	-0.009 (-0.74)
Business age: 6 – 10 years	0.004 (0.22)	0.005 (0.28)	0.004 (0.27)
Business age: 11 – 20 years	-0.003 (-0.17)	-0.004 (-0.30)	-0.003 (-0.19)
Business age: 20+ years	-0.025* (-1.96)	-0.026** (-2.02)	-0.025* (-1.93)
Location t: Urban area	-0.003 (-0.35)	-0.003 (-0.39)	-0.003 (-0.43)
Profit t-1	-0.098*** (-7.38)	-0.096*** (-7.26)	-0.096*** (-7.30)
Turnover change (stayed the same) t-1	-0.027*** (-2.72)	-0.027*** (-2.76)	-0.028*** (-2.80)
Turnover change (increased) t-1	-0.034*** (-3.31)	-0.035*** (-3.40)	-0.036*** (-3.45)
Female led t-1	0.005 (0.61)	0.005 (0.56)	0.005 (0.60)
Minority Ethnic Led t-1	0.079*** (3.09)	0.079*** (3.05)	0.079*** (3.10)

Family owned t-1	0.011 (1.40)	0.013 (1.62)	0.012 (1.47)
Legal status t: Sole proprietorship	0.003 (0.13)	-0.000 (-0.00)	0.005 (0.23)
Legal status t: Company	-0.009 (-0.49)	-0.012 (-0.62)	-0.007 (-0.35)
Legal status t: Partnership	-0.016 (-0.74)	-0.016 (-0.75)	-0.013 (-0.60)
Region t: Scotland	0.033** (2.22)	0.033** (2.22)	0.031** (2.08)
Region t: Wales	-0.004 (-0.19)	-0.003 (-0.18)	-0.004 (-0.22)
Region t: Northern Ireland	0.031 (1.50)	0.031 (1.51)	0.030 (1.47)
Sector t: GHI	-0.018* (-1.69)	-0.019* (-1.77)	-0.017 (-1.55)
Sector t: JKLMN	-0.026** (-2.56)	-0.025** (-2.47)	-0.027*** (-2.64)
Sector t: PQRS	-0.013 (-1.09)	-0.011 (-0.92)	-0.012 (-0.98)
Observations	7,406	7,365	7,383
Pseudo-R <sup>2</sup>	0.0547	0.0583	0.0570
Log pseudolikelihood	-2039.3	-2012.3	-2025.6
Wald chi2	209.67***	219.47***	219.07***

Note: This table reports average marginal effects from a probit regression. The dependent variable Discouraged borrower takes on a value of one if the firm was discouraged and did not apply for credit during the previous year. The excluded variables for control variables are: zero employees (size), 0-5 years (business age), 18-30 years old (owner's age), decreased (turnover change), other (legal status), England (region) and ABCDEF (sector). Standard errors are clustered at firm level in parentheses. \*\*\*, \*\* and \*Significant at the 1%, 5% and 10% levels respectively.

**Table 5 Probit Estimation Results: Scope of Innovation & Borrower Discouragement**

	<b>Model 1</b>	<b>Model 2</b>	<b>Model 3</b>
Pure product innovation t-1	0.014*		
	(1.80)		
Pure process innovation t-1	0.005		
	(0.43)		
Product & process innovation t-1	0.045***		
	(4.53)		
Product innovation: At least some new to the market t-1		0.036***	
		(3.34)	
Product innovation: All just new to the business t-1		0.023***	
		(2.98)	
Process innovation: At least some new to the industry t-1			0.041**
			(2.49)
Process innovation: All just new to the business t-1			0.025***
			(2.81)
Aims to grow t-1	0.034***	0.033***	0.036***
	(4.59)	(4.57)	(4.94)
Size t-1: Micro	0.012	0.013	0.012
	(1.25)	(1.36)	(1.24)
Size t-1: Small	0.017	0.019*	0.017
	(1.48)	(1.69)	(1.50)
Size t-1: Medium	-0.009	-0.005	-0.009
	(-0.73)	(-0.46)	(-0.73)
Business age: 6 – 10 years	0.005	0.004	0.003
	(0.31)	(0.25)	(0.17)
Business age: 11 – 20 years	-0.002	-0.003	-0.003
	(-0.17)	(-0.20)	(-0.22)
Business age: 20+ years	-0.024*	-0.025**	-0.025*
	(-1.91)	(-1.98)	(-1.95)
Location t: Urban area	-0.003	-0.002	-0.003
	(-0.43)	(-0.20)	(-0.40)
Profit t-1	-0.096***	-0.097***	-0.097***
	(-7.30)	(-7.32)	(-7.31)
Turnover change (stayed the same) t-1	-0.029***	-0.029***	-0.027***

	(-2.86)	(-2.89)	(-2.72)
Turnover change (increased) t-1	-0.036***	-0.035***	-0.034***
	(-3.48)	(-3.44)	(-3.26)
Female led t-1	0.005	0.006	0.006
	(0.61)	(0.69)	(0.63)
Minority Ethnic Led t-1	0.079***	0.083***	0.079***
	(3.10)	(3.18)	(3.07)
Family owned t-1	0.012	0.011	0.011
	(1.50)	(1.45)	(1.35)
Legal status t: Sole proprietorship	0.005	0.003	0.005
	(0.25)	(0.16)	(0.23)
Legal status t: Company	-0.006	-0.009	-0.006
	(-0.33)	(-0.48)	(-0.31)
Legal status t: Partnership	-0.012	-0.014	-0.013
	(-0.57)	(-0.66)	(-0.61)
Region t: Scotland	0.030**	0.032**	0.031**
	(2.04)	(2.16)	(2.07)
Region t: Wales	-0.004	-0.007	-0.004
	(-0.24)	(-0.39)	(-0.19)
Region t: Northern Ireland	0.030	0.032	0.030
	(1.46)	(1.56)	(1.45)
Sector t: GHI	-0.017	-0.018*	-0.017
	(-1.55)	(-1.69)	(-1.57)
Sector t: JKLMN	-0.027***	-0.027***	-0.026***
	(-2.64)	(-2.65)	(-2.62)
Sector t: PQRS	-0.011	-0.014	-0.009
	(-0.94)	(-1.15)	(-0.78)
Observations	7,383	7,371	7,368
Pseudo-R <sup>2</sup>	0.0574	0.0558	0.0548
Log pseudolikelihood	-2024.7	-2025.0	-2024.6
Wald chi2	222.01***	210.78***	214.78***

Note: This table reports average marginal effects from a probit regression. The dependent variable Discouraged borrower takes on a value of one if the firm was discouraged and did not apply for credit during the previous year. The excluded variables for control variables are: zero employees (size), 0-5 years (business age), 18-30 years old (owner's age), decreased (turnover change), other (legal status), England (region) and ABCDEF (sector). Standard errors are clustered at firm level in parentheses. \*\*\*, \*\* and \* Significant at the 1%, 5% and 10% levels respectively.

**Table 6 Probit Estimation Results: Probability of Switching from Non-Discouraged to Discouraged Borrower Status rather than staying in the Non-Discouraged Borrower Status**

$DV \begin{cases} 1 = ND_{t-1} \rightarrow D_t \\ 0 = ND_{t-1} \rightarrow ND_t \end{cases}$	Model 1	Model 2	Model 3
Innovator (product or process) t-1	0.015*** (2.60)		
Innovator (goods) t-1		0.025*** (2.98)	
Innovator (services) t-1		0.006 (0.87)	
Product innovator (good and/or services) t-1			0.012** (1.96)
Process innovator t-1			0.015** (1.97)
Aims to grow t-1	0.027*** (4.35)	0.027*** (4.27)	0.026*** (4.16)
Size t-1: Micro	0.016** (2.12)	0.017** (2.26)	0.016** (2.08)
Size t-1: Small	0.018** (2.01)	0.019** (2.14)	0.017* (1.91)
Size t-1: Medium	0.012 (1.16)	0.013 (1.27)	0.011 (1.07)
Business age: 6 – 10 years	0.006 (0.45)	0.007 (0.51)	0.007 (0.49)
Business age: 11 – 20 years	0.010 (0.75)	0.008 (0.66)	0.010 (0.75)
Business age: 20+ years	-0.024** (-2.18)	-0.024** (-2.24)	-0.023** (-2.15)
Location t: Urban area	-0.001 (-0.08)	-0.000 (-0.04)	-0.001 (-0.10)
Profit t-1	-0.057*** (-5.00)	-0.055*** (-4.89)	-0.057*** (-4.99)
Turnover change (stayed the same) t-1	-0.028*** (-3.02)	-0.028*** (-3.00)	-0.029*** (-3.06)
Turnover change (increased) t-1	-0.033*** (-3.50)	-0.033*** (-3.52)	-0.034*** (-3.58)
Female led t-1	-0.004 (-0.55)	-0.004 (-0.57)	-0.003 (-0.46)
Minority Ethnic Led t-1	0.056***	0.055**	0.056***

	(2.59)	(2.52)	(2.59)
Family owned t-1	0.006	0.008	0.007
	(0.97)	(1.23)	(1.05)
Legal status t: Sole proprietorship	-0.013	-0.017	-0.013
	(-0.59)	(-0.73)	(-0.57)
Legal status t: Company	-0.031	-0.034*	-0.031
	(-1.55)	(-1.67)	(-1.55)
Legal status t: Partnership	-0.032	-0.034	-0.032
	(-1.49)	(-1.55)	(-1.49)
Region t: Scotland	0.015	0.015	0.014
	(1.28)	(1.27)	(1.22)
Region t: Wales	0.006	0.006	0.005
	(0.32)	(0.32)	(0.30)
Region t: Northern Ireland	0.027	0.027	0.026
	(1.44)	(1.44)	(1.39)
Sector t: GHI	-0.017*	-0.016*	-0.016*
	(-1.82)	(-1.75)	(-1.66)
Sector t: JKLMN	-0.024***	-0.022**	-0.024***
	(-2.79)	(-2.57)	(-2.81)
Sector t: PQRS	-0.021**	-0.019*	-0.020*
	(-2.02)	(-1.78)	(-1.94)
Observations	6,687	6,653	6,671
Pseudo-R <sup>2</sup>	0.0474	0.0498	0.0492
Log pseudolikelihood	-1453.1	-1436.9	-1449.3
Wald chi2	143.06***	150.06***	147.50***

Note: This table reports average marginal effects from a probit regression. The dependent variable takes on a value of one if the firm switch from non-discouraged to discouraged borrower status and zero if it remained as non-discouraged borrower. The excluded variables for control variables are: zero employees (size), 0-5 years (business age), 18-30 years old (owner's age), decreased (turnover change), other (legal status), England (region) and ABCDEF (sector). Standard errors are clustered at firm level in parentheses. \*\*\*, \*\* and \* Significant at the 1%, 5% and 10% levels respectively.



**Table 7 Probit Estimation Results: Probability of Switching from Non-Discouraged to Discouraged Borrower Status rather than staying in the Non-Discouraged Borrower Status**

DV $\begin{cases} 1 = ND_{t-1} \rightarrow D_t \\ 0 = ND_{t-1} \rightarrow ND_t \end{cases}$	Model 1	Model 2	Model 3
Pure product innovation t-1	0.008 (1.16)		
Pure process innovation t-1	0.005 (0.46)		
Product <b>and</b> process innovation t-1	0.030*** (3.34)		
Product innovation: At least some new to the market t-1		0.018* (1.90)	
Product innovation: All just new to the business t-1		0.017** (2.44)	
Process innovation: At least some new to the industry t-1			0.027* (1.82)
Process innovation: All just new to the business t-1			0.017** (2.17)
Aims to grow t-1	0.026*** (4.20)	0.027*** (4.31)	0.027*** (4.42)
Size t-1: Micro	0.016** (2.08)	0.016** (2.10)	0.016** (2.05)
Size t-1: Small	0.017* (1.89)	0.018** (2.06)	0.017* (1.90)
Size t-1: Medium	0.012 (1.09)	0.013 (1.23)	0.011 (1.08)
Business age: 6 – 10 years	0.007 (0.53)	0.007 (0.47)	0.005 (0.35)
Business age: 11 – 20 years	0.010 (0.77)	0.010 (0.79)	0.009 (0.68)
Business age: 20+ years	-0.023** (-2.13)	-0.023** (-2.18)	-0.024** (-2.18)
Location t: Urban area	-0.001 (-0.10)	0.000 (0.00)	-0.000 (-0.04)
Profit t-1	-0.057*** (-4.98)	-0.056*** (-4.95)	-0.056*** (-4.94)
Turnover change (stayed the same) t-1	-0.029***	-0.029***	-0.028***

	(-3.09)	(-3.11)	(-3.01)
Turnover change (increased) t-1	-0.034***	-0.033***	-0.032***
	(-3.60)	(-3.52)	(-3.45)
Female led t-1	-0.003	-0.004	-0.003
	(-0.46)	(-0.55)	(-0.43)
Minority Ethnic Led t-1	0.056***	0.059***	0.056***
	(2.59)	(2.65)	(2.58)
Family owned t-1	0.007	0.007	0.006
	(1.08)	(1.04)	(0.95)
Legal status t: Sole proprietorship	-0.013	-0.009	-0.013
	(-0.56)	(-0.42)	(-0.59)
Legal status t: Company	-0.031	-0.028	-0.030
	(-1.54)	(-1.40)	(-1.51)
Legal status t: Partnership	-0.032	-0.029	-0.032
	(-1.47)	(-1.33)	(-1.47)
Region t: Scotland	0.014	0.015	0.014
	(1.18)	(1.30)	(1.22)
Region t: Wales	0.005	0.006	0.006
	(0.28)	(0.34)	(0.31)
Region t: Northern Ireland	0.026	0.029	0.026
	(1.39)	(1.50)	(1.38)
Sector t: GHI	-0.016*	-0.017*	-0.016*
	(-1.66)	(-1.84)	(-1.69)
Sector t: JKLMN	-0.024***	-0.024***	-0.024***
	(-2.80)	(-2.84)	(-2.84)
Sector t: PQRS	-0.020*	-0.022**	-0.019*
	(-1.91)	(-2.13)	(-1.82)
Observations	6,671	6,658	6,660
Pseudo-R <sup>2</sup>	0.0495	0.0478	0.0472
Log pseudolikelihood	-1448.9	-1448.1	-1446.4
Wald chi2	148.52***	142.98***	144.64***

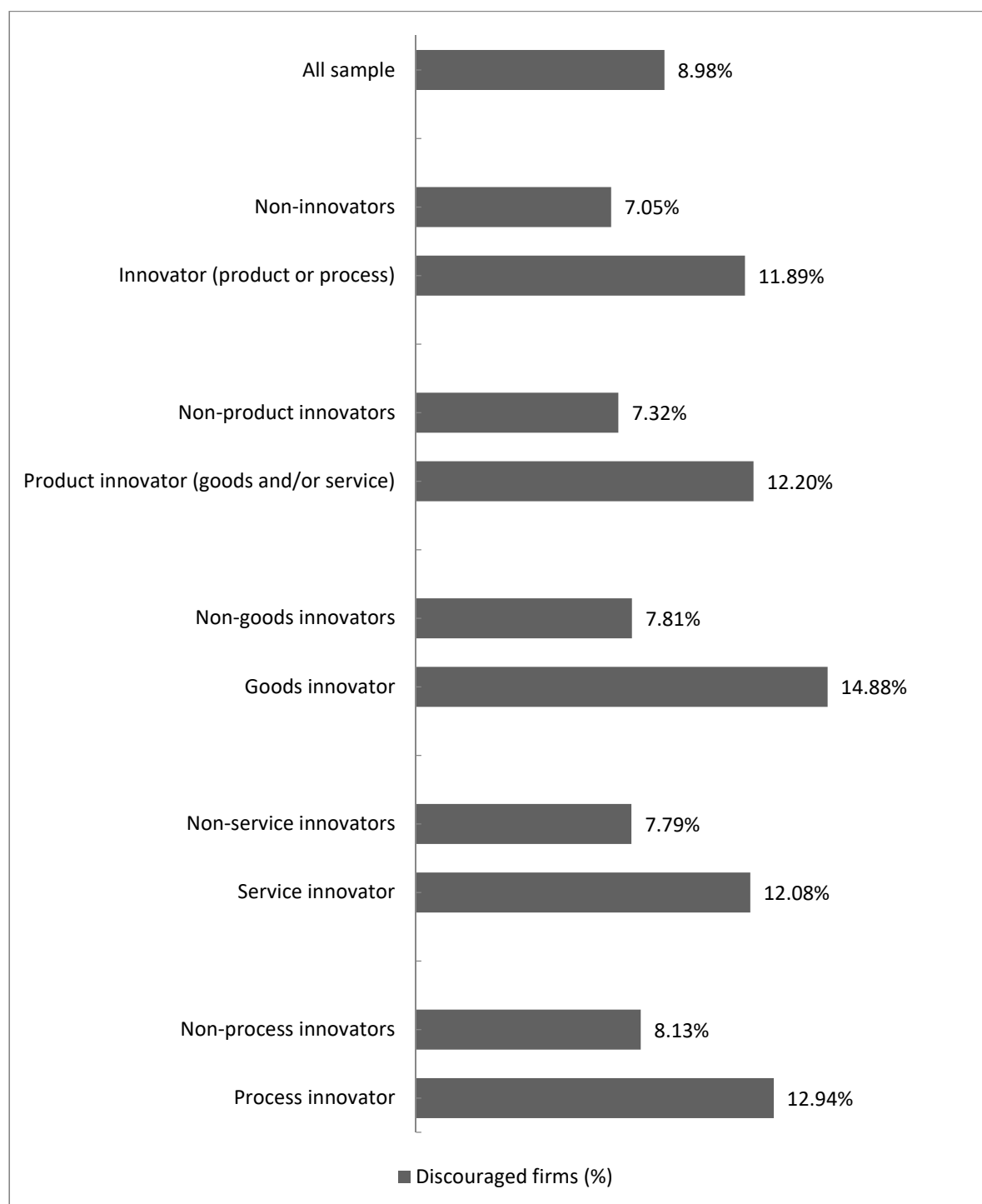
Note: This table reports average marginal effects from a probit regression. The dependent variable takes on a value of one if the firm switch from non-discouraged to discouraged borrower status and zero if it remained as non-discouraged borrower. The excluded variables for control variables are: zero employees (size), 0-5 years (business age), 18-30 years old (owner's age), decreased (turnover change), other (legal status), England (region) and ABCDEF (sector). Standard errors are clustered at firm level in parentheses. \*\*\*, \*\* and \* Significant at the 1%, 5% and 10% levels respectively.

**Table 8 Propensity score matching: average treatment effect on the treated (ATET) of being an innovative SME on the likelihood of being discouraged borrower**

		Survey Waves		
	Whole sample	2015	2016	2017
<b>Panel A: One match per observation</b>				
ATET	0.047*** (7.29)	0.032*** (2.64)	0.055*** (4.86)	0.045*** (4.35)
N	11860	3883	3985	3992
<b>Panel B: Four matches per observation</b>				
ATET	0.048*** (8.20)	0.046*** (4.41)	0.051*** (4.65)	0.045*** (4.66)
N	11860	3883	3985	3992
<b>Panel C: Eight matches per observation</b>				
ATET	0.044*** (7.44)	0.048*** (4.70)	0.057*** (5.56)	0.042*** (4.47)
N	11860	3883	3985	3992

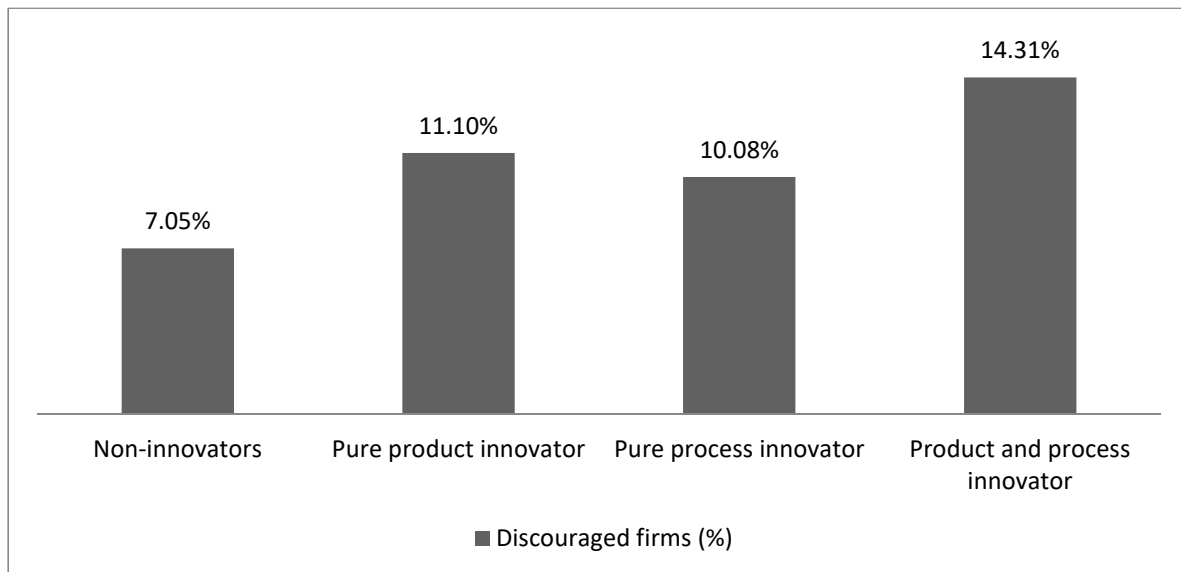
Notes: This table shows the computation of the average treatment effect of the treated (ATET). That is for a SME, on average, the effect of being innovative on the likelihood of being discouraged borrower. We match innovative firms with one, four and eight corresponding non-innovative firms. To Robust z-statistics are reported in parentheses. \*\*\*, \*\* and \*Significant at the 1%, 5% and 10% levels respectively.

**Figure 1 Discouraged firms by Type of product and process Innovation (% of firms)**



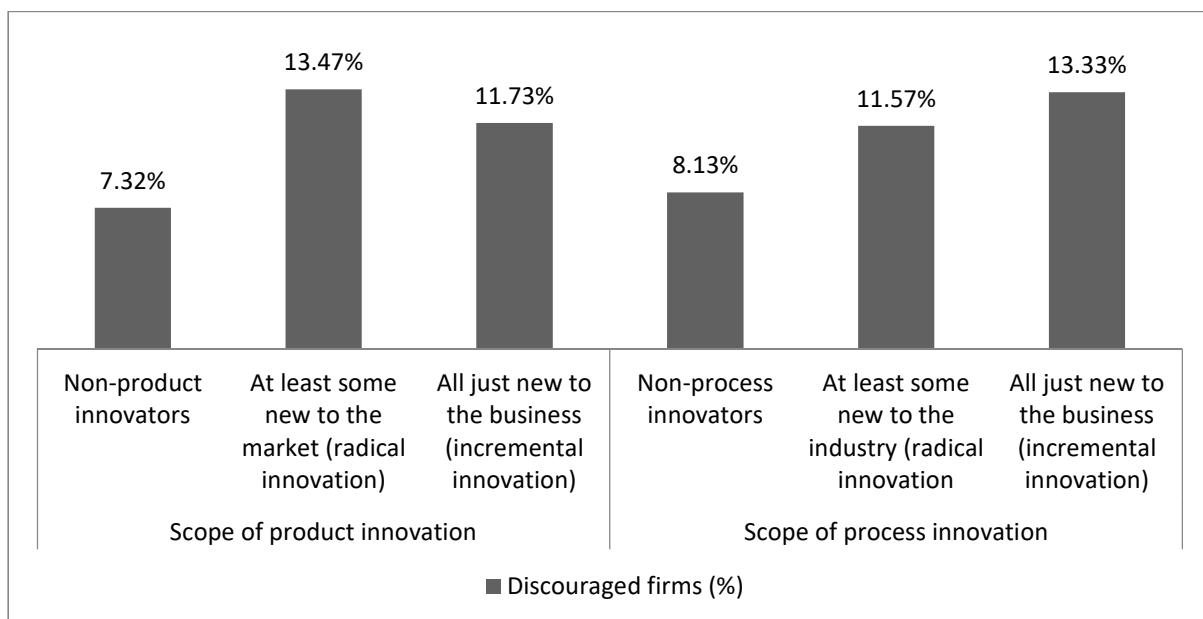
Notes: This Figure shows the percentage of SMEs which are discouraged across different types of product and process innovation compared to non-innovators based on the Longitudinal Small Business Survey, 2015-2017. Survey weights applied. Definitions of variables used in the analysis are given in Table A1 in the Appendix.

**Figure 2 Discouraged Firms by Types of combined Innovation (% of firms)**



Notes: This Figure shows the percentage of SMEs which discouraged across different combinations of innovation compared to non-innovators based on the Longitudinal Small Business Survey, 2015-2017. Survey weights applied. Definitions of variables used in the analysis are given in Table A1 in the Appendix.

**Figure 3 Discouraged Firms by Scope of Innovation (% of firms)**



Notes: This Figure shows the percentage of SMEs which discouraged across different types of innovation (radical versus incremental) compared to non-innovators, based on the Longitudinal Small Business Survey, 2015-2017. Survey weights applied. Definitions of variables used in the analysis are given in Table A1 in the Appendix.

## Appendix: Additional Tables and Figures

**Table A1 Variable definition**

<b>Variable</b>	<b>Definition</b>
<b>DISCOURAGED BORROWER</b>	
Discouraged SME	SME had a need for finance in the last 12 months but did not apply.
<b>INNOVATION</b>	
Innovation (product or process)	Introduction of product OR process innovation.
Product innovation (goods and/or service)	Introduction of new or significantly improved goods and/or services.
Goods innovation	New or significantly improved goods in the last 3 years. This excludes the resale of goods purchased from other businesses, or changes of a solely aesthetic nature.
Service innovation	New or significantly improved services in the last 3 years.
Process innovation	Business introduced any new or significantly improved processes for producing or supplying goods or services in the last three years.
<b><i>Innovation types</i></b>	
No innovation (base category)	Firm has not been an innovator in the last three years.
Pure product innovation	Business introduced any new or significantly improved goods and/or services in the last three years.
Pure process innovation	Business introduced any new or significantly improved processes for producing or supplying goods or services in the last three years.
Product and process innovation	Introduction of product AND process innovation.
<b><i>Scope of product innovation</i></b>	
No product innovation (base category)	Business has not introduced any product innovation in the last three years.
At least some new to the market	If introduced any new or significantly improved goods or services innovations: they were at least some new to the market.
All just new to the business	If introduced any new or significantly improved goods or services innovations: they were all just new to the business.
<b><i>Scope of process innovation</i></b>	
No process innovation (base category)	Business has not introduced any process innovation in the last three years.
At least some new to the industry	If introduced any improved processes for producing or supplying goods or services in the last three years: they were at least some new to the industry.
All just new to the business	If introduced any improved processes for producing or supplying goods or services in the last three years: they were all just new to the business.
<b>CONTROL VARIABLES</b>	
Aims to grow	Aim to grow sales over the next 3 years.

<i>Size</i>	Zero employees (base category)	
	Micro	1-9 employees.
	Small	10-49 employees.
	Medium	50-249 employees.
<i>Business age</i>		Age of the firm.
	0 – 5 years (base category)	
	6 – 10 years	
	11 – 20 years	
	20+ years	
<i>Urban area</i>		Broad urban/rural categorisation from postcode.
<i>Profit</i>		Firm generate a profit or surplus after taking into account all sources of income in the last financial year.
<i>Turnover change</i>		Turnover in the past 12 months, compared with the previous 12 months.
	Decreased (base category)	
	Stayed the same	
	Increased	
<i>Female led</i>		Business is women-led.
<i>Minority Ethnic Led</i>		Business is MEG-led.
<i>Family owned</i>		Business a family owned business (i.e. one which is majority owned by members of the same family).
<i>Legal status</i>		Legal for of the firm.
	Other (base category)	
	Sole proprietorship	
	Company	
	Partnership	
<i>Region</i>		Region where the firm has its headquarters.
	England (base category)	
	Scotland	
	Wales	
	Northern Ireland	
<i>Sector</i>		
	ABCDEF (base category)	Production and construction.
	GHI	Transport, retail and food service/ accommodation.
	JKLMN	Business services.
	PQRS	Other services.

Notes: Table A1 shows variable names and definitions of our dependent and explanatory variables. All variables are binary and were gathered from the Longitudinal Small Business Survey, 2015-2017.

**Table A2 Pairwise correlations**

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Aim to grow	(1)	1											
Size	(2)	0.2619*	1										
Business age	(3)	-0.0690*	0.1901*	1									
Urban	(4)	0.0547*	0.0983*	-0.0375*	1								
Profit	(5)	0.0082	0.0172	-0.0006	-0.0169	1							
Turnover change	(6)	0.1865*	0.1366*	-0.0762*	-0.009	0.1843*	1						
Female led	(7)	-0.0655*	0.0244	0.0024	0.0136	-0.0639*	-0.0204	1					
Minority led	(8)	0.018	-0.0227	-0.0298*	0.0579*	0.0069	-0.0009	0.0069	1				
Family owned	(9)	-0.1283*	-0.3084*	-0.0654*	-0.1288*	0.1084*	-0.0478*	-0.0918*	0.0290*	1			
Legal status	(10)	0.1019*	0.0996*	-0.0051	-0.0656*	0.0847*	0.0332*	-0.1597*	0.0246	0.0526*	1		
Region	(11)	0.0084	0.0094	-0.0106	-0.0692*	-0.0215	-0.0206	-0.0035	-0.0267	0.0096	-0.0041	1	
Sector	(12)	-0.0037	0.0793*	-0.0520*	0.1596*	-0.0688*	0.021	0.2358*	0.0481*	-0.2374*	-0.1885*	-0.0495*	1

Notes: Pairwise correlations among the variables used in the empirical analysis are reported in this Table. \* correlations significant at the 1% level. Definitions of variables presented in this Table are reported in Table A1 in the Appendix.



**Table A3 Probit Estimation Results: Probability of switching from Discouraged to Non-Discouraged Borrower Status rather than staying in the Discouraged Borrower status.**

DV $\begin{cases} 1 = D_{t-1} \rightarrow ND_t \\ 0 = D_{t-1} \rightarrow D_t \end{cases}$	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Innovator (product <b>or</b> process) t-1	-0.004 (-0.11)					
Innovator (goods) t-1		-0.008 (-0.19)				
Innovator (services) t-1		-0.036 (-0.93)				
Product innovator (good and/or services) t-1			-0.030 (-0.80)			
Process innovator t-1			0.006 (0.14)			
Pure product innovation t-1				-0.008 (-0.18)		
Pure process innovation t-1				0.061 (0.91)		
Product <b>and</b> process innovation t-1				-0.028 (-0.61)		
Product innovation: At least some new to the market t-1					-0.068 (-1.39)	
Product innovation: All just new to the business t-1					0.001 (0.02)	
Process innovation: At least some new to the industry t-1						-0.048 (-0.73)
Process innovation: All just new to the business t-1						0.000 (0.01)
Observations	687	684	682	682	682	678
Full set of controls	YES	YES	YES	YES	YES	YES
Pseudo-R <sup>2</sup>	0.058	0.060	0.059	0.061	0.063	0.060
Log pseudolikelihood	-408.1	-404.6	-404.0	-403.6	-401.9	-402.4
Wald chi2	47.8***	49.1***	48.1***	49.4***	53.0***	48.8***

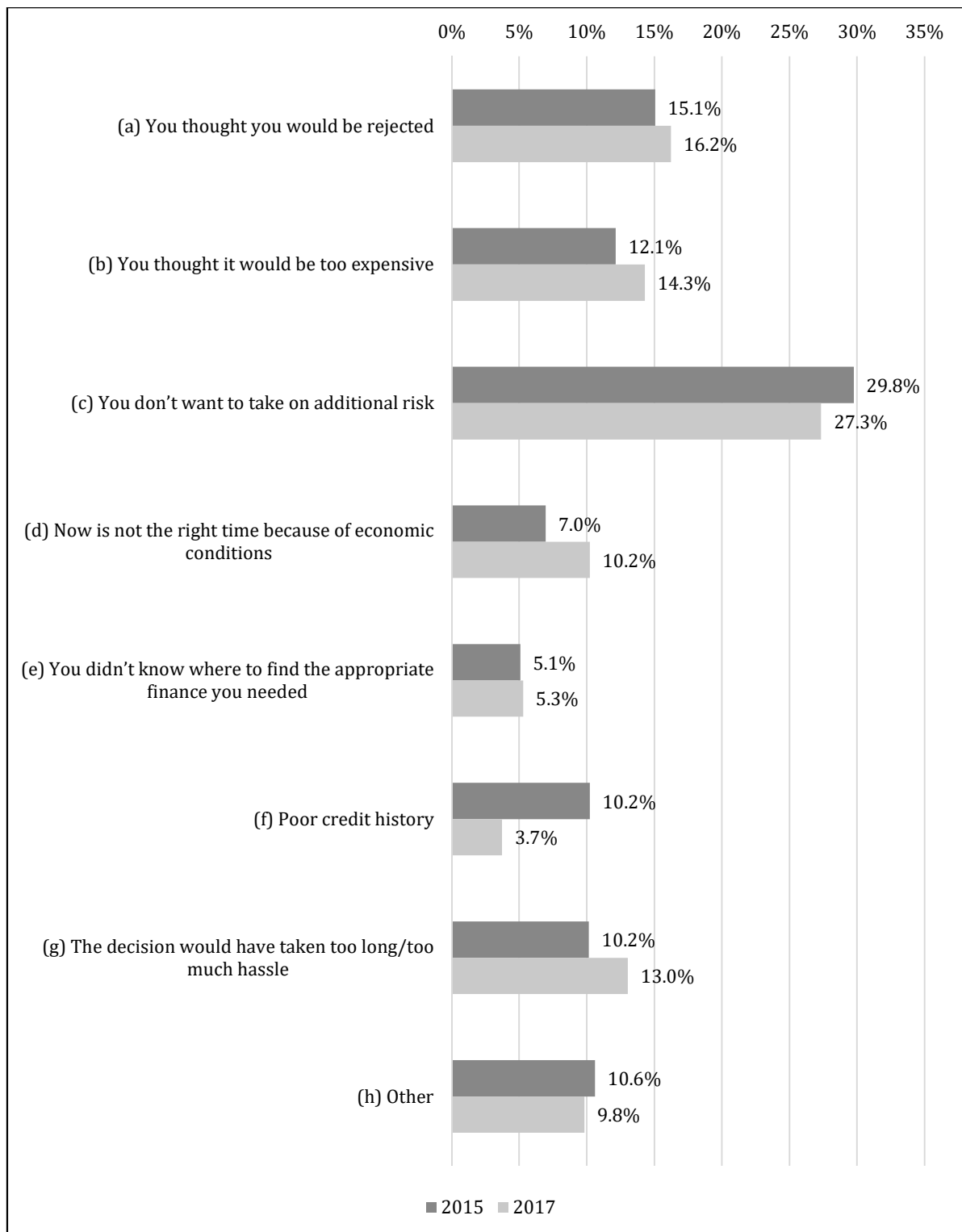
Note: This table reports average marginal effects from a probit regression. For the sake of brevity we only report the coefficients of the innovation variables. We follow the same methodology to estimate models reported in Tables 6-7. Standard errors are clustered at firm level in parentheses. \*\*\*, \*\* and \* Significant at the 1%, 5% and 10% levels respectively.

**Table A4 Covariate balance summary**

	Standardized differences		Variance ratio	
	Raw	Matched	Raw	Matched
Aims to grow	0.4864	-0.0044	0.6550	1.0068
Size: Micro	-0.0686	0.0035	0.9485	1.0030
Size: Small	0.0892	0.0039	1.0922	1.0034
Size: Medium	0.1736	-0.0053	1.3672	0.9921
Age: 6 – 10 years	0.0441	0.0048	1.1080	1.0107
Age: 11 – 20 years	0.0392	0.0232	1.0663	1.0380
Age: 20+ years	-0.0809	-0.0097	1.0373	1.0037
Location: Urban	0.0647	-0.0227	0.9421	1.0236
Profit	-0.0185	-0.0235	1.0376	1.0481
Turnover: Stay the same	-0.2290	-0.0282	0.9297	0.9852
Turnover: Increase	0.2743	0.0220	1.1183	1.0033
Legal: Sole proprietorship	-0.1561	0.0121	0.7121	1.0315
Legal: Company	0.1945	-0.0200	0.8274	1.0254
Legal: Partnership	-0.0907	0.0271	0.7832	1.0860
Region: Scotland	-0.0135	0.0705	0.9573	1.2851
Region: Wales	-0.0300	0.0492	0.8495	1.3569
Region: Northern Ireland	-0.0066	0.0304	0.9656	1.1858
Sector: GHI	-0.1829	0.0073	0.7826	1.0120
Sector: JKLMN	0.1419	-0.0247	1.0967	0.9884
Sector: PQRS	0.0515	0.0085	1.0754	1.0116
Number of observations	11,860	11,304	11,860	11,304
Treated observations	5,652	5,652	5,652	5,652
Control observations	6,208	5,652	6,208	5,652

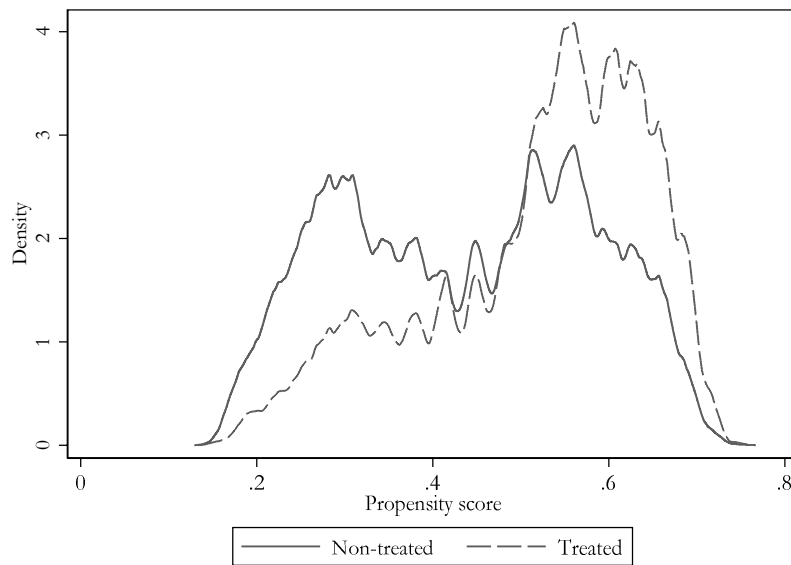
Notes: Standardized differences (which take into account both means and variances) and the variance ratio for the raw and matched sample of SMEs are reported in this Table. The standardized differences are all close to zero, and the variance ratios are all close to one, which indicate that matching on the estimated propensity score balanced the covariates. Covariate balance summary used to estimate the ATET in Table 8, Panel A (1 match per observation) for the whole sample. Results for Panels B, C and across years offer similar results and available upon request. The test is implemented via Stata's *tebalance* command.

**Figure A1. Main reasons for borrower discouragement (as percentage of discouraged borrowers)**



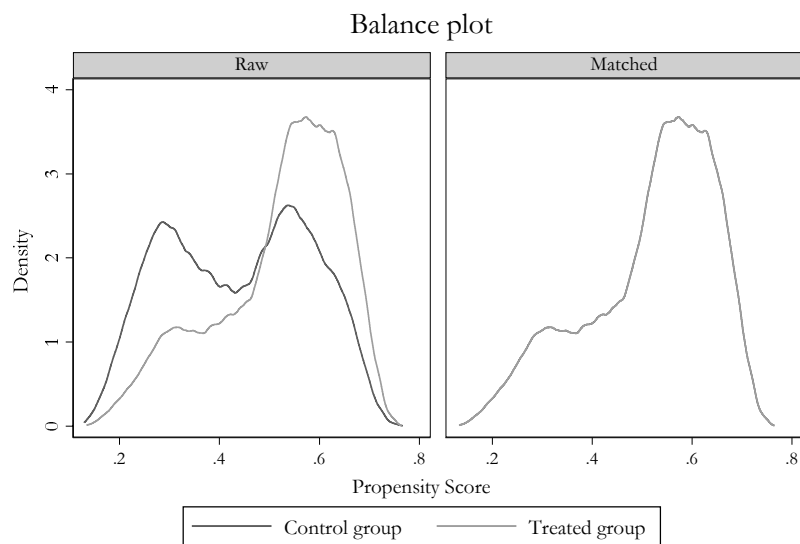
Note: This table shows the percentage of discouraged borrowers classified by main reasons of discouragement. Survey weights for the year under analysis are used to calculate the means.

**Figure A2. Overlap plot for treatment group**



Notes: This Figure allows us to check whether the overlap assumption is valid, which states that each firm has a positive probability of receiving each treatment level. This Figure is based on results reported in Table 8, Panel A (1 match per observation) for the whole sample. Results for Panels B, C and across years offer similar results and available upon request.

**Figure A3. Density plots for the propensity score**



Notes: This Figure shows kernel density plots that are used to check for covariate balance after estimation. The density plots for the matched sample are nearly indistinguishable, implying that matching on the estimated propensity score balanced the covariates. This Figure is based on results reported in Table 8, Panel A (1 match per observation) for the whole sample. Results for Panels B, C and across years offer similar results and available upon request.



**The Centre for Responsible Banking & Finance  
CRBF Working Paper Series**

School of Management, University of St Andrews  
The Gateway, North Haugh,  
St Andrews, Fife,  
KY16 9RJ.

Scotland, United Kingdom  
<http://www.st-andrews.ac.uk/business/rbf/>



**Recent CRBF Working papers published in this Series**

**Third Quarter | 2020**

20-013 **Ivan Lim and Duc Duy Nguyen:** Hometown Lending.

20-012 **Dimitris K. Chronopoulos, Marcel Lukas, John O.S. Wilson:** Consumer Spending Responses to the COVID-19 Pandemic: An Assessment of Great Britain.

20-011 **Xiaping Cao, Frank Hong Liu, Yue Zhou:** Doing Good for Borrowing? Evidence from a Quasi-Natural Experiment on Bank Deregulation.

**Second Quarter | 2020**

20-010 **Dimitris Andriosopoulos and Sheikh Tanzila Deepty:** Can Social Capital and Reputation Mitigate Political and Industry-wide Risk?

20-009 **Ross Brown, Ronald V. Kalafsky, Suzanne Mawson, Lori Davis:** Shocks, Uncertainty and Regional Resilience: The Case of Brexit and Scottish SMEs.

20-008 **Ross Brown and Augusto Rocha:** Entrepreneurial Uncertainty during the Covid-19 Crisis: Mapping the Temporal Dynamics of Entrepreneurial Finance.

20-007 **Foly Ananou, Amine Tarazi, John O.S. Wilson:** Liquidity Regulation and Bank Lending.

20-006 **Marc Cowling, Ross Brown, Neil Lee:** The Geography of Business Angel Investments in the UK: Does Local Bias (Still) Matter?

**First Quarter | 2020**

20-005 **Donal McKillop, Declan French, Barry Quinn, Anna L. Sobiech, John O.S. Wilson:** Cooperative Financial Institutions: A Review of the Literature.



**University of St Andrews**  
*Scotland's first university*

**600 YEARS**  
**1413 – 2013**