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Luca Farè[a], Marcus Dejardin[b], Eric Toulemonde[c]

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Abstract

Small businesses often face a high risk of bankruptcy and harsh financing conditions, which can hamper them to engage in innovation. This paper investigates whether a bankruptcy system that guarantees a good recovery rate for creditors in case of firms' liquidation stimulates small businesses' innovation investments through lower interest rates and therefore easier access to credit. With the help of a borrower-lender model we derive insights about the interactions between bankruptcy recovery rate, borrowing interest rates and firms' investments in innovation. The model gives theoretical underpinnings for a subsequent empirical analysis. By using a cross-country sample of micro (1-9 employees)-, small (10-49 employees)-, and medium (50-249 employees)-sized enterprises (MSMEs), our study provides three main results. It shows that an increase in the bankruptcy recovery rate a) is positively associated to MSMEs' investments in innovation (*investment effect*); b) reduces the share of MSMEs that are credit constrained because the cost of borrowing is too high (*constraint effect*); c) reduces the interest rates dispersion for high profitable MSMEs (*dispersion effect*). Overall, our findings suggest that improving creditors recovery rate can help promoting the innovative behaviour of small businesses through easier financing conditions.

JEL codes: G20, G33, L25, O30

Keywords: innovation, bankruptcy, financing, recovery rate, MSMEs.

[a]CERPE/DeFIPP - Université de Namur.
[b]CERPE/DeFIPP - Université de Namur and CIRTES/LIDAM - Université catholique de Louvain.
[c]CERPE/DeFIPP - Université de Namur.

1 Introduction

Starting with the seminal work of Acs and Audretsch (1988), economics scholars have devoted a growing attention to the relevant role of small businesses in the innovative processes. Compelling evidence challenges the widespread view that large companies are the real engine of technological progress. Not only small and medium firms, but also micro enterprises have been recently found to be a non-negligible source of innovation, especially in Europe (Audretsch et al., 2020; Farè, 2022). Concomitantly, the growing flow of research on small businesses has revealed remarkable difference vis-à-vis large firms. Micro, small, and medium enterprises (MSMEs) usually face scarcity of internal resources, lower access to knowledge, harsher financing conditions and higher risks of bankruptcy (White, 2016; Banerjee and Blickle, 2021). As such, MSMEs are highly sensitive to bankruptcy systems (White, 2016; Traczynski, 2019) and substantially dependent on external credit to pursue innovative projects (Hall, 2002; 2010; Czarnitzki and Hottenrott, 2011).

Yet, despite the acknowledged influence that bankruptcy systems and external financing exercise on small businesses, understanding how they jointly affect MSMEs' innovative behaviour is still an unchartered territory. While the extant literature examines primarily the impact of debtor-related factors on the creation of new ventures, very little is known on the links between the creditor-side of the bankruptcy system and the innovativeness of established firms, including microbusinesses. MSMEs dispose of little internal resources and they often seek for external funds to finance innovation projects. This makes them highly sensitive to credit supply, which motivate to deeply investigate the creditor rather than the debtor-side of bankruptcy systems. In this study, we focus on the bankruptcy recovery rate, that is the amount of money that creditors manage to recover after the liquidation of the debtor firm. Creditors' recovery expectations are indeed a key element affecting borrowing interest rates and access to credit. Those who expect to recover a good amount of their credits should indeed be more oriented to charge lower borrowing interest rates, thus facilitating access to credit and investments. To our best knowledge, the link between the recovery rate and innovation investments of small businesses has not received attention from prior research.

Specifically, we ask whether a bankruptcy system where creditors have a good recovery rate

in case of firms' liquidation can stimulate MSMEs' innovation investments through lower interest rates and therefore easier access to credit. To answer this question we first develop a simple borrower-lender model, aimed at providing theoretical insights for a subsequent empirical analysis. The model links firms' decision to invest in innovation with the level of bankruptcy recovery rate and the borrowing interest rate, which is firm's specific and endogenously determined. According to the model, the borrowing interest rate is lower the higher the recovery rate. We derive three propositions that we test empirically by using firm-level data for small businesses. Along with small (10-49 employees) and medium firms (50-249 employees), we also include in the analysis micro enterprises with fewer than 10 employees.[1] Microbusinesses are still an under-studied category in the extant literature and very little is known about their innovative behaviour (Roper and Hewitt-Dundas, 2017; Henley and Song, 2020). Given their economic relevance, high risk of failure, and precarious financing conditions we find it crucial to include them in the population of small businesses. We assemble a multi-source and multi-level dataset by collecting firm-level data from the Survey on the Access to Finance of Enterprises (SAFE) and country-level indicators from the World Bank/Doing Business database.

From our empirical analysis we derive three main results. First, we show that an increase in the bankruptcy recovery rate is positively associated with MSMEs' investments in innovation (*investment effect*). Where creditors expect to recover a good amount of their credits, we observe more innovation investments by small businesses. Second, our findings suggest that this larger amount of investments can be explained by lower interest rates and easier access to credit, as better recovery rates are negatively associated with MSMEs' likelihood to be credit constrained because of too high interest rates (*constraint effect*). Finally, we find that where recovery rates are higher, profitable MSMEs face lower interest rates dispersion, which further facilitates access to credit (*dispersion effect*). The beneficial effect on innovation investments and access to credit is also observable for micro firms.

The remaining of the paper is organized as follows. In section 2, we present the related literature and we highlight the main contributions of the study. Section 3 illustrates the theoretical model and states propositions. In section 4, we develop the empirical analysis,

[1] We refer to the European Commission definition of micro, small, and medium enterprises in the Recommendation of 6 May 2003.

where we illustrate data, methodologies, and main results. Section 5 reports robustness checks of baselines specifications. In section 6, we discuss the main implications of the research and conclude.

2 Related literature and contributions

This study adds and contributes to two strands of the literature, one focusing on the nexus between bankruptcy systems and business activity, with the other on the link between firms' innovation and financing.

The extant literature distinguishes between pro-creditor ("harsh") and pro-debtor ("lenient" or "forgiving") bankruptcy systems. The level of assets exemption and the time that business owners dispose to become discharged of their debt-related obligations are the main elements distinguishing the two systems (Parker, 2018). On the one hand, a more forgiving bankruptcy regime offers to business owners a partial wealth insurance against the consequences of failure (Fan and White, 2003; Armour and Cumming, 2008). On the other, by limiting the amount of assets that creditors can seize in bankruptcy, a lenient system can reduce credit supply and worsen borrowing conditions (Gropp et al., 1997; Mankart and Rodano, 2015; Cerqueiro and Penas, 2017; Cerqueiro et al., 2019). Larger exemptions are also correlated with greater incidence of credit rationing to small businesses (Berkowitz and White, 2004; Fu et al., 2020). Thus, prior research highlights a trade-off between the "insurance" and the "credit supply" effects, which also influences business activity. Evidence shows that a pro-debtor bankruptcy regime positively affects business ownership, measured as the probability of owning a business (Fan and White, 2003), self-employment (Armour and Cumming, 2008) or firm-formation rate (Lee et al., 2011). However, while the quantity of business seems to be favoured by pro-debtor systems, understanding which system is more conducive to innovativeness is still an open question. On the one hand, generous assets exemptions can also facilitate business ownerships that are ultimately successful (Rohlin and Ross, 2016); on the other, they are more likely to unleash business creation by risk-averse rather than risk-taking individuals (White, 2016), who are usually more innovative and more sensitive to credit supply (Koellinger, 2008; Estrin et al., 2017). Recent studies also point out that higher exemptions are associated

with a greater entry of low quality firms, as they encourage excess entry of unproductive enterprises (Cerqueiro et al., 2019; Fu et al., 2020). Similarly, where debtor protection is stronger, the quantity and quality of firms' patents seems to be lower (Cerqueiro and Penas, 2017).

We add to this compelling debate by offering three main contributions. First, while prior literature mainly considers debtor-related factors, we focus on the creditor side of the bankruptcy system. We do that by considering the recovery rate, which has not yet procured attention from the literature on bankruptcy law and business activity. Second, while the connection between bankruptcy regimes and new ventures creation has been largely studied, very little is known about the links with the innovative behaviour of existing small businesses. By asking how the recovery rate affects firms' innovativeness, arguably one of the primary determinants of high-quality firms (Covin and Wales, 2012; Dai et al., 2014), we shift the focus from the quantity to the quality of small businesses. To this regard, prior research has mainly considered the output-side and the last-stage of the innovation process by looking at patents or other outputs (Cerqueiro and Penas, 2017). In this study, we rather focus on firms' decision to invest in innovation, which concerns the input-side and the early-stage of the process. This is our third contribution. Small businesses, due to their limited access to knowledge and financial resources, usually find more problematic the input-side of the innovation process than the output-side (Tang, 2006; Conte and Vivarelli, 2014; Baumann and Kritikos, 2016).

Our research also expands the literature on firms' innovation and financing. According to the Schumpeterian paradigm, being innovative is a crucial requirement for firms to be resilient and to grow. Investing in innovation creates new skills and knowledge spillovers (Block et al., 2013), which in turn promote the development of innovative firms (Hall, 2010). However, the high level of risk and uncertainty associated with investments in innovation makes them costly and hardly accessible (Hall, 2002; Block, 2012). Accordingly, financing constraints can often inhibit firms' innovation propensity (Gorodnichenko and Schnitzer, 2013; Chiu et al., 2017). This is particularly pressing for small businesses, due to their more fragile conditions vis-à-vis large firms (Beck and Demirguc-Kunt, 2006; Beck, 2013; Cowling et al., 2018; Ughetto et al., 2019; Banerjee and Blickle, 2021). The small size, along with limiting the gains from scale economies, might also contribute to increase

uncertainty, asymmetric information, and moral hazard (Akerlof, 1970; Spence, 1978, and Stiglitz and Weiss, 1981). All of these elements may disincentive financial intermediaries from lending money or granting credit to finance innovative projects. This is known as "the liability of smallness". Evidence that smaller firms are usually more financially constrained is also confirmed by the fact that they are more sensitive to improvements in access to credit conditions than larger firms (Czarnitzki and Hottenrott, 2011).

Our study advances knowledge in this field in two ways. First, we unravel the so far unexplored link between bankruptcy systems and small businesses' innovation investments. Specifically, we show that MSMEs' decisions to engage in innovation are connected with creditors' recovery expectations in case of bankruptcy. Second, by including firms with fewer than 10 employees we contribute to have a more comprehensive understanding of the innovative behaviour of the whole small business' population. Very little is still known about microbusinesses and we do not find research that jointly studies and compares micro, small, and medium enterprises. We believe that including micro firms is of primary importance. Despite their large number and relevant economic function, they still dispose of highly limited resources to invest in innovation (Baumann and Kritikos, 2016; Audretsch and Belitski, 2020).

In sum, we link the two aforementioned strands of literature by investigating the interaction between bankruptcy recovery rate, access to credit and MSMEs' investment in innovation. We do that in a cross-country framework, which represents a further novelty of our analysis.

3 The model

We first develop a borrower-lender model linking firms' decision to invest in innovation with the bankruptcy recovery rate and the borrowing interest rate. The aim is providing theoretical insights for empirically testable propositions. To do so, we build a simple partial equilibrium static model in which firm i makes a non-negative operating profit π_i, which is considered to be given and observable.[2] The firm's owner also faces a fixed cost f_i that must be financed by capital. In particular, the owner is able to finance e_i with

[2]Developing a more complex dynamic model in a general equilibrium framework would be an interesting theoretical contribution. However, our static model is in itself sufficient to derive valuable testable results.

his/her own funds, which are assumed to be insufficient to cover the entire fixed cost. Accordingly, s/he must borrow the remaining part ($k_i = f_i - e_i$) from external creditors at interest rate r_i, which is firm's specific and endogenously determined.[3]

3.1 The non-innovative firm

Assuming that everything is observable and that the firm decides not to invest in innovation, we can write the firm's profit as

$$\Pi_i = \pi_i - e_i - k_i(1 + r_i).$$

As long as the firm's operating profit exceeds the borrowed amount ($\pi_i > k_i$) and everything is observable, there is no reason for an external creditor to be compensated for the risk of potential losses. Therefore, the creditor charges the risk free interest rate ($r_i = 0$).[4] On the contrary, if $\pi_i < k_i$ the firm could not pay back what it borrowed. If this is the case, there is no chance for the firm to receive external funding.

At the zero interest rate, the equilibrium profit is

$$\Pi_i^N = \pi_i - (e_i + k_i)\,, \tag{1}$$

where superscript N means "no investment". Note that agents who are only interested in maximizing profit would agree to continue to invest their own capital in this firm only if $\pi_i > e_i + k_i$.

3.2 The innovative firm

We now consider the case where the firm decides to invest an amount, z_i, in innovation. The outcome of the investment is uncertain: if it succeeds, the operating profit increases by factor Δ_i; if it fails, the operating profit is unchanged. We denote p_i the probability of success of the investment and $(1 - p_i)$ the probability of failure.[5] Both Δ_i and p_i are

[3] As shown in section 3.2, parameters e_i and k_i are introduced to account for the fact that firms not investing in innovation may need external resources regardless. In this case, being charged a risk free rate depends on the values of these parameters.

[4] The risk free interest rate is normalized to zero for modelling purposes. In the empirical analysis, this rate will be associated with low values of borrowing interest rates.

[5] We follow a similar approach to Manso (2011) concerning the probability setting.

firm-specific and they can vary according to firm's characteristics, including the size. Since we assume that the firm's own funds are insufficient to finance fixed costs, we also assume that z_i is financed by external capital.

In case of success of the investment, the equilibrium profit is

$$\Pi_i^{\text{success}} = (1 + \Delta_i)\,\pi_i - e_i - (k_i + z_i)(1 + r_i),$$

while in case of failure it is

$$\Pi_i^{\text{failure}} = \pi_i - e_i - (k_i + z_i)(1 + r_i).$$

In the scenario illustrated in section 3.1, where the firm does not invest in innovation, there is no risk and the interest rate is equal to zero. Now, when the firm decides to invest in innovation, risk is potentially present because the outcome of the investment is uncertain. If the investment in innovation fails and if the firm cannot pay back the capital and the interest, because $\pi_i < (k_i + z_i)(1 + r_i)$, then the firm goes bankrupt. It is thus legitimate for the creditor to hedge against this risk by demanding a positive interest rate. By contrast, if the firm can reimburse the capital and the interest, the firm survives from its failure of innovation and the creditor does not face any risk. There is then no reason for the interest rate to be positive, which implies $r_i = 0$.

Suppose first that $\pi_i > k_i + z_i$. Then the creditor could accept a zero interest rate because the full amount granted can be recovered.[6] For instance, a firm makes a profit $\pi_i = 105$ and decides to invest in innovation. With a probability $p_i = 0.5$, this investment is successful and it increases the profit to $(1 + \Delta_i)\,\pi_i = (1 + \Delta_i) * 105 = 120$; while it fails with a probability of 0.5. The creditors lend $k_i + z_i = 100$. If they are convinced that the firm will not go bankrupt if the investment fails, they know that they will get their entire loan back in any case. As there is no risk, they accept a zero interest rate. The solid line in Figure 1 illustrates this condition. In this case, with $\pi_i > k_i + z_i$ and $r_i = 0$, the firm's expected profit is

$$E(\Pi_i) = p_i\left[(1 + \Delta_i)\,\pi_i - e_i - k_i - z_i\right] + (1 - p_i)\left[\pi_i - e_i - k_i - z_i\right]. \tag{2}$$

[6] The firm would not get back its own capital e_i if $0 < \pi_i - (k_i + z_i) < e_i$.

The first and the second terms represent the profit the firm will have if the investment succeeds and if it fails, respectively.

Suppose now that the firm goes bankrupt if the investment in innovation fails. We assume that, during the liquidation procedure, part of the firm's value is deteriorated, such that only a fraction of it is recovered. We define this restored value as $\delta_i \pi_i$ (where $0 < \delta_i < 1$).[7] We also assume that the amount recovered by creditors is proportional to the firm's restored value, so that δ_i reflects the recovery rate for creditors. Given that $0 < \delta_i < 1$ (i.e. $\delta_i \pi_i < \pi_i$), lenders are always at least partially reimbursed in the event of bankruptcy, but they will not recover the entire amount granted. In case of bankruptcy, the firm is not able to pay back the full debt. Specifically, creditors will be fully reimbursed if the investment in innovation succeeds, while only partially if it fails. Such possibility of partial repayment introduces a degree of uncertainty, which leads them to charge a positive interest rate to be compensated for the potential losses in case of failure by higher revenues in case of success.

On the one hand, the configuration of the parameters ensuring that the principal and interest will be fully repaid in case of success is given by

$$(1 + \Delta_i)\, \pi_i > (k_i + z_i)(1 + r_i) \iff \pi_i > (k_i + z_i)\, \frac{1 + r_i}{1 + \Delta_i}. \tag{3}$$

On the other hand, the condition for partial repayment of the principal and interest in the event of failure is

$$\pi_i < (k_i + z_i)(1 + r_i). \tag{4}$$

Any situation where the operating profit π_i is above the limit in (4) would imply that the capital and interest are fully repaid even if the investment fails. In this case, there is no reason to have a positive equilibrium interest rate.[8]

Assuming a risk-neutral creditor and a perfectly competitive credit supply, the creditor will lend money to the firm only if the expected profit is at least equal to the granted amount. Moreover, given that creditors' recovery is proportional to the firm's profit,

[7] Though determined mainly at country level, parameter δ_i might be affected by firm-specific characteristics as well. Thus, we keep the subscript i.

[8] In our framework, there cannot be an equilibrium in which creditors would not be fully repaid if the investment in innovation is successful. If this was not the case, creditors would be sure to never recover part of their credit and, consequently, they would refuse to grant credit.

the equilibrium interest rate is firm's specific. In case of success (with probability p_i), creditors receive the principal and interest $(k_i + z_i)(1 + r_i)$, while in case of failure (with probability $(1 - p_i)$) they recover $\delta_i \pi_i$ (the amount of operating benefits recovered after the liquidation). Accordingly, the capital market equilibrium condition for firm i is given by

$$p_i(k_i + z_i)(1 + r_i) + (1 - p_i)\,\delta_i \pi_i = k_i + z_i,$$

which gives the equilibrium interest rate:

$$1 + r_i = \frac{1}{p_i}\left[1 - (1 - p_i)\,\frac{\delta_i \pi_i}{k_i + z_i}\right]. \tag{5}$$

We obtain an endogenous interest rate, which is a function of the main parameters of the model. Specifically, it increases with the amount of credit $(k_i + z_i)$, while it decreases with the recovery rate (δ_i), the probability of success (p_i) and the firm's operating profit (π_i). Equation (5) links the recovery rate to the borrowing interest rate. Specifically, it shows that better recovery rates (i.e. higher δ_i) lead to lower interest rates, meaning more favourable borrowing conditions.

Plugging (5) into (3), we get

$$\pi_i > \frac{k_i + z_i}{p_i\,(1 + \Delta_i) + \delta_i\,(1 - p_i)} \tag{6}$$

which is represented by the dot line in Figure 1. Any π_i below this limit implies that firm i is not in a position to repay the principal and interest of the loan incurred to finance innovation, even if the investment succeeds. Thus, there is no equilibrium with a positive interest rate.

Plugging (5) into (4), we get

$$\pi_i < \frac{k_i + z_i}{p_i + \delta_i\,(1 - p_i)} \tag{7}$$

which is represented by the dash line in Figure 1. Any π_i above this limit implies that firm i is always able to repay the principal and interest even if the investment fails. In this case, the equilibrium interest rate must be equal to zero.[9]

[9] See Appendix A.1 for the analytical derivations of the relationships between the three functions represented in Figure 1.

In the region between the dot and the dash lines, the final repayment is uncertain: the firm will pay back the entire debt if the investment in innovation succeeds and only a part if it fails. Given the uncertainty, this region has the strictly positive equilibrium interest rates $r_i > 0$ defined by equation (5). Consequently, in the area between the solid and the dash curves we observe either $r_i > 0$ or $r_i = 0$, meaning that multiple equilibria interest rates are possible. Which of the two is charged depends on creditors' expectations about firms' bankruptcy. If all the creditors are convinced that the firm will not go bankrupt when the investment in innovation fails, they accept a zero interest rate because they know they will get their entire loan back. On the contrary, if they believe that the firm will go bankrupt, which would mean recovering only part of the credit, they will charge a positive interest rate satisfying equation (5).[10]

[Insert Figure 1 about here]

When both (6) and (7) hold, such that $r_i > 0$, the expected profit for the firm i investing in innovation is

$$E(\Pi_i) = (1 - p_i)(-e_i) + p_i[(1 + \Delta_i)\pi_i - e_i - (k_i + z_i)(1 + r_i)]. \tag{8}$$

Equation (8) is composed by the sum of the loss the firm will face in case of failure (i.e. the share of fixed costs internally financed) and the profit in case of success. Equation (8) would coincide with equation (2) if δ_i was equal to 1.

3.3 To be or not to be innovative

In section 3.1 we present the firm's equilibrium profit with no investment in innovation (equation 1), while section 3.2 reports the expected equilibrium profit when the firm invests in innovation and there is certainty about the full debt repayment (equation 2) or uncertainty (equation 8). Once these profits defined, we can derive the conditions such that firm i finds it profitable (and therefore decides) to invest in innovation.

When the entire debt repayment is certain (i.e. $r_i = 0$), the firm decides to invest in

[10] In Appendix A.2 we provide a numerical example concerning the multiple equilibria interest rates region.

innovation if and only if the expected profit in case of investment (equation 2) is higher than the equilibrium profit without investment (equation 1). Thus, if $p_i \Delta_i \pi_i > z_i$, which means that the expected increase in profits is larger than the cost of the investment in innovation. Accordingly, the firm invests if the following condition is satisfied:

$$\pi_i > \tilde{\pi}_i \equiv \frac{z_i}{p_i \Delta_i}, \tag{IPC$_c$}$$

where IPC$_c$ stays for "investment profitability condition with certainty". It shows the profit cut-off value whereby the firm decides to invest in innovation. The firm will be more prone to invest (i.e. $\tilde{\pi}_i$ is lower) the lower the cost of the investment (z_i) and the higher the probability of success (p_i) and the profit gain (Δ_i).

When the entire debt repayment is uncertain (i.e. $r_i > 0$), the firm decides to invest in innovation if and only if the expected profit in case of investment (now defined by equation 8) is higher than the equilibrium profit without investment (equation 1). Thus, if the following condition is satisfied:

$$\pi_i > \hat{\pi}_i \equiv \frac{z_i}{p_i \Delta_i - (1 - p_i)(1 - \delta_i)}, \tag{IPC$_u$}$$

where IPC$_u$ stays for "investment profitability condition with uncertainty".[11] This defines a new profit cut-off value. As before, a firm will be more prone to invest in innovation (i.e. $\hat{\pi}_i$ is lower) the lower the cost of the investment (z_i) and the higher the probability of success (p_i) and the profit gain (Δ_i). In addition, an increment in the recovery rate (δ_i) contributes as well to reduce $\hat{\pi}_i$, increasing the likelihood of investing in innovation.

Figure 2 adds to Figure 1 the two thresholds $\tilde{\pi}_i$ and $\hat{\pi}_i$, with $\hat{\pi}_i > \tilde{\pi}_i$. The white area describes the region where firms never find it profitable (i.e decide) to invest in innovation, regardless of the interest rate. The light grey area identifies the region where firms always find it profitable (i.e decide) to invest in innovation, regardless of the interest rate. We name it "IPS" (investment profitability space). The dark grey area defines the region where firms find it profitable (i.e decide) to invest only if $r_i = 0$, while they do not if $r_i > 0$. Firms in this space are constrained by high borrowing interest rates, which prevent them from investing in innovation. We name this space "CIPS" (constrained investment

[11] We refer to Appendix A.1 for the analytical derivations of IPC$_c$ and IPC$_u$.

profitability space). The hatched area can be neglected, as here no creditor lends money to firms.

[Insert Figure 2 about here]

3.4 The role of the bankruptcy recovery rate

We now examine how changes in the bankruptcy recovery rate (δ_i) affect firms' decision to invest in innovation. The IPC_u provides analytical evidence that an increase in δ_i reduces the cut-off value $\hat{\pi}_i$, making investing in innovation easier. Equation (5) suggests that this can be due to lower borrowing interest rates associated to higher recovery rates. Figure 3 helps to delve deeper into this mechanism.

[Insert Figure 3 about here]

When δ_i increases, the threshold $\hat{\pi}_i$ moves downwards to $\hat{\pi}_i'$, while $\tilde{\pi}_i$ does not change. We observe three main effects. First, the IPS increases by the light grey dotted area 1 and the dark grey dotted area 2. This means that the number of firms investing in innovation regardless of the rate increases. Enterprises with $\pi_i < \hat{\pi}_i$, which did not find it profitable to invest, now do if $\hat{\pi}_i' < \pi_i < \hat{\pi}_i$. We call this the *investment effect*. Secondly, the CIPS decreases by the dark grey dotted area 2. Prior to the rise in δ_i, firms in this area only invested in innovation with $r_i = 0$. Now, they do also with $r_i > 0$. Thus, the number of firms constrained by high interest rates declines. We call this the *constraint effect*. It suggests that the investment effect is partly explained by the fact that firms can benefit from lower interest rates due to better recovery rates, which make it easier to borrow and therefore invest.

Figure 3 also shows that, following an increase in δ_i, the slopes of the dotted and dashed lines flatten. The shift of the dotted curve simply reduces the hatched area, where no equilibrium with $r_i > 0$ exists, while the lowering of the dashed curve produces more intriguing consequences. On the one hand, prior to the increase in δ_i, firms in the black area 3 of the IPS could pay back the entire debt only in case of success of the investment, which made them facing either $r_i = 0$ or $r_i > 0$. Afterwards, they satisfy the condition

such that they can always repay entirely the creditor, whereby the only equilibrium rate is $r_i = 0$. Accordingly, we have less interest rates dispersion. Firms in the black areas $4'$ and $4''$ as well are able to always repay their debt after the change in δ_i, which implies $r_i = 0$. However, the null interest rate was the only one observed also before, as they only invested with this rate. As such, there is no impact on interest rates dispersion in these two regions. On the other hand, firms in the dark grey dotted area 2 of the IPS only invested with $r_i = 0$ before, while now they do with both $r_i = 0$ and $r_i > 0$. Their profit is not high enough to guarantee full repayment if the investment fails and uncertainty is still present. Thus, interest rates dispersion increases in this region. In sum, among the firms investing in innovation, an increase in the recovery rate leads borrowing interest rates dispersion to decline for highly profitable firms (those in the black area 3 of the IPS) and to increase for less profitable ones (those in dark grey dotted area 2 of the IPS). We call this third effect the *dispersion effect*.

In light of this findings, we formulate the following concluding propositions:

Proposition 1 *An increase in the bankruptcy recovery rate is positively associated to firms' investments in innovation (investment effect - areas 1 and 2).*

Proposition 2 *An increase in the bankruptcy recovery rate is negatively associated to the number of firms constrained by a high cost of borrowing (constraint effect - area 2).*

Proposition 3 *An increase in the bankruptcy recovery rate is negatively (positively) associated to the interest rates dispersion for high (low) profitable firms investing in innovation (dispersion effect - areas 3 and 2).*

4 Empirical analysis

In this section we perform a set of empirical analyses to test the validity of propositions 1,2, and 3 for small businesses. Where it is possible, we separate the subsamples of micro, small, and medium enterprises to study whether differences emerge. We assemble a multi-source dataset by combining firm-level data from the Survey on the Access to Finance

of Enterprises (SAFE) and country-level indicators from the World Bank/Doing Business database.

4.1 Data and variables construction

4.1.1 The Survey on the Access to Finance of Enterprises (SAFE)

SAFE is the main data source for our analysis. Started in 2009, it is run every six months in two different rounds, one by the European Central Bank (ECB round), covering a limited number of the euro area countries, and one by the European Commission (Common round), including all EU countries plus some neighbouring ones. SAFE provides comparable precision for micro (1-9 employees), small (10-49), and medium (50-249) enterprises, guaranteeing a well representativeness of the whole small businesses' population. This makes SAFE particularly suitable for our analysis.[12] The quality and reliability of this database are supported by several studies that refer to it.[13]

We select the five sample waves of the Common rounds conducted between 2014 and 2018.[14] The reason is threefold. First, Common rounds waves include a larger set of countries than the ECB round, which also omits some key variables. Secondly, the SAFE questionnaire has substantially been amended in 2014. As such, we want to consider as similar as possible questionnaires. Finally, by referring to this period we can leave out distortions due to the financial crisis and the recent pandemic. After maintaining the countries included in all the five waves, we obtain a cross-section sample of 77,709 observations in 30 countries.[15]

4.1.2 Measuring innovation investments

The model presented in section 3 examines how bankruptcy recovery rate affects firm's decision to invest in innovation. Thus, we need a measure to identify those firms that

[12]SAFE methodology and results are published on the ECB website every 6 months. For more information on the survey and its individual waves we refer to Appendix B.1 and to `https://www.ecb.europa.eu/stats/ecb_surveys/safe/html/index.en.html`.

[13]See, for instance, Casey and O'Toole (2014), Holton et al. (2014), Roux and Savignac (2017), Ferrando et al. (2019), Gómez (2019), Banerjee and Blickle (2021), Ferrando and Mulier (2022), Ferrando et al. (2022) and Santos and Cincera (2022).

[14]Wave 11 (reference period April-September 2014), wave 13 (reference period April-September 2015), wave 15 (reference period April-September 2016), wave 17 (reference period April-September 2017), and wave 19 (reference period April-September 2018).

[15]Table B.2.1 in Appendix B.2 shows the number of observations by country in the final dataset.

invest in innovation and those that do not. We consider the following survey question: *"For what purpose was financing used by your enterprise during the past six months?"*. We define a dummy (*innovation*) equal to one if the firm answers *"Developing and launching of new products or services"*. Whether these products or services are new to the market or to the firm, along with the amount of the investment, are not specified. Thus, we consider the extensive margin of the investments in innovation, whether it is to the firm or to the market.

As Table B.2.3 in Appendix B.2 illustrates, almost 19% of the MSMEs in our sample declare to use financing to develop and launch new products or services.[16] Looking at the country percentages reported in Figure 4, France, Hungary, Estonia, and the Czech Republic have the lowest percentage of firms investing in innovation; while Finland, Austria, Greece, and Cyprus the highest. It is worth noting that the high level of Greece and Cyprus might be driven by the financial assistance they received during and after the sovereign debt crises.[17] We will account for this in the empirical specifications.

[Insert Figure 4 about here]

4.1.3 Measuring firms constrained by high interest rates

To test proposition 2, we need to identify constrained firms that cannot invest in innovation because the borrowing interest rate is too high (those in the dark grey area of Figure 2). The survey does not allow to know whether a firm decides to invest or not in innovation according to the borrowing interest rate. However, we can detect those firms that do not access to credit (i.e. that are credit constrained) because the borrowing interest rates are too high. We do so with the help of the following question: *"You mentioned that bank loans are not relevant for your enterprise. What is the main reason for this?"*.[18] We build a dummy (*hcost*) equal to one if the answer is *"interest rate or price too high."*. The

[16] Tables B.2.2 and B.2.3 in Appendix B.2 report the definitions and summary statistics of the variables used in the empirical analysis.

[17] Cyprus received financial assistance from the European Stability Mechanism (ESM) comprising €6.3 billion between 2013 and 2015. Greece obtained a total of €245.7 billion over the 2010-2018 period from three different programs: €52.9 billion from bilateral EU and IMF loans (2010-2012), €130.9 billion from the European Financial Stability Facility (EFSF) (2012-2015), and €61.9 billion from the ESM (2015-2018). See `https://www.esm.europa.eu/financial-assistance` for further details about the ESM-EFSF programs.

[18] "Relevant" means the firm have used them in the past or is considering using them in the future.

question focuses on bank loans, which is the chief form of financing available to European MSMEs (Holton et al., 2014 OECD, 2015; European Commission, 2017).

Figure 5 illustrates the percentage of constrained MSMEs because of a high cost of borrowing. Sweden, Finland, and Luxembourg show the lowest percentage; Greece, Romania, and Montenegro the highest. As the geographical distribution suggests, Eastern-European countries have on average more constrained firms than Western-European ones.

[Insert Figure 5 about here]

4.1.4 Measuring interest rates dispersion

To assess the interest rates dispersion claimed in proposition 3, we rely on the following question: *"What interest rate was charged for the credit line or bank overdraft for which you applied?"*. This gives the values of firms' specific rates. We also compute the average rate observed in each country and in each wave. To measure the interest rates dispersion for firm i, we do the difference between the rate declared by firm i and the average rate observed in the firm's country in the respective year. By doing so, we obtain a firm-level variable (*dispersion*) measuring the spread between the individual rate and the country average rate. An increment in this spread reflects an increase in the interest rates dispersion.

Figure 6 reports the average country interest rate dispersion over the 2014-2018 period. Malta, Finland, and Austria show the lowest dispersion levels; while Germany, the UK, and Latvia the highest. The short values range suggests that there are not substantial differences among countries.

[Insert Figure 6 about here]

4.1.5 Measuring the bankruptcy recovery rate

In our model, parameter δ_i reflects the bankruptcy recovery rate, that is the amount of credit recovered by lenders in case of firm's liquidation. To measure δ_i we rely on three country indicators from the World Bank/Doing Business database. Launched in 2002, the Doing Business project collects quantitative data to compare regulations faced by small

and medium-sized enterprises across economies and over time and it has became a major resource for academics (Besley, 2015; Contractor et al., 2020). To our best knowledge, it is the first and to date unique project collecting internationally comparable data on business and regulatory environments. As primary measure, we use the *recovery rate* (or *recovery*), which records the cents on the dollar recovered by secured creditors through judicial reorganisation, liquidation, or debt enforcement proceedings. It is a function of the time, cost, and outcome of insolvency proceedings and it ranges from 0 to 100, where 0 is the lowest and 100 the best performance.[19] We are conscious that recovery rates in insolvency cases are influenced by many factors, including the efficiency of the insolvency law, the level of debtor protection and the amount of collateral required for credit. Assumptions made to construct the index do not allow to grasp all the elements that can potentially affect recovery rates. Accordingly, this indicator is to be considered as a proxy rather than as an exhaustive measure.

The Doing Business database also includes a broader indicator, the *resolving insolvency score* (or *score*), which is a function of two sub-indices: the *recovery rate* itself and the *strength of the insolvency framework*. We use it as a validation measure and not as the main one because the *strength of the insolvency framework* does not exactly reflect what we measure in the model, which is more properly assessed by the *recovery rate*. The *resolving insolvency score* is a relative indicator, measuring the gaps of each economy from the best performance observed across all economies in the Doing Business sample. It ranges from 0 to 100, where a score of 75, for instance, means an economy is 25 percentage points away from the best performance constructed across all economies and across time. The second alternative to *recovery rate* we use is the indicator *time*, measuring the period of time (in years) from the company's default until the payment of some or all the money owed to the creditor. This indicator is a component of the *recovery rate*, but we isolate it to have a narrower validation measure that may reflect more directly the efficiency of the bankruptcy system. Time delay destroys value and represents an important source of bankruptcy inefficiency (Dou et al., 2021). The longer the case duration (Dou et al., 2021) and the time to repayment (Djankov et al., 2008), the smaller the recovery rate.

[19]Doing Business recovery rate refers to secured creditors, who thus have a lien on debtor's property in the form of collateral. Despite such protection, there still might be uncertainty about the full recovery. This explains why values of the recovery rate indicator can be below the maximum level.

To summarize, we use variable *recovery* as primary proxy of parameter δ_i, while variables *score* and *time* as validation measures, being the former broader and the latter narrower. An increase in *recovery* and *score* means an increment in the recovery rate for lenders, while an increase in *time* a reduction.[20]

We acknowledge that bankruptcy systems are complex and that they can hardly be exhaustively assessed by the aforementioned measures. Although they are intended to be internationally comparable, developing harmonized indicators across countries and over time is challenging given that legal practices vary a lot from country-to-country. However, despite their imperfections, we believe these measures can provide useful information for the purpose of our research, which aims to conduct a first explorative analysis on the relationship between bankruptcy recovery rate and innovation investments. As far as we know, there is no other project comparable to Doing Business in terms of scale and scope. Thus, the three indicators we use are the best proxies we could find for the bankruptcy recovery rate indicated by parameter δ_i in the model. Figure 7 reports the country average values of these three indicators over the 2014-2018 period and the geographical distribution. Continental and North-European countries seem to have higher recovery rates than South-East ones.

[Insert Figure 7 about here]

4.2 Stylized facts

Table 1 provides preliminary stylized facts about propositions 1,2, and 3. By considering the three variables measuring the bankruptcy recovery rate (*recovery*, *score* and *time*) we divide the sample countries into two groups ("High recovery rate") and ("Low recovery rate"). A country is assigned to the high recovery group if the value of the indicator is higher (lower for *time*) than the sample median. The reported values suggest that the high recovery group has a larger percentage of firms investing in innovation and a lower percentage of credit constrained firms because of high borrowing interest rates. Table 1 also shows that the interest rates dispersion in the high recovery group is larger for firms in the lowest turnover category (turnover $\leq$ €500 thousands) and smaller for those in the

[20] We refer to `https://archive.doingbusiness.org/en/methodology/resolving-insolvency` for an extended explanation of the methodology used to build these indicators.

highest category (turnover > €50 million). Being turnover a proxy of firms' profit, this might suggest that, as proposition 3 states, an increase in the recovery rate is associated to an increment in the interest rates dispersion for low profitable firms and to a reduction for high profitable ones.

Though preliminary, these insights seem to support our propositions and they motivate us to proceed to test them with systematic empirical specifications.

[Insert Table 1 about here]

4.3 Empirical methodology and results

We now illustrate the methodology and the main results of the empirical models. To conduct our analysis we both consider the whole sample of MSMEs and, where it is possible, the subsamples of micro, small, and medium enterprises separately for comparisons.

4.3.1 Proposition 1 - Investment effect

Firstly, we want to verify whether an improvement in the bankruptcy recovery rate is positively associated to MSMEs' investments in innovation. To do that, we specify the following probit model:

$$innovation_{i,c,s,t} = \beta_0 + \beta_1 RR_{c,t} + \beta_j X_{i,c,s,t} + \beta_z Z_{c,t} + \eta_s + \gamma_t + \epsilon_{i,c,s,t} \quad (1)$$

Where i denotes firm, c country, s sector, and t time. The dependent variable $innovation_{i,c,s,t}$ is the dummy equal to one if the firm uses financing for developing and launching of new products and services. Variable $RR_{c,t}$ (recovery rate) is alternatively expressed by variables *recovery*, *score*, or *time*. Vector $X_{i,c,s,t}$ collects a set of firm controls that may influence the decision to invest in innovation: firm size (number of employees), age, turnover (both the level and the growth rate), ownership type, legal form, and subsidies.[21] To account for potential unobserved heterogeneity at the industry and time levels, both sector (η_s) and time (γ_t) dummies are included. Considering the country nature of our measures of $RR_{c,t}$ and the fact that their values are quite stable within countries and over time, we

[21] We refer to Table B.2.2 in Appendix B.2 for detailed variables definitions.

exclude country dummies from the present specification.[22] However, we include additional indicators (vector $Z_{c,t}$) to control for country-dimensions that might affect firms' investment in innovation. Specifically, we include the level of GDP and the GDP growth rate to account for the country macroeconomic performance (Claessens and Klapper, 2005; Lee et al., 2011); the domestic credit provided by banks to the private sector to control for the level of financial development (La Porta et al., 2002; Chowdhury et al., 2019); the general government final consumption expenditure (as a % of GDP) to capture the government expenditure (Chowdhury et al., 2019), and inflation.[23] In the robustness checks section 5, we also consider additional controls for other potentially relevant dimensions, including indicators on the business environment, the market structure of credit institutions and the availability of talented workers. Results are similar to the baseline model, even though we observe a slight reduction in the number of observations. Finally, we cluster the standard errors at the country level to account for heteroscedasticity and spatial correlation in the error term.

Figure 8 plots country percentages of MSMEs investing in innovation over the three recovery rate indicators. Cyprus, Greece, and, to some extent, Montenegro appear to be outliers in the distribution. As mentioned in section 4.1.2, investments in Cyprus and Greece might have been boosted by the considerable international financial aid they received after the financial and the sovereign debt crises.[24] To this regard, Figure B.2.1 in Appendix B.2 shows that to the introduction of the assistance programs (2013 in Cyprus and 2010 in Greece) corresponds the beginning of an upward trend in research and development expenditures in both countries. Concerning Montenegro, we are not aware of possible events that could have affected innovation investments. This outlier value might be driven by the small number of observations in this country. Accordingly, to limit these potential confounding effects, we also estimate model (1) by excluding Greece and Cyprus first, and then Montenegro.[25]

[Insert Figure 8 about here]

[22] The inclusion of country dummies would cancel out the between countries variation, which represents the largest share of the total variation.

[23] All these indicators are collected from the World Bank-World Development Indicators (WDI) database.

[24] See note 17.

[25] Spain, Portugal, and Ireland also received ESM funding, but only before and not during the sample period (2014-2018). In the robustness section, we also estimate regression (1) by excluding these countries.

Table 2 reports the average partial effects (APEs) of an increase in the recovery rate ($RR_{c,t}$) on MSME's likelihood to invest in innovation ($innovation_{i,c,s,t}$). We consider all MSMEs together (col.1) and the subsamples of micro, small, and medium firms separately (cols.2, 3, 4). In panel A, which includes all countries, the coefficients have the expected sign: positive for *recovery* and *score*, negative for *time*. For *recovery* and *time*, coefficients are statistically significant for medium firms only (col.4), both at the 1% level. For *score*, coefficients are also statistically significant for the full sample of MSMEs (col.1) and for small firms (col.3). In panel B, we report the APEs by excluding Cyprus and Greece. All the coefficients (except for *time* for micro firms) become statistically significant. This suggests that part of the effects might have previously been hidden by the biased investments observed in Cyprus and Greece.[26] Concerning the size of the effects, it looks quite similar for micro, small and medium firms, suggesting that the effect is observable regardless of the firm's size. As panel B suggests, an increment in the recovery rate also unleashes investment in innovation of micro firms. Overall, these findings provide evidence supporting proposition 1. An increase in the recovery rate for creditors is positively associated to MSMEs' investments in innovation.

[Insert Table 2 about here]

4.3.2 Proposition 2 - Constraint effect

According to proposition 2, the increment in innovation investments associated to an increase in the recovery rate can be explained by the fact that, due to lower interest rates, firms are less constrained and are therefore enabled to borrow and invest. The recovery rate is indeed negatively associated to the likelihood of being constrained because of too high rates. To test this prediction we develop the following probit model:

$$hcost_{i,c,s,t} = \beta_0 + \beta_1 RR_{c,t} + \beta_j X_{i,c,s,t} + \beta_z Z_{c,t} + \eta_s + \gamma_t + \epsilon_{i,c,s,t} \quad (2)$$

Model (2) follows the same specification of model (1) except for the new dependent variable ($hcost_{i,c,s,t}$), which is a dummy equal to 1 if the firm declares not to use bank loans

[26] We also exclude Montenegro, but the results are similar to those reported in panel B.

because the associated interest rates are too high. We expect $RR_{c,t}$ to be negatively associated with the dependent variable.

Figure 9 plots country percentages of constrained firms over the three recovery rate indicators. Montenegro appears to be an outlier in the distribution. We then re-estimate regression (2) by excluding this country. Moreover, since the financial assistance received by Cyprus and Greece could have also influenced the level of interest rates and the cost of borrowing, we exclude also these two countries.

[Insert Figure 9 about here]

Table 3 reports the average partial effects (APEs) of an increase in the recovery rate on MSME's likelihood to be credit constrained by excessive cost of borrowing. In panel A, which includes all countries, coefficients have the expected signs and all of them are statistically significant. An increase in the recovery rate (i.e., a rise in *recovery* and *score* and a decrease in *time*) is negatively associated with firms' borrowing constraints. The likelihood of not having access to bank loans because of too high interest rate is reduced. Stated differently, MSMEs are more likely to access bank loans when the recovery rate improves. As for proposition 1, the effect occurs regardless of the firm's size: no marked differences emerge between micro, small, and medium firms. Estimates in panel B (excluding Montenegro) and panel C (excluding Montenegro, Cyprus, and Greece) confirm results of panel A and further enhance evidence supporting proposition 2. On the whole, model (2) suggests that easier access to credit conditions are a potential mechanism driving the increase in MSMEs' innovation investments claimed in proposition 1.

[Insert Table 3 about here]

4.3.3 Proposition 3 - Dispersion effect

The model illustrated in section 3 assumes that, in case of firm's bankruptcy, lenders cannot recover the whole credit ($\delta_i < 1$). Due to the uncertainty about the final repayment, some firms (those in the region between the solid and the dash curves in Figure 1) face either $r_i = 0$ or $r_i > 0$. This leads to multiple equilibria interest rates and interest rates

dispersion. Figure 3 shows that, among firms investing in innovation, an increase in the recovery rate (δ_i) makes such dispersion larger for low profitable firms (in area 2) and lower for high profitable firms (in area 3). This effect is stated in proposition 3.
To test this, we develop the following OLS regression with a triple interaction term involving turnover (which is used as a proxy of firm's profit), recovery rate, and innovation variables:

$$dispersion_{i,c,s,t} = \beta_0 + \beta_1 RR_{c,t} + \beta_2 innovation_{i,c,s,t} + \beta_a turnover_{i,c,s,t} + \quad (3)$$
$$\beta_b RR_{c,t} * turnover_{i,c,s,t} + \beta_c RR_{c,t} * innovation_{i,c,s,t} + \beta_d innovation_{i,c,s,t} * turnover_{i,c,s,t} +$$
$$\beta_e RR_{c,t} * turnover_{i,c,s,t} * innovation_{i,c,s,t} + \beta_i X_{i,c,s,t} + \beta_z Z_c + \eta_s + \gamma_t + \epsilon_{i,c,s,t}$$

Where $turnover_{i,c,s,t}$ is the vector including six turnover categories.[27] The other variables and vectors follow the same specification of models (1) and (2). With this model we aim to assess the impact on interest rates dispersion ($dispersion$) of an increase in the bankruptcy recovery rate (RR) for those MSMEs' that invest in innovation ($innovation = 1$), for each profit category ($turnover$). According to proposition 3, we expect this effect to be positive for the lowest categories and negative for the highest. We initially report Table 4, which illustrates the estimates of model (3). Then, we derive from it the overall effect on investing firms for each turnover category. Table 5 illustrates these effects. Given the reduced number of observations, we jointly consider MSMEs. The first line of Table 5 ("Turn1, innovation") shows that, in the lowest turnover category (turnover $\leq$ €500 thousands), an increase in the recovery rate (i.e., a rise in *recovery* and *score* and a decrease in *time*) is positively associated to an increment in the interest rates dispersion for those firms that invest in innovation. For two out of three indicators, including the primary variable *recovery*, the coefficient is statistically significant. From the second line on ("Turn[2-6], innovation"), that is for higher turnover categories, coefficients become negative and they increase (in absolute value) with turnover size. Coefficients are statistically significant from the fourth category on (i.e. if turnover $>$ €2mln). This confirms that, for high profitable enterprises investing in innovation, an increase in the bankruptcy recovery rate reduces rates dispersion.

[27] We refer to Table B.2.2 in Appendix B.2 for a definition of the six turnover categories.

Overall, these findings support what proposition 3 states: an increase in the bankruptcy recovery rate is associated to interest rates dispersion positively for low profitable investing firms and negatively for high profitable ones. Not only do higher recovery rates reduce MSMEs' likelihood to be credit constraint (proposition 2), but they also allows most productive investing MSMEs to benefit from lower interest rates dispersion (proposition 3).

[Insert Tables 4 and 5 about here]

5 Robustness checks

To further test the validity of the results presented in section 4.3, we perform a set of robustness analyses. These include the exclusion of those countries that received ESM assistance during and after the financial and sovereign debt crises, a Heckman probit model to control for sample selection bias, and the inclusion of additional control variables. All the alternative specifications confirm our main findings. We report detailed explanation and estimates of the robustness tests in Appendix B.3.

6 Discussion and conclusion

This study examines the interaction between bankruptcy systems, access to credit and small businesses' investments in innovation. Specifically, it investigates whether a bankruptcy system that guarantees a good recovery rate for creditors in case of firms' liquidation can help small businesses to engage in innovation, and if it does so by easing their access to credit through lower interest rates. With the help of a simple borrower-lender model, we develop three propositions that we test by performing a set of alternative empirical specifications. We do so by using a cross-country sample of micro, small, and medium enterprises (MSMEs).

We provide three main results. First, we find evidence that an increase in the bankruptcy recovery rate is positively associated with MSMEs' decision to invest in innovation (*investment effect*). The higher the recovery rate the more these firms engage in innovation.

This is true also for micro firms with fewer than 10 employees, which is still an understudied category in the extant literature. Secondly, we show that the increase in MSMEs' investments in innovation associated to higher recovery rates can be explained by easier access to credit conditions due to lower interest rates. The model and empirical estimates show that where creditors can recover a good amount of their loans, borrowing interest rates are lower and MSMEs are less likely to be credit constrained because of too high interest rates (*constraint effect*). Lenders who expect to recover a large share of their credit are more prone to charge lower borrowing interest rates, which facilitates MSMEs' access to credit and investments. Again, this occurs for micro firms also. Thirdly, our findings suggest that where the recovery rate is high, profitable MSMEs investing in innovation benefit of a lower borrowing interest rates dispersion, which can further stimulates access to credit and the engagement in innovative projects (*dispersion effect*).

These findings have valuable implications, which contribute to advance knowledge on the links between bankruptcy systems, financing and MSMEs' innovativeness. First, by looking at the bankruptcy recovery rate we shift the focus from debtor to creditor. Prior research agrees that a debtor-friendly system is conducive to firms' creation, boosting the quantity of enterprises. What this study shows is that a creditor-friendly system as well can generate positive effect for small businesses. By stimulating their investments in innovation, it can contribute to promote their quality. Thus, we challenge the view that only debtor-oriented systems are beneficial for business: when we look at firms' innovative behaviour, the creditor side also matters and plays a positive role. Second, we move the attention from the quantity to the quality of small businesses. While the extant literature mainly examines the impact of bankruptcy laws on firms' creation, we rather investigate the link with the propensity to engage in innovation, arguably the most qualifying characteristic of high-quality businesses. Not only having more firms matters, but in particular having more innovative firms. Third, this study provides first evidence that the bankruptcy system, and particularly creditors' recovery rate, is connected with MSMEs' decision to invest in innovation. We focus on the input-side and early-stage of the innovation process rather than on the output-side and final-stage. The former looks more problematic for small businesses due to the scarcity of internal resources and their limited access to external finance. Further, our research advances knowledge on firms' innovation

and financing by including firms with fewer than 10 employees, which is an under-studied category in this field. By doing so, we help developing a more comprehensive understanding of the innovation behaviour of the whole small businesses' population.

From policy perspective, we join the ongoing debate on to promotion of firms' innovation. This is particularly pressing for MSMEs, which are more likely to face financial constraints and limited access to knowledge. Our findings suggest that policies aimed at improving creditors recovery rate can contribute to ease MSMEs' access to finance and to stimulate their investments in innovation. Moreover, it is often question for policy makers as to whether one-size-fits-all or rather size-specific policies are more conducive to innovation. To this regard, our estimates show that the beneficial effects of an improvement in the recovery rate occur for the whole population of MSMEs, regardless of their size.

We are also conscious of some limitations of our study that can offer intriguing venues for future research. First, the binary variable *innovation* allows us to assess the extensive margin of innovation investments but not the intensive one. Information about the level of innovation expenditures are not reported by the survey we consider. Examining the impact of bankruptcy recovery rate on the intensity of investments might be an interesting extension of this research. Moreover, among financing used for innovation, SAFE does not distinguish between secured and unsecured credits. Hence, we cannot separate firms according to the type of credit. Considering such distinction would be helpful to have a more detailed understanding of the relationship between bankruptcy systems and innovation investments. Second, our measure of interest rates dispersion only relies on interest rates for credit line and bank overdraft. No other rates are provided by SAFE. Having a wider array of borrowing interest rates should contribute to delve deeper into the link between bankruptcy laws and interest rates dispersion. Concerning these shortcomings, an extension of SAFE with additional questions on the level of innovation expenditures, the type of credit and alternative borrowing interest rates would definitely offer useful insights to inspire new research. We also acknowledge that the three measures of recovery rate (*recovery*, *score*, and *time*) might embed information related to other institutional dimensions, such as the rule of law, the level of bureaucracy, or the capital markets' efficiency. The effectiveness of insolvency procedures should indeed be favoured by well-functioning institutions. However, the high interdependence among the several components of public

institutions makes it difficult to disentangle each of them. Simultaneously controlling for all of them would rise multicollinearity problems. We try to limit this issue by using alternative measures of recovery rate and by including country indicators to control for several economic and institutional dimensions. We are also aware that, despite being a quite unique source of comparable global data, Doing Business project has limitations and controversies (Besley, 2015). It relies on assumptions that might simplify complex legal frameworks, as well as raise questions on its general validity and measurement accuracy. Though helpful to shed light on diverse aspects of the business climate where little was known, including insolvency issues, this project does not capture a complete picture of the business and legal environments. Hence, more holistic and fine-grained indicators would be helpful to delve deeper into the relationship between bankruptcy systems and firms' innovativeness. In this regard, the World Bank is currently working on a new project known as the Business Enabling Environment (BEE), aimed at formulating a new approach to develop a more comprehensive view of the business and regulatory environments in economies worldwide. As such, once available, the BEE project might be an interesting alternative that future research should consider.

We hope that our findings, together with the aforementioned limitations, could open new horizons for other important and fruitful research in this field.

Data availability statement

Access to the anonymised microdata of the Survey on the Access to Finance of Enterprises (SAFE) is granted by the European Central Bank. Data are confidential and not publicly available. Access conditions are available in the SAFE web page at:
`https://www.ecb.europa.eu/stats/ecb_surveys/safe/html/index.en.html`

World Bank-Doing Business data are openly available in the World Bank-Doing Business archive at:
`https://archive.doingbusiness.org/en/data`

World Bank-World Development Indicators are openly available in the World Bank database at:
`https://data.worldbank.org`

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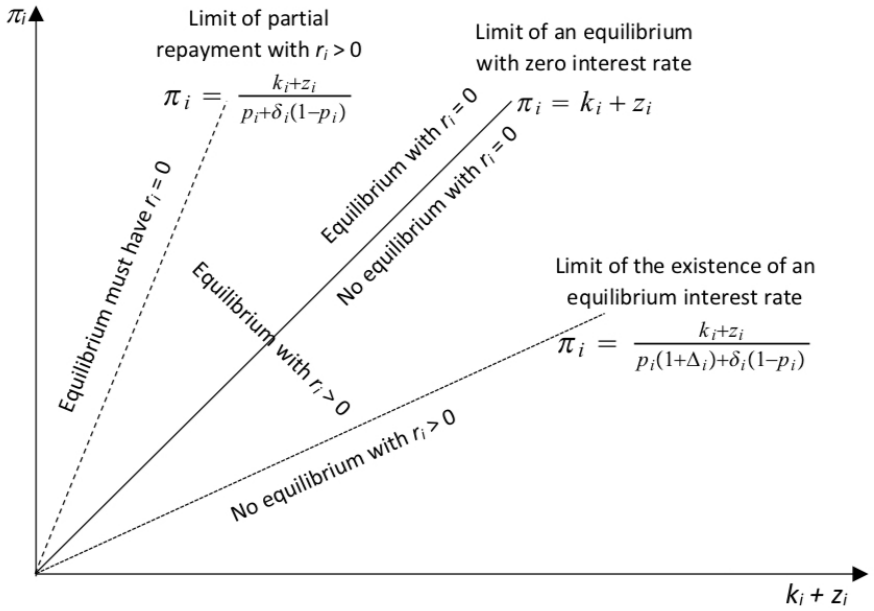
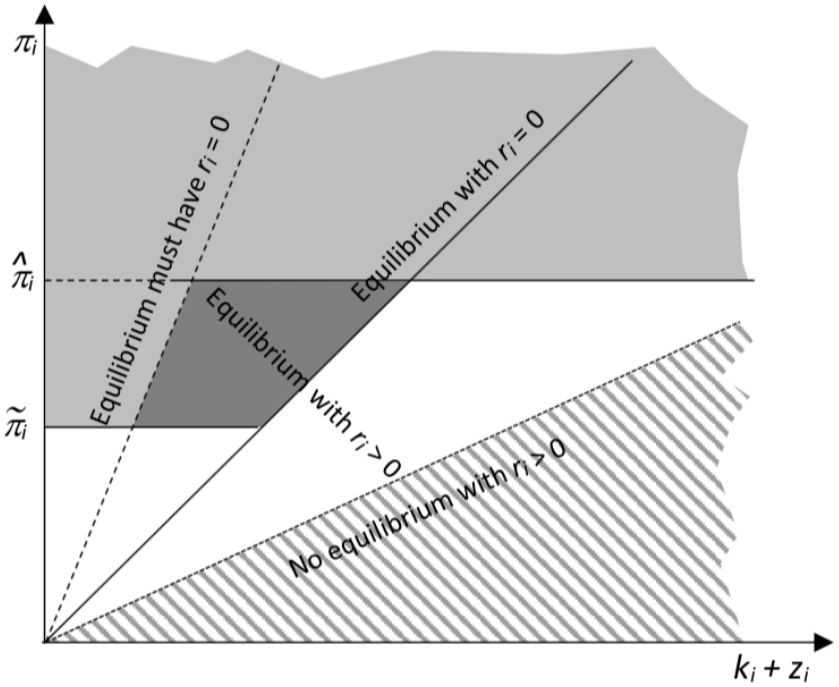
Figures and Tables

Figure 1: Equilibrium interest rates.



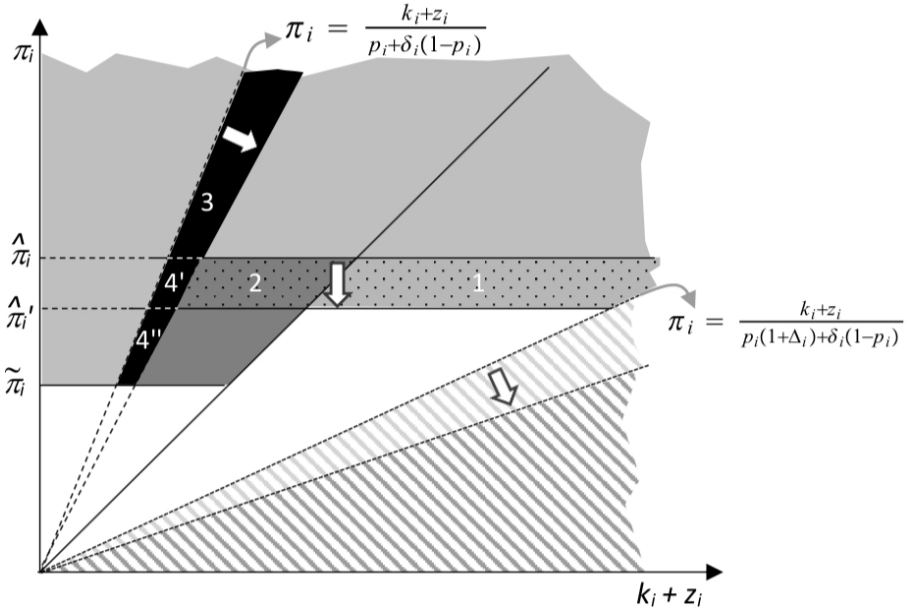
Notes: The figure reports the equilibrium interest rates according to the conditions illustrated in section 3.2.

Figure 2: Investment in innovation (light grey area + dark grey area only if $r_i = 0$).



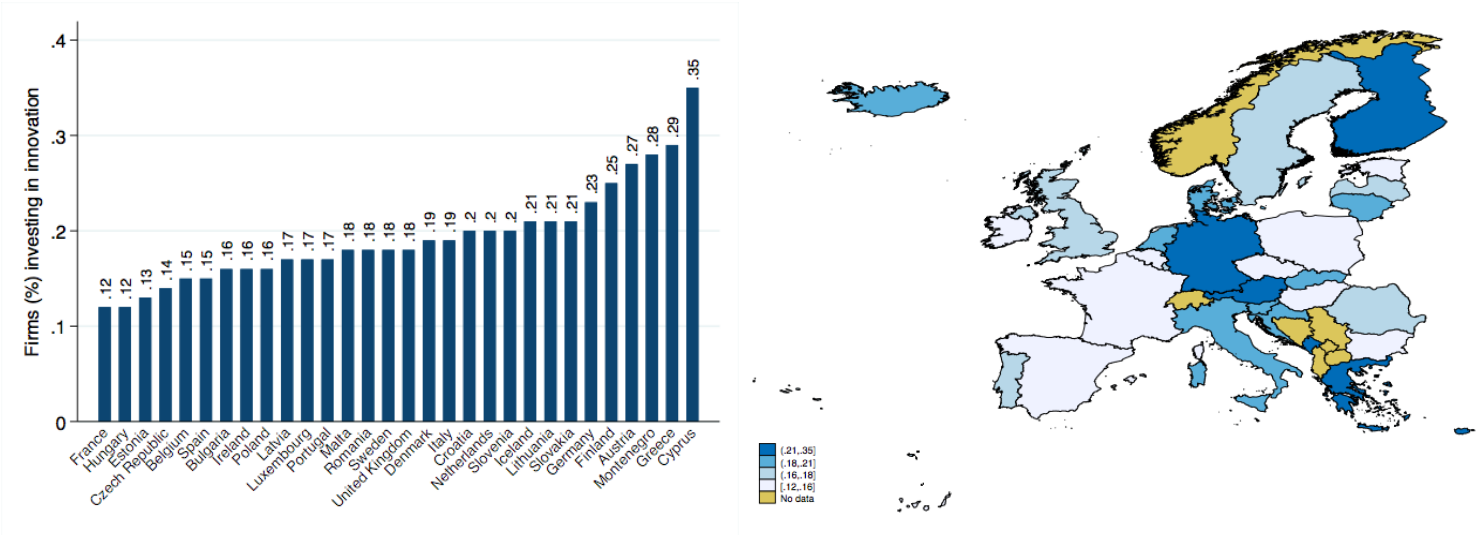
Notes: The figure reports the profit cut-off values defined by the IPC_c ($\tilde{\pi}_i$) and by the IPC_u ($\hat{\pi}_i$), along with the four regions defining firm's decision to invest in innovation illustrated in section 3.3.

Figure 3: Effects of an increase in the recovery rate (δ_i).



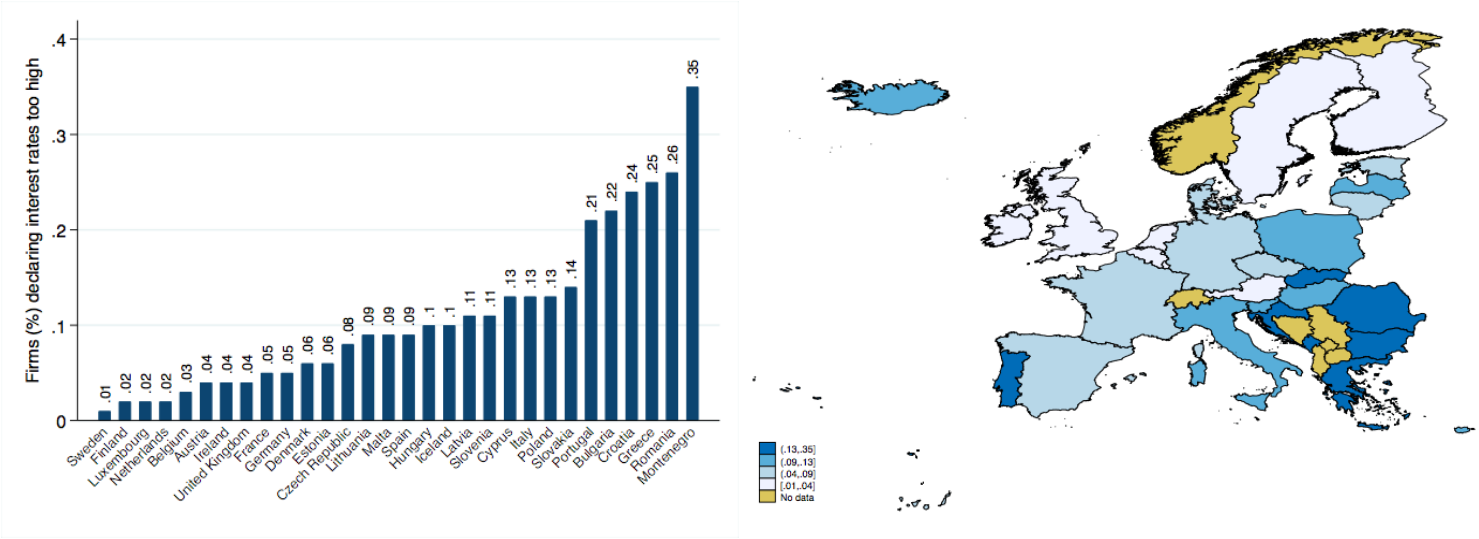
Notes: The figure illustrates the effects of an increase in the bankruptcy recovery rate (δ_i) explained in section 3.4.

Figure 4: Firms (%) investing in innovation.



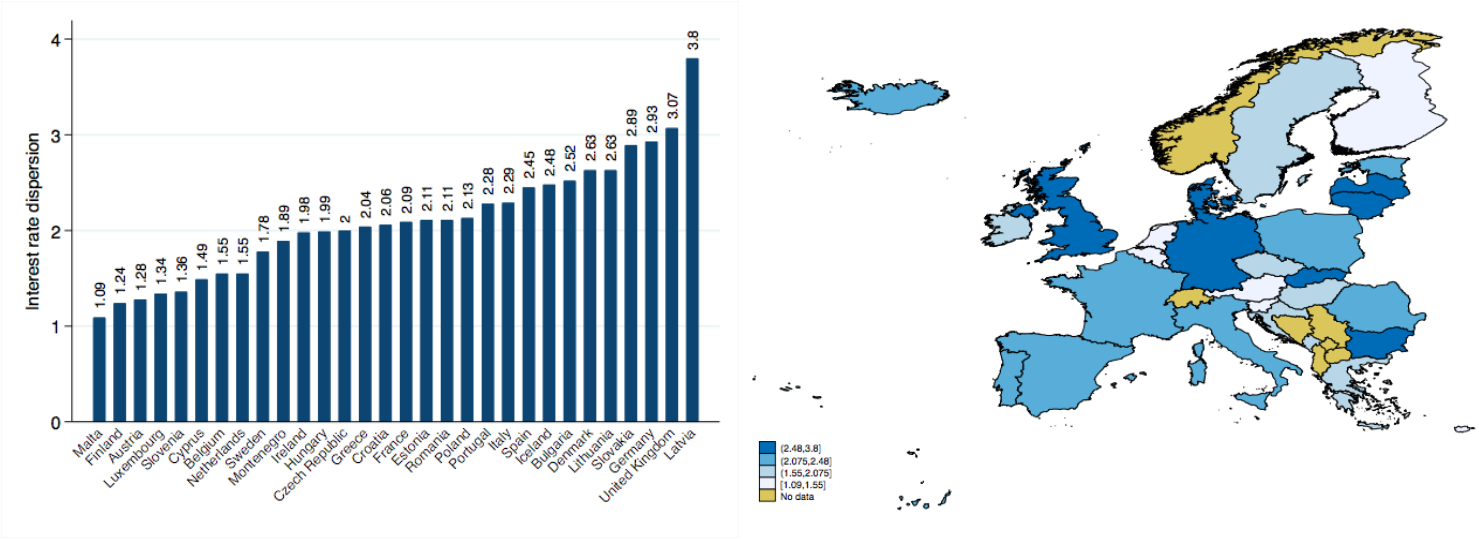
Notes: Authors' calculations on SAFE data. The figure reports the weighted percentage of firms that invest in innovation over the 2014-2018 period.

Figure 5: Firms (%) constrained because of too high interest rates.



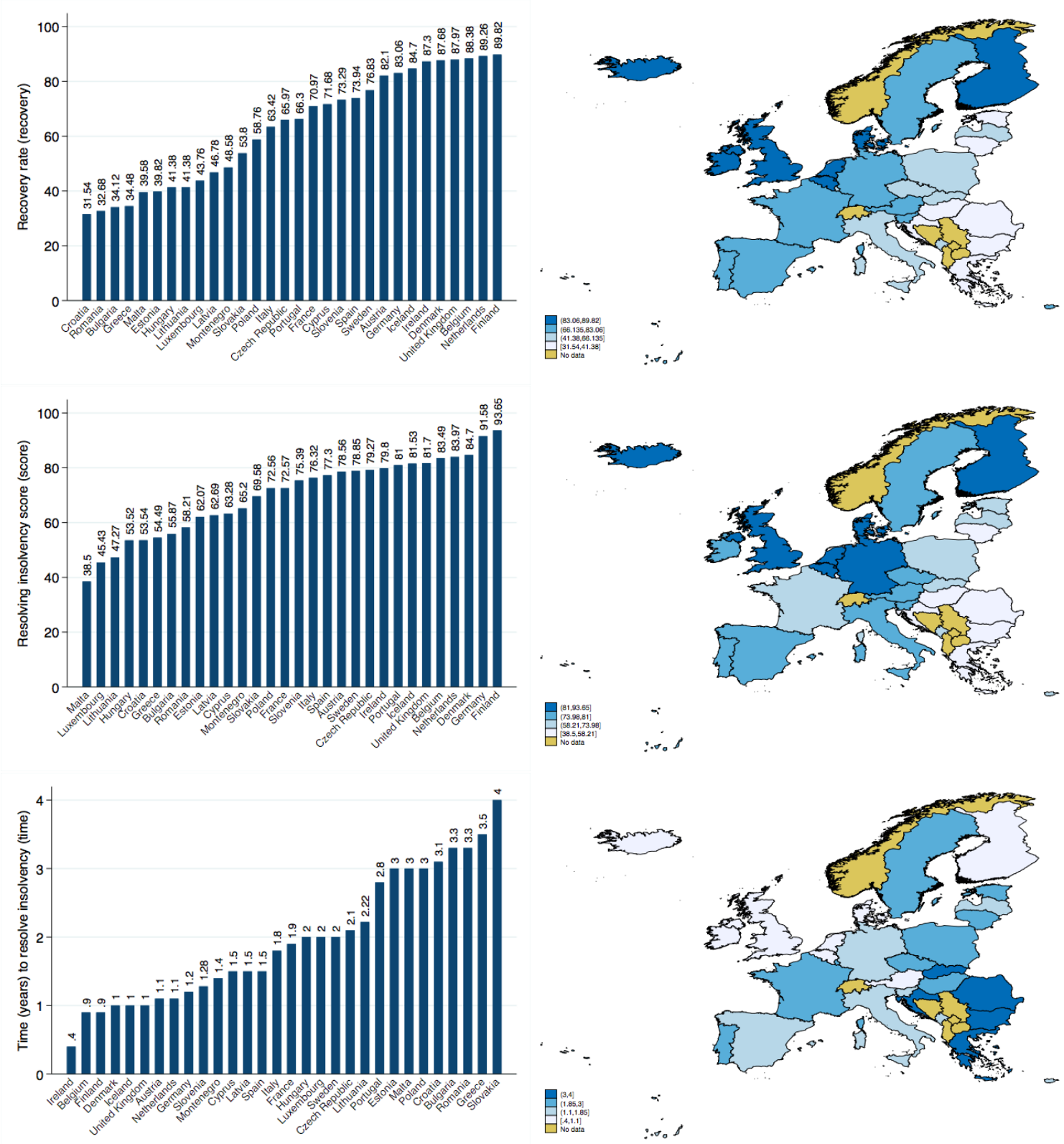
Notes: Authors' calculations on SAFE data. The figure reports the weighted percentage of firms that do not consider bank loans because interest rates are too high over the 2014-2018 period.

Figure 6: Interest rate dispersion.



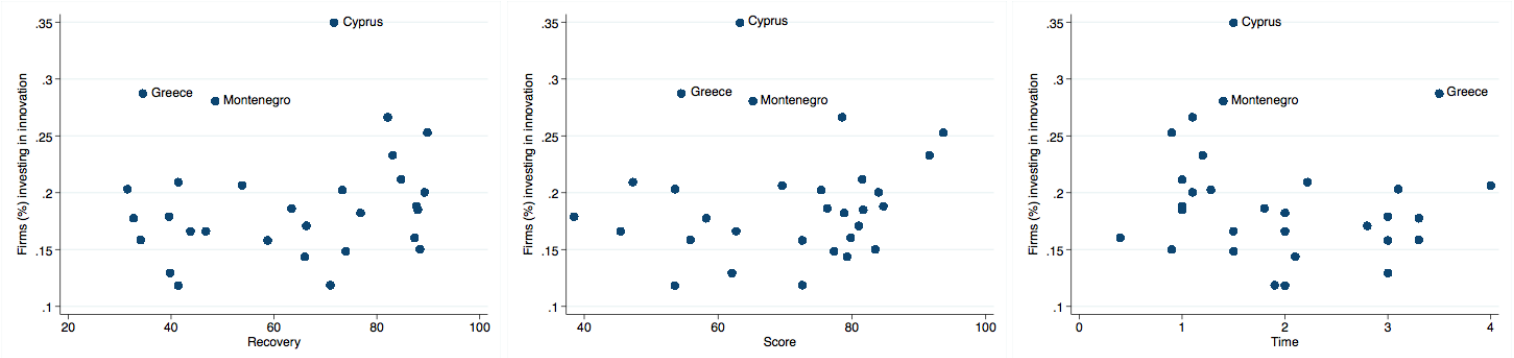
Notes: Authors' calculations on SAFE data. The figure reports the weighted average interest rate dispersion over the 2014-2018 period.

Figure 7: Bankruptcy recovery rate.



Notes: Authors' calculations on World Bank/Doing Business data. The figure reports the country average values of the bankruptcy recovery rate indicators over the 2014-2018 period.

Figure 8: Innovation investments and bankruptcy recovery rate.



Notes: Authors' calculations over the 2014-2018 period. The figure plots the country percentages of firms investing in innovation over the recovery rate indicators.

Figure 9: Constrained firms and bankruptcy recovery rate.

Notes: Authors' calculations over the 2014-2018 period. The figure plots the country percentages of firms that do not access to bank loans for high interest rates over the recovery rate indicators.

Table 1: Stylized facts.

Panel A	High recovery rate (recovery $\geq$ 71)	Low recovery rate (recovery $<$ 71)
Country	Austria, Belgium, Cyprus, Denmark, Finland, France, Iceland, Ireland, Germany, Netherlands, Slovenia, Spain, Sweden, UK	Bulgaria, Croatia, Cz. Rep., Estonia, Greece, Hungary, Italy Latvia, Lithuania, Luxembourg, Malta, Montenegro, Poland, Portugal, Romania, Slovakia
Innovation (%)	20.15	17.36
Hcost (%)	4.49	13.80
Dispersion (mean)		
Low profit	3.16	2.77
High profit	2.11	2.45
Panel B	**High recovery rate (score $>$ 77)**	**Low recovery rate (score $\leq$ 77)**
Country	Austria, Belgium, Cz. Rep., Denmark, Finland, Germany, Iceland, Ireland, Netherlands, Portugal, Spain, Sweden, UK	Bulgaria, Cyprus, Croatia, Estonia, France, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Malta, Montenegro, Poland, Romania, Slovakia, Slovenia
Innovation (%)	19.50	17.84
Hcost (%)	5.22	13.72
Dispersion (mean)		
Low profit	3.18	2.73
High profit	2.13	2.39
Panel C	**High recovery rate (time $<$ 1.8 years)**	**Low recovery rate (time $\geq$ 1.8 years)**
Country	Austria, Belgium, Cyprus, Germany, Denmark, Finland, Iceland, Ireland, Latvia, Montenegro, Netherlands, Slovenia, Spain, UK	Bulgaria, Czech Rep., Estonia, France, Greece, Croatia, Hungary, Italy, Lithuania, Luxembourg, Malta, Poland, Portugal, Romania, Sweden, Slovakia
Innovation (%)	20.16	16.79
Hcost (%)	6.36	12.91
Dispersion (mean)		
Low profit	3.08	2.72
High profit	2.20	2.29

Notes: Authors' calculations. Countries are divided in two groups according to the level of recovery rate. Panel A refers to *recovery*, panel B to *score*, and panel C to *time*. "High recovery rate" group collects countries where the respective indicators are above the median (below for *time*), while "Low recovery rate" those below (above for *time*). The table shows, for the two groups, the percentage of firms investing in innovation ("innovation"), the percentage of firms that do not consider bank loans because interest rates are too high ("hcost"), and the average interest rates dispersion ("dispersion"). Being turnover a proxy of firms' profit, categories "low profit" includes firms in the lowest turnover category (turnover $\leq$ €500 thousands) and "high profit" those in the highest (turnover $>$ €50 million).

Table 2: Investment effect.

Dependent variable: Innovation	(1) Full sample	(2) Micro	(3) Small	(4) Medium
Panel A: all countries				
Recovery	0.001	0.001	0.001	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	57511	20785	18261	18465
Pseudo-R^2	0.02	0.02	0.02	0.04
Score	0.002**	0.002	0.002**	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	57511	20785	18261	18465
Pseudo-R^2	0.02	0.03	0.03	0.04
Time	-0.018	-0.009	-0.024	-0.029***
	(0.015)	(0.016)	(0.017)	(0.010)
Observations	57511	20785	18261	18465
Pseudo-R^2	0.02	0.02	0.02	0.03
Panel B: excluding Greece and Cyprus				
Recovery	0.002***	0.001**	0.002***	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)
Observations	55189	19472	17695	18022
Pseudo-R^2	0.03	0.03	0.03	0.04
Score	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.000)
Observations	55189	19472	17695	18022
Pseudo-R^2	0.03	0.03	0.03	0.04
Time	-0.028**	-0.022	-0.034**	-0.032***
	(0.014)	(0.016)	(0.015)	(0.010)
Observations	55189	19472	17695	18022
Pseudo-R^2	0.03	0.03	0.03	0.04
Firms controls	Yes	Yes	Yes	Yes
Country indicators	Yes	Yes	Yes	Yes
Time, sector FE	Yes	Yes	Yes	Yes

Notes: Authors' calculations. Cluster robust standard errors in parentheses. Cluster level: country. *** p<0.01, ** p<0.05, * p<0.1. The table reports probit average partial effects (APEs) and all the specifications use sampling weights. Column (1) considers the full sample, while columns (2), (3), and (4) consider the subsamples of micro (1 to 9 employees), small (10 to 49 employees), and medium (50 to 249 employees) firms, respectively. Panel A includes all countries, while panel B excludes Greece and Cyprus. The size and the signs of the coefficients do not change with respect to panel B if we also exclude Montenegro. The set of firm controls include size (only in col.1), turnover (levels and past growth), age, legal status, ownership type, and subsidies. The country indicators are GDP (log, constant 2010 USD), GDP growth (annual %), domestic credit to private sector (% of GDP), general government final consumption expenditure (% of GDP), and inflation. Each column estimates regression (1) by including both sector and time FE.

Table 3: Constraint effect.

Dependent variable: hcost	(1) Full sample	(2) Micro	(3) Small	(4) Medium
Panel A: all countries				
Recovery	-0.002***	-0.003***	-0.002***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	33876	14877	10054	8945
Pseudo-R^2	0.1	0.07	0.09	0.13
Score	-0.001**	-0.002**	-0.001*	-0.001**
	(0.001)	(0.001)	(0.001)	(0.000)
Observations	33876	14877	10054	8945
Pseudo-R^2	0.09	0.07	0.08	0.12
Time	0.033***	0.039***	0.031***	0.022***
	(0.007)	(0.008)	(0.006)	(0.006)
Observations	33876	14877	10054	8945
Pseudo-R^2	0.1	0.07	0.09	0.13
Panel B: excluding Montenegro				
Recovery	-0.002***	-0.003***	-0.002***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	33732	14804	10018	8910
Pseudo-R^2	0.1	0.07	0.09	0.13
Score	-0.002**	-0.002**	-0.001*	-0.001***
	(0.001)	(0.001)	(0.001)	(0.000)
Observations	33732	14804	10018	8910
Pseudo-R^2	0.09	0.07	0.08	0.12
Time	0.034***	0.041***	0.032***	0.023***
	(0.007)	(0.008)	(0.006)	(0.006)
Observations	33732	14804	10018	8910
Pseudo-R^2	0.1	0.07	0.09	0.13
Panel C: excluding Montenegro, Cyprus, Greece				
Recovery	-0.002***	-0.003***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	32564	14027	9759	8778
Pseudo-R^2	0.1	0.07	0.09	0.13
Score	-0.001*	-0.002*	-0.001	-0.001**
	(0.001)	(0.001)	(0.001)	(0.000)
Observations	32564	14027	9759	8778
Pseudo-R^2	0.09	0.06	0.08	0.12
Time	0.032***	0.039***	0.029***	0.022***
	(0.007)	(0.009)	(0.006)	(0.006)
Observations	32564	14027	9759	8778
Pseudo-R^2	0.1	0.07	0.08	0.13
Firms controls	Yes	Yes	Yes	Yes
Country indicators	Yes	Yes	Yes	Yes
Time, sector FE	Yes	Yes	Yes	Yes

Notes: Authors' calculations. Cluster robust standard errors in parentheses. Cluster level: country. *** p<0.01, ** p<0.05, * p<0.1. The table reports probit average partial effects (APEs) and all specifications use sampling weights. Column (1) considers the full sample, while columns (2), (3) and (4) the subsamples of micro (1 to 9 employees), small (10 to 49 employees), and medium (50 to 249 employees) firms, respectively. The set of firm controls includes size (only in col.1), turnover (levels and past growth), age, legal status, ownership type, and subsidies. The country indicators are GDP (log, constant 2010 USD), GDP growth (annual %), domestic credit to private sector (% of GDP), general government final consumption expenditure (% of GDP), and inflation. Each column estimates regression (2) by including both sector and time FE.

Table 4: Dispersion effect.

Dependent variable: Dispersion	(1) Recovery	(2) Score	(3) Time
RR (a)	0.005	0.011	-0.009
	(0.008)	(0.012)	(0.172)
Innovation	-1.450*	-2.851**	1.092*
	(0.776)	(1.038)	(0.580)
RR*Innovation (b)	0.026**	0.041***	-0.403
	(0.011)	(0.012)	(0.286)
Turn2	0.000	-0.732	-0.747
	(0.736)	(1.259)	(0.562)
Turn2*RR (c)	-0.006	0.004	0.169
	(0.011)	(0.016)	(0.247)
Turn2*Innovation	0.156	2.125	-0.458
	(1.313)	(2.019)	(0.773)
Turn2*RR*Innovation (d)	-0.008	-0.032	0.034
	(0.019)	(0.024)	(0.353)
Turn3	-0.467	-0.975	-0.055
	(0.516)	(1.129)	(0.429)
Turn3*RR (e)	0.000	0.007	-0.203
	(0.008)	(0.015)	(0.169)
Turn3*Innovation	1.431	2.843	-1.312
	(1.248)	(1.897)	(0.921)
Turn3*RR*Innovation (f)	-0.030	-0.044*	0.381
	(0.018)	(0.023)	(0.398)
Turn4	-0.755*	-0.973	-0.511*
	(0.389)	(0.735)	(0.256)
Turn4*RR (g)	-0.000	0.003	-0.127
	(0.005)	(0.009)	(0.103)
Turn4*Innovation	1.673*	3.417**	-1.585**
	(0.876)	(1.283)	(0.716)
Turn4*RR*Innovation (h)	-0.031**	-0.050***	0.579*
	(0.014)	(0.016)	(0.309)
Turn5	0.169	-0.416	-0.793***
	(0.425)	(0.780)	(0.282)
Turn5*RR (i)	-0.010*	-0.002	0.144
	(0.005)	(0.009)	(0.106)
Turn5*Innovation	1.280	3.384**	-1.250*
	(0.852)	(1.342)	(0.679)
Turn5*RR*Innovation (l)	-0.026**	-0.050***	0.387
	(0.012)	(0.016)	(0.315)
Turn6	-0.721	-1.570*	0.255
	(0.961)	(0.815)	(0.566)
Turn6*RR (m)	0.008	0.018*	-0.227
	(0.014)	(0.010)	(0.264)
Turn6*Innovation	3.357*	6.690***	-2.557*
	(1.948)	(1.962)	(1.269)
Turn6*RR*Innovation (n)	-0.059*	-0.095***	1.031
	(0.029)	(0.025)	(0.639)
Observations	6412	6412	6412
Adjusted-R^2	0.05	0.06	0.05
Firms controls	Yes	Yes	Yes
Country indicators	Yes	Yes	Yes
Time, sector FE	Yes	Yes	Yes

Notes: Authors' calculations. Cluster robust standard errors in parentheses. Cluster level: country. *** p<0.01, ** p<0.05, * p<0.1. The table reports OLS estimates by using sampling weights. Column (1) considers *recovery* as measure for *RR*, while columns (2) and (3) *score* and *time*, respectively. The set of firms controls includes size, turnover (levels and past growth), age, legal status, ownership type, and subsidies. The country indicators are GDP (log, constant 2010 USD), GDP growth (annual %), domestic credit to private sector (% of GDP), general government final consumption expenditure (% of GDP), and inflation. Turn1 indicates turnover (T) ≤ €500k; Turn2 €500k < T ≤ €1mln; Turn3 €1mln < T ≤ €2mln; Turn4 €2mln < T ≤ €10mln; Turn5 €10mln < T ≤ €50mln; Turn6 T > €50mln. Sector and time FE are included.

Table 5: Dispersion effect - interactions.

Effect of RR on:	(1) Recovery	(2) Score	(3) Time
Turn1, innovation (a+b)	0.031** [4.72; 0.0381]	0.052*** [14.51; 0.0007]	-0.412 [1.50; 0.2313]
Turn2, innovation (a+c+d)	-0.009 [0.25; 0.6211]	-0.017 [0.44; 0.5103]	0.194 [0.41; 0.5287]
Turn3, innovation (a+e+f)	-0.025 [2.35; 0.1359]	-0.026 [1.24; 0.2754]	0.169 [0.19; 0.6630]
Turn4, innovation (a+g+h)	-0.026** [4.83; 0.0361]	-0.036** [6.77; 0.0145]	0.443 [2.33; 0.1379]
Turn5, innovation (a+i+l)	-0.031** [6.41; 0.0171]	-0.041*** [8.08; 0.0081]	0.522* [2.99; 0.0946]
Turn6, innovation (a+m+n)	-0.046** [6.21; 0.0186]	-0.066** [5.86; 0.0220]	0.795* [3.09; 0.0891]

Notes: Authors' calculations. The table shows the overall effects of *RR* on *dispersion* for firms that invest in innovation in each turnover category. Effects are derived from table 5 (as letters in round brackets shows). Column (1) considers *recovery* as measure for *RR*, while columns (2) and (3) *score* and *time*, respectively. Turn1 indicates turnover (T) $\leq$ €500k; Turn2 €500k $<$ T $\leq$ €1mln; Turn3 €1mln $<$ T $\leq$ €2mln; Turn4 €2mln $<$ T $\leq$ €10mln; Turn5 €10mln $<$ T $\leq$ €50mln; Turn6 T $>$ €50mln. "Turn[1-6], innovation" refers to firms in the respective turnover category that invest in innovation. F-values and p-values in squared brackets.

Appendix

A The model

A.1 Analytical appendix

A.1.1 Analytical relationship of the functions reported in Figure 1

$$\text{Dash line}: \pi_i = \frac{k_i + z_i}{p_i + \delta_i (1 - p_i)} \qquad \text{Solid line}: \pi_i = k_i + z_i \qquad \text{dot line}: \pi_i = \frac{k_i + z_i}{p_i (1 + \Delta_i) + \delta_i (1 - p_i)}$$

▷ The slope of the dash line is always greater than that of the solid line if $\delta_i < 1$.

$$\text{if} \quad \delta_i < 1 \Longrightarrow p_i + \delta_i (1 - p_i) < 1 \Longrightarrow \text{(dash line slope)} \quad \frac{1}{p_i + \delta_i (1 - p_i)} > 1 \quad \text{(solid line slope)}$$

The wedge between the dash and the solid line, due to $\delta_i < 1$, explains the multiple equilibria interest rates.

▷ The intercept of the dash line is always greater than that of the dot line.

$$\text{Since} \quad \Delta_i > 0 \Longrightarrow (1 + \Delta_i) > 1 \Longrightarrow p_i (1 + \Delta_i) + \delta_i (1 - p_i) > p_i + \delta_i (1 - p_i) \Longrightarrow$$

$$\Longrightarrow \text{(dash line intercept)} \quad \frac{1}{p_i + \delta_i (1 - p_i)} > \frac{1}{p_i (1 + \Delta_i) + \delta_i (1 - p_i)} \quad \text{(dot line intercept)}$$

▷ The intercept of the dot line is $\lesseqgtr$ than that of the solid line if $\delta_i \gtreqless 1 - \frac{p_i \Delta_i}{(1 - p_i)}$

$$\text{if} \quad \delta_i \gtreqless 1 - \frac{p_i \Delta_i}{(1 - p_i)} \Longrightarrow p_i (1 + \Delta_i) + \delta_i (1 - p_i) \gtreqless 1 \Longrightarrow$$

$$\Longrightarrow \text{(dot line intercept)} \quad \frac{1}{p_i (1 + \Delta_i) + \delta_i (1 - p_i)} \lesseqgtr 1 \quad \text{(solid line intercept)}$$

The underlying intuition is the following. The higher (lower) the bankruptcy recovery rate (i.e. the higher δ_i), the lower (higher) the limit defined by condition (6) under which the firm is not able to pay back the full borrowed amount even if the investment in innovation succeeds (i.e. where no equilibrium with $r_i > 0$ exists). Intuitively, the higher (lower) the probability of success (p_i) and the profit gain (Δ_i), the lower (higher) this limit. Note that multiple equilibria interest rates would emerge even if the dotted curve was over the solid one.

A.1.2 Proof of IPC$_c$ (investment profitability condition with certainty) with $r_i = 0$

$$E(\Pi_i) > \Pi_i^N \qquad \text{if} \qquad (2) > (1)$$

that is

$$p_i \left[(1 + \Delta_i) \pi_i - e_i - k_i - z_i \right] + (1 - p_i) \left[\pi_i - e_i - k_i - z_i \right] > \pi_i - (e_i + k_i)$$

We can simplify the left-hand side to find

$$(1 + p_i \Delta_i) \pi_i - (e_i + k_i + z_i) > \pi_i - (e_i + k_i)$$

By isolating and collecting π_i we get

$$\pi_i (p_i \Delta_i) > z_i \Longrightarrow \pi_i > \frac{z_i}{p_i \Delta_i} \qquad \blacksquare$$

A.1.3 Proof of IPC$_u$ (investment profitability condition with uncertainty) with $r_i > 0$

$$E(\Pi_i) > \Pi_i^N \qquad \text{if} \qquad (8) > (1)$$

that is

$$(1 - p_i) (-e_i) + p_i \left[(1 + \Delta_i) \pi_i - e_i - (k_i + z_i) (1 + r_i) \right] > \pi_i - (e_i + k_i)$$

We can simplify the left-hand side to find

$$\left[p_i (1 + \Delta_i) + \delta_i (1 - p_i) \right] \pi_i - (e_i + k_i + z_i) > \pi_i - (e_i + k_i)$$

By isolating and collecting π_i we obtain

$$\pi_i \left[p_i \Delta_i - (1 - p_i)(1 - \delta_i) \right] > z_i \Longrightarrow \pi_i > \frac{z_i}{\left[p_i \Delta_i - (1 - p_i)(1 - \delta_i) \right]} \qquad \blacksquare$$

A.2 Multiple equilibria interest rates - a numerical example

We provide a numerical example concerning the multiple equilibria interest rates region (between the dot and the dash lines in Figure 1). Consider a firm making a profit $\pi_i = 105$. Assume that, if the investment fails and it is forced to bankrupt, the restored value is 90 (suppose $90 = \delta_i * 105$). This means that creditors receives back only 90 of the 100 they granted. Thus, they would receive 90 if the investment fails and $100*(1+r_i)$ if it succeeds. They therefore expect to recover $0.5 * 90 + 0.5 * 100 * (1 + r_i) = 95 + 50r_i$. As creditors are risk neutral, this value must be equal to their initial stake (100). This is the case if $95 + 50r_i = 100$, i.e., if the interest rate is $r_i = 0.10$. Along with the risk free rate, we have a second equilibrium interest rate equal to 10%. Whether $r_i = 0$ or $r_i = 0.10$ is charged depends on what creditors expect if the investment in innovation fails. They will choose $r_i = 0$ if they expect the firm does not go bankrupt, while $r_i = 0.10$ if they expect it does. This second rate is due to the fact that, in case of bankruptcy, the firm cannot restore the entire operating profit (because of $\delta_i < 1$). If δ_i was equal to 1 the value of the firm would stay at 105 even in the event of bankruptcy. Creditors would then always recover the entire amount and therefore only the risk free interest rate would be observed.

B Empirical analysis

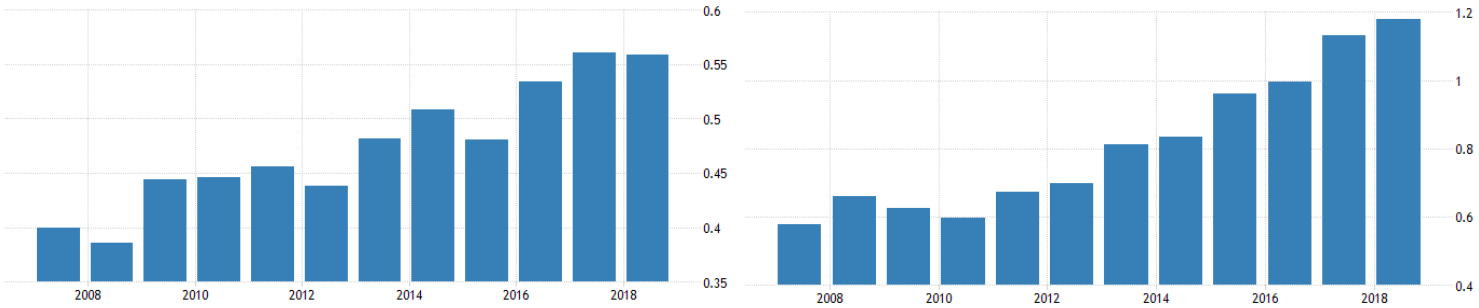
B.1 The SAFE survey

Firms are selected randomly from the DUN & Bradstreet business register and their number is adjusted by weights to restore the proportions of the economic weight of each size class, economic activity, and country.[1] Surveyed firms are grouped into four main sectors (industry, construction, trade, and other services) and only non-financial enterprises outside agriculture, public administration, or financial services are included. Respondents are top-level executives (general manager, financial director, or chief accountant), who reply voluntarily and anonymously by telephone or, to a less extent, by on-line questionnaires.

[1] According to official statistics, 92% of enterprises in the euro area are micro enterprises, 7% small, 1% medium, and 0.2% large. However, in terms of economic weight, as measured by the number of persons employed, micro firms represent the 31% of all enterprises, small firms the 22%, medium firms the 16%, and large firms the 30%.

B.2 Additional Figures and Tables

Figure B.2.1: Research and development expenditures in Cyprus and Greece.



(a) Cyprus **(b)** Greece

Notes: The figure reports the annual expenditures in research and development (% of GDP) in Cyprus (panel a) and Greece (panel b). Source: World Bank.

Table B.2.1: Observations by country.

Country	Freq.	Percent	Micro	Small	Medium
Austria	2,305	2.97	778	829	698
Belgium	2,278	2.93	1,002	702	574
Bulgaria	2,306	2.97	752	752	802
Croatia	1,332	1.71	476	403	453
Cyprus	481	0.62	177	151	153
Czech Rep.	2,015	2.59	724	597	694
Denmark	2,213	2.85	605	830	778
Estonia	477	0.61	151	151	175
Finland	2,255	2.90	827	753	675
France	6,564	8.45	2,604	2,083	1,877
Germany	6,444	8.29	1,731	2,357	2,356
Greece	2,408	3.10	1,503	552	353
Hungary	2,261	2.92	958	651	652
Iceland	501	0.64	191	167	143
Ireland	2,310	2.97	807	777	726
Italy	7,056	9.08	3,751	2,002	1,303
Latvia	926	1.19	275	325	326
Lithuania	1,377	1.77	375	475	527
Luxembourg	455	0.59	125	152	178
Malta	477	0.61	175	151	151
Montenegro	504	0.65	187	172	145
Netherlands	3,660	4.71	1,406	1,128	1,126
Poland	5,968	7.68	2,886	1,204	1,878
Portugal	2,388	3.07	1,178	678	532
Romania	2,211	2.85	653	727	831
Slovakia	2,019	2.60	861	578	580
Slovenia	902	1.16	325	252	325
Spain	6,012	7.74	2,855	1,825	1,332
Sweden	2,158	2.78	697	736	725
UK	5,446	7.01	1,720	1,984	1,742
Total	77,709	100.00	30,755	24,144	22,810

Notes: This table presents the number of observations by each sample country. It refers to the five SAFE common round waves over the 2014-2018 period. "Micro" indicates firms with 1-9 employees, "Small" those with 10-49, and "Medium" those with 50-249.

Table B.2.2: Variables definitions and sources.

Variable	Definition	Source
Dependent variables		
Innovation	Dummy equal to 1 if the firm used financing to develop or launch new products or services.	SAFE
Hcost	Dummy equal to 1 if the main reason why the firm does not use bank loans is interest rates or price too high.	SAFE
Dispersion	Difference between the individual and the country average interest rates. It refers to the rate charged for credit line or bank overdraft. Continuous variable.	SAFE
Bankruptcy recovery rate (RR)		
Recovery rate (recovery)	Cents per dollar recovered by secured creditors through judicial reorganisation, liquidation, or debt enforcement proceedings. Continuous variable (0-100 scale).	World Bank/Doing Business
Resolving insolvency score (score)	Gap of each economy from the best performance observed in terms of resolving insolvency. Continuous variable (0-100 scale).	World Bank/Doing Business
Time	The period of time from the company's default until the payment of some or all of the money owed to creditor. Continuous variable.	World Bank/Doing Business
Firm dummies		
Size	Micro (from 1 to 9 employees); Small (from 10 to 49); Medium (from 50 to 249).	SAFE
Sector	Industry (if *industry* is the main activity); Construction (if *construction* is the main activity); Trade (if *trade* is the main activity); Services (if *services* is the firm's main activity).	SAFE
Age	Age < 2; $2 \leq$ Age < 5; $5 \leq$ Age < 10; Age ≥ 10.	SAFE
Annual turnover (T)	T $\leq$ €500k (Turn1); €500k $<$ T $\leq$ €1mln (Turn2); €1mln $<$ T $\leq$ €2mln (Turn3); €2mln $<$ T $\leq$ €10mln (Turn4); €10mln $<$ T $\leq$ €50mln (Turn5); T $>$ €50mln (Turn6).	SAFE
Turnover past growth (TG)	TG < 0; TG $= 0$; $0 <$ TG $< 20\%$; TG $\geq 20\%$; (over the past 3 years).	SAFE
Ownership type	Public shareholders; family; business associate; venture capital (VC) or business angel (BA); single owner; others.	SAFE
Legal status	Autonomous (if the firm is an autonomous profit-oriented enterprise).	SAFE
Subsidised	Subsidies (if in the past six months the firm received grants or subsidised bank loans).	SAFE
Country controls	GDP (log, constant 2010 USD); GDP growth (annual %); Domestic credit provided by banks to private sector (% of GDP); General government final consumption expenditure (% of GDP); Inflation (CPI, annual %).	World Bank
Post-hoc variables		
Apply	Dummy variable equal to 1 if the firm applied for one of the following types of financing: credit line, bank overdraft or credit card overdraft, bank loans, trade credit, others.	SAFE
Apply_bank_loans	Dummy variable equal to 1 if the firm applied for bank loans.	SAFE
Outlook	Dummy variable equal to 1 if the firm's general economic outlook improved.	SAFE
Starting a business	It records all procedures officially required, or commonly done in practice, for an entrepreneur to start up and formally operate an industrial or commercial business, as well as the time and cost to complete these procedures and the paid-in minimum capital requirement. Continuous variable (0-100 scale).	World Bank/Doing Business
Getting credit	It measures the extent to which lenders have credit information on entrepreneurs seeking credit and to which the law is favourable to borrowers and lenders movable assets as collateral. Continuous variable (0-100 scale).	World Bank/Doing Business
Protecting minority investors	It measures the extent to which minority shareholders are protected from conflicts of interest. Continuous variable (0-100 scale).	World Bank/Doing Business
Bank concentration index (BC5)	Assets of the five largest banks as a share of total commercial banking assets. Continuous variable (0-100 scale).	World Bank
Talents	How important is the problem "availability of skilled workers and experienced managers". Continuous variable (1-10 scale).	SAFE

Notes: This table presents the definitions of the variables used in the empirical analysis.

Table B.2.3: Descriptive statistics.

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Innovation	62,047	0.1871	0.3900	0	1
Hcost	36,287	0.0930	0.2904	0	1
Dispersion	6,838	2.1830	2.3707	0	42.29
Recovery	77,709	68.1919	18.5327	30	90.3
Score	77,709	74.8704	11.8987	38.07	93.89
Time	77,709	1.8743	0.8989	0.4	4
Micro	77,709	0.3958	0.4890	0	1
Small	77,709	0.3107	0.4628	0	1
Medium	77,709	0.2935	0.4554	0	1
Industry	77,709	0.2340	0.4234	0	1
Construction	77,709	0.1191	0.3239	0	1
Trade	77,709	0.2590	0.4381	0	1
Services	77,709	0.3879	0.4873	0	1
Age < 2	77,607	0.0133	0.1145	0	1
$2 \leq$ Age < 5	77,607	0.0492	0.2163	0	1
$5 \leq$ Age < 10	77,607	0.1312	0.3376	0	1
Age ≥ 10	77,607	0.8063	0.3952	0	1
T $\leq$ €500k	75,317	0.2918	0.4546	0	1
€500k $<$ T $\leq$ €1mln	75,317	0.1359	0.3427	0	1
€1mln $<$ T $\leq$ €2mln	75,317	0.1300	0.3363	0	1
€2mln $<$ T $\leq$ €10mln	75,317	0.2500	0.4327	0	1
€10mln $<$ T $\leq$ €50mln	75,317	0.1583	0.3650	0	1
T $>$ €50mln	75,317	0.0346	0.1827	0	1
TG < 0	75,553	0.1630	0.3693	0	1
TG $= 0$	75,553	0.2143	0.4104	0	1
$0 <$ TG $< 20\%$	75,553	0.4627	0.4986	0	1
TG $\geq 20\%$	75,553	0.1600	0.3666	0	1
Public shareholders	77,488	0.0262	0.1597	0	1
Family	77,488	0.4098	0.4918	0	1
Business Associate	77,488	0.1270	0.3329	0	1
VC or BA	77,488	0.0074	0.0858	0	1
Single owner	77,488	0.3928	0.4884	0	1
Others	77,488	0.0369	0.1885	0	1
Autonomous	77,709	0.8570	0.3501	0	1
Subsidised	75,028	0.0801	0.2715	0	1
Apply	67,519	0.4264	0.494	0	1
Apply_bank_loans	45,512	.2719	.4449	0	1
Outlook	71,807	0.2302	0.4209	0	1
GDP (log)	77,709	27.0871	1.4779	22.20	29.00
GDP growth	77,709	2.6956	2.3532	-1.86	25.16
Domestic credit	77,709	86.1142	33.9267	25.70	252.78
Government expenditures	77,709	19.9098	2.9893	11.9003	26.3653
Inflation	77,709	.7727	1.0428	-2.09	4.6254
Starting a business	77,709	88.20	4.79	75.20	95.15
Getting credit	77,709	60.06	13.22	10	85
Protecting minority investors	77,709	66.96	7.17	50	84

Notes: This table presents unweighted summary statistics for the variables used in the empirical analysis. It refers to the five SAFE common round waves over the 2014-2018 period.

B.3 Robustness checks

This appendix section reports the detailed explanation and results of the empirical specifications performed as robustness tests. In panels A and B of Table B.3.1, we estimate models (1) and (2) by excluding Ireland, Spain, and Portugal, which also received ESM assistance during and after the financial and sovereign debt crises. Unlike Cyprus and Greece, these three countries did not obtain funds during our sample period (2014-2018) but only prior to 2014. Yet, such financial aids may have influenced investments in innovation and the cost of borrowing even after. Estimates in panel A of Table B.3.1 are similar to those reported in panel B of Table 2. Similarly, results in panel B confirms what Table 3 shows.

A second issue concerning propositions 1 and 2 is sample selection. The likelihood of observing variables *innovation* (i.e. whether the firm invest in innovation) and *hcost* (i.e. whether the firm does not consider bank loans because of too high interest rates) might be driven by unobserved factors that make a firm more likely to ask for and to receive loans. To control for sample selection bias we perform a Heckman maximum likelihood probit model. Following a similar approach as Ferrando et al. (2019), we use as selection variable a dummy (*outlook*) equal to one if the firm's own outlook has improved in the past six months.[2] As the authors argue, not only does this variable satisfy the relevance condition, because a better outlook should increase both demand funding and credit, but it also respects the exclusion restriction condition as it is unlikely for banks to observe such improvement in firm's outlook so quickly. To measure the demand for credit, we build a dummy (*apply*) equal to one if the firm applied for one of the following external source of financing in the past six months: a) credit line, bank overdraft, or credit card overdraft; b) bank loans; c) trade credit; and d) other external financing.[3] Panels A and B of Table B.3.2 report estimates of the Heckman selection model related to propositions 1 and 2,

[2]We refer to the following survey question: *"For each of the following factors, would you say that they have improved, remained unchanged or deteriorated over the past six months?"* The dummy is equal to one if firm answers *"improved"* for the option *"general economic outlook"*.

[3]We refer to the following survey question: *"Have you applied for the following types of financing in the past six months?"*. We also build a specific dummy (*applied_bank_loans*) measuring demand for bank loans only, which equals one in case of an affirmative response for (b). The selection variable *outlook* has a positive and statistically significant effect on both variables *apply* and *applied_bank_loans*. Results are available upon request.

respectively.[4] Results in panel A of Table B.3.2 do not change substantially from those in panel B of Table 2. Comparing panel B of Table B.3.2 with results in Table 3, *recovery* and *time* have similar coefficients, while those related to *score* are no longer significant but of the expected sign. In panel B of Table B.3.2, coefficients for the medium sized firms subsample are no longer statistically significant. This might suggest that, after controlling for selection, the impact of recovery rate on the borrowing costs is driven primarily by smaller firms, which are usually more constrained.

In Table B.3.3, we integrate baseline regressions with additional controls. Firstly, we include three indicators from the World Bank/Doing Business database concerning business activity. The first indicator (*starting a business*) assesses the ease of starting a business by considering the time, cost, paid-in minimum capital, and number of procedures needed to get a company started. The second (*getting credit*) considers the level of credit information the lenders have on entrepreneurs seeking credit and the extent to which the law is favourable to credit. The third (*protecting minority investors*) focuses on the protection of minority investors.[5] We add these variables to verify that the estimated effects of bankruptcy recovery rate do not incorporate information that are rather attributable to other dimensions of the business environment. Secondly, we control for the country banking market structure. Prior literature suggests that it might affect access to finance conditions, particularly for small businesses (Beck et al., 2004; Ryan et al., 2014; Dou et al., 2022). To proxy the banking market structure, we include the bank concentration index from the World Bank (*BC5*), measuring assets of the five largest banks as a share of total commercial banking assets.[6] Thirdly, we want to account for the fact that the innovative activities of small businesses might be hampered by the difficulty to find highly educated and skilled workers. Scientists are key resources to develop innovation and their wages count for a consistent part of R&D spending (Lach and Schankerman, 1989; Hall, 2010; Brown et al., 2012). To proxy the obstacle of searching for talents we gather

[4] Cyprus and Greece are excluded in panel A, Montenegro in panel B.

[5] For more detailed information about the three additional indicators we refer to `https://archive.doingbusiness.org/en/methodology`.

[6] We also consider two alternative indicators for banking market structure, both from the ECB database: the share of the five largest Credit Institutions in total assets (*CR5*) and the Herfindahl-Hirschman Index for Credit Institutions (*HHI*). These two ECB indicators are available for 28 out of the 30 sample countries. Hence, we prefer to use the World Bank *BC5* indicator. Results hold even with *CR5* and *HHI* and they are available upon request.

firm-level information from SAFE. Enterprises declare how important the problem of the availability of skilled staff or experienced managers is, from 1 (not at all) to 10 (extremely important).[7] We named this variable *talents*. Estimates in Table B.3.3, incorporating the aforementioned additional controls, are in line with the baseline results reported in section 4.3.

Concerning model (3), which is related to proposition 3, we want to verify that baseline estimates are not driven by the highest interest rates that might have exceptionally been charged to few firms. These rates can indeed bias the countries average rate and, consequently, our measure of interest rates dispersion. To address this concern, we recompute the interaction effects shown in Table 5 by excluding rates higher than 25 percent. New estimates are reported in panel A of Table B.3.4 and they are similar to those illustrated in Table 5. In panel B of Table B.3.4 we do the same exercise by excluding Cyprus and Greece, to eliminate confounding effects due to financial aids. Finally, in panel C we incorporate the three aforementioned business activity indicators (*starting a business*, *getting credit*, *protecting minority investors*), as well as the banking concentration index *BC5* and variable *talents*. Columns (1) and (2) of panels B and C confirm the baseline results reported in Table 5. Coefficients in column (3) are of the expected sign but no longer statistically significant. Two out of three indicators, including the primary variable *recovery*, confirm the validity of proposition 3.

[Insert Tables B.3.1, B.3.2, B.3.3, B.3.4 about here]

[7] We refer to the following survey question: *"How important has the problem - availability of skilled staff or experienced managers - been in the past six months? Please answer on a scale of 1-10, where 1 means it is not at all important and 10 means it is extremely important."*

Table B.3.1: Excluding financially assisted countries.

	(1) Full sample	(2) Micro	(3) Small	(4) Medium
Panel A: investment effect (Dependent variable: innovation)				
Recovery	0.002***	0.002**	0.002***	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)
Observations	47040	16099	15104	15837
Pseudo-R^2	0.03	0.03	0.03	0.04
Score	0.003***	0.004***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.000)
Observations	47040	16099	15104	15837
Pseudo-R^2	0.03	0.03	0.03	0.04
Time	-0.039**	-0.034	-0.047***	-0.037***
	(0.017)	(0.021)	(0.018)	(0.012)
Observations	47040	16099	15104	15837
Pseudo-R^2	0.03	0.03	0.03	0.04
Panel B: constraint effect (Dependent variable: hcost)				
Recovery	-0.002***	-0.002***	-0.002***	-0.001***
	(0.000)	(0.001)	(0.000)	(0.000)
Observations	28785	12071	8712	8002
Pseudo-R^2	0.1	0.08	0.09	0.13
Score	-0.001**	-0.002**	-0.001**	-0.001**
	(0.001)	(0.001)	(0.000)	(0.000)
Observations	28785	12071	8712	8002
Pseudo-R^2	0.09	0.07	0.08	0.13
Time	0.031***	0.036***	0.031***	0.020***
	(0.009)	(0.010)	(0.007)	(0.007)
Observations	28785	12071	8712	8002
Pseudo-R^2	0.1	0.07	0.09	0.13
Firms controls	Yes	Yes	Yes	Yes
Country indicators	Yes	Yes	Yes	Yes
Time, sector FE	Yes	Yes	Yes	Yes

Notes: Authors' calculations. Cluster robust standard errors in parentheses. Cluster level: country. *** p<0.01, ** p<0.05, * p<0.1. The table reports probit average partial effects (APEs) and all the specifications use sampling weights. Column (1) considers the full sample, while columns (2), (3), and (4) the subsamples of micro (1 to 9 employees), small (10 to 49 employees), and medium (50 to 249 employees) firms, respectively. Panel A considers "innovation" as dependent variable, while panel B "hcost". The set of firms' controls includes size (only in col.1), turnover (levels and past growth), age, legal status, ownership type, and subsidies. The country indicators are GDP (log, constant 2010 USD), GDP growth (annual %), domestic credit to private sector (% of GDP), general government final consumption expenditure (% of GDP), and inflation. Time and sector FE are included.

Table B.3.2: Probit model with sample selection.

	(1) Full sample	(2) Micro	(3) Small	(4) Medium
Panel A: investment effect				
(Dependent variable: innovation)				
Recovery	0.002***	0.001*	0.002**	0.002***
	(0.001)	(0.001)	(0.001)	(0.000)
Observations	63825	24097	20130	19598
Wald χ^2	[859.04; p < 0.00]	[291.92; p < 0.00]	[262.20; p < 0.00]	[494,50; p < 0.00]
Score	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.000)
Observations	63825	24097	20130	19598
Wald χ^2	[891.52; p < 0.00]	[316.24; p < 0.00]	[267.68; p < 0.00]	[530,41; p < 0.00]
Time	-0.028**	-0.023	-0.032**	-0.030***
	(0.013)	(0.015)	(0.013)	(0.010)
Observations	63825	24097	20130	19598
Wald χ^2	[853.44; p < 0.00]	[289.72; p < 0.00]	[275.44; p < 0.00]	[442.99; p < 0.00]
Panel B: constraint effect				
(Dependent variable: hcost)				
Recovery	-0.003**	-0.004***	-0.001***	-0.001
	(0.001)	(0.001)	(0.000)	(0.002)
Observations	66051	25472	20627	19952
Wald χ^2	[1201.86; p < 0.00]	[524.83; p < 0.00]	[408.66; p < 0.00]	[318.94; p < 0.00]
Score	-0.003	-0.004	-0.000	-0.001
	(0.002)	(0.002)	(0.000)	(0.002)
Observations	66051	25472	20627	19952
Wald χ^2	[1110.81; p < 0.00]	[507.67; p < 0.00]	[386.20; p < 0.00]	[304.95; p < 0.00]
Time	0.056**	0.069***	0.013***	0.023
	(0.025)	(0.018)	(0.004)	(0.027)
Observations	66051	25472	20627	19952
Wald χ^2	[1249.39; p < 0.00]	[539.65; p < 0.00]	[400.23; p < 0.00]	[300.34; p < 0.00]
Firms controls	Yes	Yes	Yes	Yes
Country indicators	Yes	Yes	Yes	Yes
Time, sector FE	Yes	Yes	Yes	Yes

Notes: authors' calculations. Cluster robust standard errors in parentheses. Cluster level: country. *** p<0.01, ** p<0.05, * p<0.1. The table reports probit average partial effects (APEs) and all the specifications use sampling weights. Column (1) considers the full sample, while columns (2), (3), and (4) the subsamples of micro (1 to 9 employees), small (10 to 49 employees), and medium (50 to 249 employees) firms, respectively. The table shows the APEs of the probit model with sample selection. Panel A considers "innovation" as dependent variable and excludes Greece and Cyprus; panel B considers "hcost" as dependent variable and excludes Montenegro. The set of firms' controls includes size (only in col.1), turnover (levels and past growth), age, legal status, ownership type, and subsidies. The country indicators are GDP (log, constant 2010 USD), GDP growth (annual %), domestic credit to private sector (% of GDP), general government final consumption expenditure (% of GDP), and inflation. Time and sector FE are included.

Table B.3.3: Including additional controls.

	(1) Full sample	(2) Micro	(3) Small	(4) Medium
Panel A: investment effect				
(Dependent variable: innovation)				
Recovery	0.001**	0.001**	0.001**	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	54166	18983	17415	17768
Pseudo-R^2	0.03	0.03	0.03	0.04
Score	0.003***	0.002***	0.002**	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	54166	18983	17415	17768
Pseudo-R^2	0.03	0.03	0.03	0.04
Time	-0.026***	-0.022**	-0.029***	-0.032***
	(0.010)	(0.011)	(0.011)	(0.010)
Observations	54166	18983	17415	17768
Pseudo-R^2	0.03	0.03	0.03	0.04
Panel B: constraint effect				
(Dependent variable: hcost)				
Recovery	-0.002***	-0.003***	-0.002***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	32905	14289	9839	8777
Pseudo-R^2	0.1	0.08	0.09	0.13
Score	-0.002**	-0.002**	-0.002**	-0.001***
	(0.001)	(0.001)	(0.001)	(0.001)
Observations	32905	14289	9839	8777
Pseudo-R^2	0.1	0.07	0.08	0.12
Time	0.033***	0.039***	0.032***	0.023***
	(0.006)	(0.007)	(0.006)	(0.005)
Observations	32905	14289	9839	8777
Pseudo-R^2	0.1	0.08	0.09	0.13
Firms controls	Yes	Yes	Yes	Yes
Country indicators	Yes	Yes	Yes	Yes
Time, sector FE	Yes	Yes	Yes	Yes

Notes: Authors' calculations. Cluster robust standard errors in parentheses. Cluster level: country. *** p<0.01, ** p<0.05, * p<0.1. The table reports probit average partial effects (APEs) and all the specifications use sampling weights. Greece and Cyprus are excluded. Column (1) considers the full sample, while columns (2), (3), and (4) the subsamples of micro (1 to 9 employees), small (10 to 49 employees), and medium (50 to 249 employees) firms, respectively. Panel A considers "innovation" as dependent variable and excludes Greece and Cyprus; panel B considers "hcost" as dependent variable and excludes Montenegro. The set of firms' controls includes size (only in col.1), turnover (levels and past growth), age, legal status, ownership type, and subsidies. The country indicators are GDP (log, constant 2010 USD), GDP growth (annual %), domestic credit to private sector (% of GDP), general government final consumption expenditure (% of GDP), and inflation. The following additional indicators are included: "starting a business", "getting credit", "protecting minority investors", "banking market concentration (BC5)", and "talents" . Time and sector FE are included.

Table B.3.4: Dispersion effect - interactions.

Effect of RR on:	(1) Recovery	(2) Score	(3) Time
Panel A: considering rates > 25 as missing			
Turn1, innovation	0.028* [4.16; 0.0505]	0.055*** [16.01; 0.0004]	-0.335 [1.09; 0.3057]
Turn2, innovation	-0.006 [0.16; 0.6961]	-0.018 [0.59; 0.4468]	0.128 [0.28; 0.6019]
Turn3, innovation	-0.0021 [2.34; 0.1370]	-0.025 [1.20; 0.2828]	0.094 [0.07; 0.7966]
Turn4, innovation	-0.024** [5.54; 0.0256]	-0.035** [6.45; 0.0167]	0.412 [2.48; 0.1260]
Turn5, innovation	-0.030** [6.82; 0.0141]	-0.042*** [8.73; 0.0062]	0.506* [2.90; 0.0993]
Turn6, innovation	-0.043*** [8.20; 0.0077]	-0.064** [6.17; 0.0190]	0.723* [3.35; 0.0774]
Panel B: excluding Cyprus and Greece			
Turn1, innovation	0.029*[3.16; 0.0866]	0.05*** [9.66; 0.0044]	-0.368 [1.00; 0.3273]
Turn2, innovation	-0.007[0.10; 0.7552]	-0.015 [0.28; 0.6020]	0.132 [0.16; 0.6893]
Turn3, innovation	-0.025 [1.64; 0.2116]	-0.026 [0.80; 0.3789]	0.098 [0.05; 0.8222]
Turn4, innovation	-0.028* [3.88; 0.0592]	-0.038** [5.61; 0.0253]	0.44[1.91; 0.1783]
Turn5, innovation	-0.028* [4.08; 0.0535]	-0.037** [5.15; 0.0314]	0.442 [2.00; 0.1686]
Turn6, innovation	-0.045** [5.09; 0.0323]	-0.066** [5.26; 0.0299]	0.76 [2.53; 0.1233]
Panel C: Including additional controls			
Turn1, innovation	0.025* [3.35; 0.0776]	0.043*** [11.96; 0.0017]	-0.381 [1.48; 0.2343]
Turn2, innovation	-0.009 [0.29; 0.5962]	-0.015 [0.86; 0.3602]	0,139 [0.23; 0.6326]
Turn3, innovation	-0.021 [1.69; 0.2034]	-0.024 [1.36; 0.2530]	0.007 [0.00; 0.9867]
Turn4, innovation	-0.030** [4.82; 0.0363]	-0.046** [6.95; 0.0133]	0.383 [1.60; 0.2159]
Turn5, innovation	-0.038** [7.21; 0.0118]	-0.058*** [11.25; 0.0022]	0.521 [2.56; 0.1203]
Turn6, innovation	-0.051** [7.37; 0.0111]	-0.078*** [10.11; 0.0035]	0.772 [2.55; 0.1208]

Notes: Authors' calculations. The table shows the overall effects of *RR* on *dispersion* for firms that invest in innovation in each turnover category. Column (1) considers *recovery* as measure for *RR*, while columns (2) and (3) *score* and *time*, respectively. Turn1 indicates turnover (T) $\leq$ €500k; Turn2 €500k $<$ T $\leq$ €1mln; Turn3 €1mln $<$ T $\leq$ €2mln; Turn4 €2mln $<$ T $\leq$ €10mln; Turn5 €10mln $<$ T $\leq$ €50mln; Turn6 T $>$ €50mln. "Turn[1-6], innovation" refers to firms in the respective turnover category that invest in innovation. Panel A includes rates $\leq$ 25; panel B excludes Greece and Cyprus; in panel C, the following additional indicators are included: "starting a business", "getting credit", "protecting minority investors", "banking market concentration (BC5)", and "talents". F-values and p-values in squared brackets.

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