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The Impact of Bank Loan Terms on Intangible Investment in Europe

Matthieu Segol* Atanas Kolev† Laurent Maurin‡

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Abstract

Using European firm-level data from a new survey, the EIBIS, we document the effect of bank loan terms on investment in intangible assets of non-financial corporations. We show that quantity rationing is a primary determinant borrowers' propensity to invest in intangible assets. Provided that firms are satisfied with their loan size; unfavorable rate, maturity and collateral requirements have no significant effects on the probability to invest in intangible assets. These terms however, do have a negative impact on the probability to invest in multiple intangible assets, undermining the ability of firms to benefit from the complementarities of these assets. We document the effect of loan conditions on investment intensity, as well. The effect of quantity rationing on the amount invested in intagible assets is found to be limited. Other loan conditions however, like cost, maturity and collateral requirements, have significant effect on investment intensity.

JEL Codes: G21, D82, O30, H81, C35

Key Words: Firm investment, Intangible assets, Loan terms, Credit constraint, Survey data, Instrumental variable approach

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1 Introduction

Intangible assets are essential for innovation and long-term growth. Their accumulation, however, is constrained by several market failures resulting from their specific characteristics. In particular, asymmetric information and agency problems between firms and lenders can result in inadequate external finance conditions that can ultimately lead to underinvestment in intangible assets. Bank loans for capital expenditure are typically collateralized by the acquired assets. This practice, however, is not very common for loans that finance the acquisition of intangible assets, because their valuation is difficult and the transferring of ownership is often impractical. As a result, access to external financing for investment in intangible assets is reduced. The problem is especially accute in bank-based economies, such as most European ones.

Empirical evidence on impediments to investment in intangibles is scarce, given the difficulty to measure the amount invested in these assets and the constraints faced by firms in obtaining a loan. We use a new survey provided by the European Investment Bank (EIB), the EIB Investment Survey (EIBIS), to add to the empirical literature on constraints to investment in intangible assets. EIBIS data allow breaking down the effects of bank loan terms on investment in several classes of intangibles assets, providing the possibility to exploit synergies among them. The EIBIS has important advantages compared to surveys used in previous studies. First, the EIBIS is representative at the country-, sector- and size level across all European countries. Second, survey respondents are asked to provide the amount invested in several categories of intangible assets: research and development (R&D), which also includes the acquisition of intellectual property; software, data, IT networks and website activities; training of employees; organisation and business processes improvements. Third, the EIBIS measures the satisfaction of firms with their external finance along four different dimensions: amount, cost, maturity and collateral requirements.

These features allow to extend the analysis beyond the existing literature. Most studies focus on R&D, partly because of its key role in the innovation process, but also partly because of the lack of data on other assets. Capitalized R&D expenditure represents only one of the several intangible assets which are important for innovation

(OECD 2013) and there are significant complementarities and synergies among them in the production process (Crass and Peters 2014). Regarding the measurement of financial constraints, data allow for the use of a direct indicator and thus avoid the limits of indirect measures based on investment cash-flow sensitivity, which are prevalent in the literature. To our knowledge, this is the first analysis studying the impact of bank lending on investment in intangible assets with such breadth of information.

Using EIBIS, we reveal a set of new stylized facts and empirical evidence on the effects of loan conditions on intangible investment in Europe. Our analysis is based on an instrumental variable approach to properly identify the causal impact of bank loan conditions on investment in intangible assets. Savignac (2008) and Mancusi and Vezzulli (2014) use a similar methodology to tackle the endogeneity of the financial constraint indicator. More specifically, following Mancusi and Vezzulli (2014), we use the index of external finance constraints developed by Whited and Wu (2006) as an instrument for our indicator of satisfaction with loan conditions. We provide evidence that this approach is valid for our sample.

We first document that the loan amount is the primary determinant of the likelihood to invest in intangibles. Quantity rationing has a significantly negative effect on investment propensity.[1] Other possibly unfavorable loan terms, such as unsatisfactory interest rates or capital requirements, have no significant impact as long as firms are granted a satisfactory loan amount. This is in line with previous analyses documenting the critical impact of quantity rationing on intangible investment propensity (Mancusi and Vezzulli 2014, Popov 2014). These studies focus on investment in a single intangible asset, R&D or on-the-job training. We contribute to this literature by showing that the negative effect of such rationing is more general as it hinders the propensity to invest in a wide range of intangible assets.[2]

In order to account for the complementarity between intangible assets, it is essential

[1]Quantity rationing here is a reduction in the initially requested loan amount, measured by borrowers' dissatisfaction with the loan size in our data.

[2]A closely related literature analyzes the impact of a constrained access to bank credit on innovation, using frameworks different from the cash-flow based model. Benfratello et al. (2008) find that local banking development in Italy over the 1990s increased the probability of process innovation in sectors more dependent on external finance. Several subsequent empirical analyses confirmed these results (Savignac 2008, Amore et al. 2013, Nanda and Nicholas 2014, Bircan and De Haas 2015, Qi and Ongena 2018).

to measure the effect of loan terms on the propensity to invest in at least two types of intangible assets simultaneously.[3] This type of analysis, generally not possible with most datasets, can be conducted with EIBIS data. When focusing on investment in multiple assets, our results show that other loan terms have a significant negative effect. This difference with our first result can be attributed to the fact that firms investing in diversified intangible assets display healthier balance sheets, which implies lower agency costs. Sounder financials allow these firms to overcome quantity rationing when applying for loans. For those borrowers, dissatisfaction with the remaining terms are likely to represent the main constraint. Our results show that dissatisfaction with cost, maturity and collateral requirements have a negative effect on firms' ability to invest in a portfolio of intangible assets. This suggests that when lenders avoid the extreme outcome of quantity rationing, they resort to other constraining loan terms, like high collateral requirements for example.

We document that quantity rationing has a limited effect on the amount invested in intangible assets. This finding is in line with previous studies that found that quantity rationing is likely to have a stronger impact on investment propensity rather than investment intensity. The phenomenon is usually explained by the high adjustment costs or limited scalability of investment in intangible assets: once started, the size of the investment cannot be adjusted without large losses. Thus, quantity rationing is more likely to have an impact on the decision to invest than on the amount invested. Another contribution of this study is the measurement of the extent to which dissatisfaction with the remaining terms – cost, maturity and collateral requirements – affects intangible investment intensity.

The rest of the paper proceeds as follows. Section 2 reviews the literature on the specific nature of intangible assets and on the impact of agency costs on intangible investment. Section 3 presents the dataset used in the paper, the EIBIS, and provides stylized facts on intangible investment and its financing. Section 4 describes the different empirical models used to analyze the effects of loan terms on investment in intangibles. Section 5 discusses the results and Section 6 concludes.

[3] Firms investing in several types of intangibles are those investing in several assets for a specific project, i.e. a "multi-asset" investment.

2 Related literature

Intangible investment represents an investment in capital that is different from physical or financial assets.[4] Intangibles, also called knowledge assets, are mostly embodied in people (Andrews and Serres 2012). They share distinctive characteristics, extensively defined by Andrews and Serres (2012), which make them particularly hard to finance using external funds. First, most intangibles are generally *non-marketable*, i.e. they cannot be traded on designated markets. Second, they are *non-separable*, i.e. these assets cannot be separated from the original unit of creation without some loss of value (Webster and Jensen 2006). Third, they are characterized by a *lack of visibility* in the sense that, without physical embodiment, it is difficult to assess the stock of an intangible asset based on past investment flows. Fourth, given that they correspond to a specific knowledge, *transferability* of intangible assets depends on whether this knowledge is tacit or codified. Finally, investment in intangible assets entails exposure to uncertainty, above and beyond that of investment in tangible assets.[5]

These specific characteristics explain why firms investing in these assets are likely to face important information asymmetries when seeking external finance. Indeed, lenders have difficulty valuing such assets, because of the embodied uncertainty, lack of visibility and non-tradability. Moreover, firms have incentives to limit information about their investment for fear of leak of information to competitors. Another limitation is the incomplete account for intangible assets in firms' balance sheets. The reason is that existing accounting frameworks do not measure properly some of types of intangible assets, due to the difficulties to value them. As a result, intangible assets are not properly accounted for in corporate balance sheet (Hunter et al. 2005).[6]

These issues amount to significant agency costs, due to adverse selection and moral hazard concerns.[7] Such costs are likely to be passed on to borrowers, resulting in less

[4] An intangible asset is defined as "a claim to future benefits that does not have a physical or financial [...] embodiment" (Lev 2000). They are generally organized in three broad categories: computerized information, innovative property and economic competencies (Corrado et al. 2005).

[5] Innovation process implies sunk costs and failures. Using patent data, Stevens and Burley (1997) argue that out of 3000 raw ideas, 1 turns out to be a commercial success.

[6] Banks can obviously rely on more information than balance sheet data, but inadequate accounting frameworks means a higher screening cost for banks.

[7] Agency costs are used in a broad sense in this paper, encompassing all contracting, or transaction costs, screening costs and moral hazard costs (Meckling and Jensen 1976, Smith 1989). They include all

favourable contract terms. These problems are compounded by the difficulty to collateralize intangible assets, due to non-separability and transferability, limiting the possibility for creditors to recover their funds in case of bankruptcy. All these factors reduce access to external finance for investment in intangible assets, relative to tangible assets.

Given this possibility of substantial financial frictions when accessing external finance, one would expect that investment in intangibles is highly dependent on internal finance. However, an important strand of empirical literature, which focuses on the sensitivity of R&D to cash flows, provides mixed evidence (see Hall and Lerner 2010 for a review). Two arguments have been put forward to explain this puzzle. First, the econometric problem is difficult to tackle because of possible high adjustment costs of intangibles (Hall and Lerner 2010, Brown et al. 2012, Peters and Taylor 2017). Knowledge assets are mostly embodied in persons, who cannot be hired or fired without substantial costs, especially when knowledge is tacit and firm-specific. Because firms anticipate both these high adjustment costs and the possibility of facing external finance constraints, they are likely to invest in intangibles only when they are certain of being able to cope with temporary adverse financial conditions. As a result, both high and low sensitivity of intangible investment to cash flows can be interpreted as evidence of financial frictions, preventing easy identification. Second, Kaplan and Zingales (1997) strongly criticized the soundness of cash-flow-based analyses. In their seminal paper, the authors demonstrate using firms' own assessments that an important share of firms with high cash flow sensitivity were actually not financially constrained. This conclusion spurred a large strand of literature confirming their results (Alti 2003, Cleary et al. 2007). These two important issues led to conflicting results regarding the impact of financial constraints on R&D expenditures, the most studied intangible asset (Brown et al. 2012).

Loan contracts have been studied extensively in the theoretical literature, in particular through the lens of agency theory. In this framework, the lender and the borrower are in a principal-agent relationship in which the borrower (agent) may have information unknown to the lender (principal). More specifically, the literature has focused

costs that result from the willingness of a principal (lender) to contract with an agent (borrower) in a setting with possibly conflicting objective functions and information asymmetries.

on cases where the borrower has private information on his own characteristics/type (i.e. adverse selection or hidden-knowledge model) or his action (i.e. moral hazard of hidden-action model). These information asymmetries have important implications for the design of loan contracts. To limit the costs of adverse selection and moral hazard (i.e. agency costs) the lender has to offer contract terms that elicits borrower's private knowledge of his type and induces the borrower to act in the principal's best interest.[8]

In their seminal paper, Stiglitz and Weiss (1981) document that each of these information asymmetries can lead to equilibrium credit rationing in the loan market. They demonstrate this result by showing that with adverse selection or moral hazard, banks' profit is not a monotonic function of the lending rate. Increasing interest rates above a certain threshold can decrease banks' expected returns. This upper bound on interest rates means that in equilibrium banks can set a rate which is lower than the market-clearing rate, resulting in an excess demand for credit. This implies that some loan applicants are denied loans in equilibrium even though they are willing to pay an interest rate above the one charged by banks to identical borrowers who did obtain a loan. Following this important breakthrough, a stream of work has extended this framework to evaluate whether equilibrium credit rationing could occur with more complex loan contracts. In particular, Bester (1985, 1987) shows that banks can use collateral requirements in addition to interest rates to attenuate adverse selection and moral hazard, and thereby limit credit rationing. Similarly, contract with different maturities can also help mitigating information asymmetry issues as shown by Ortiz-Molina and Penas (2008).[9]

Given these different ways of addressing adverse selection and moral hazard, De Meza and Webb (2006) question whether equilibrium credit rationing *a la* Stiglitz and Weiss (1981) could be observed at all in the data. They demonstrate that if collateral requirements and interest rates prove insufficient to fully control asymmetric information, lenders can always provide loans of smaller size which are profitable to both parties instead of denying credit altogether. They conclude that this type of quantity ra-

[8]If both parties have the same information (i.e. symmetric information), the lender can always offer a contract that perfectly controls the agent, thereby eliminating any principal-agent issues (Laffont and Martimort 2002)

[9]Freixas and Rochet (2008) provide a comprehensive analysis of credit rationing *a la* Stiglitz and Weiss (1981) and how it can be alleviated.

tioning, where borrowers are granted a smaller loan than requested, is more likely to be observed than pure credit rationing *a la* Stiglitz and Weiss (1981), where borrowers are randomly denied loans because of excessive demand.[10] In this paper, we focus on the impact of quantity rationing on investment rather than Stiglitz and Weiss' credit rationing at the loan approval stage.[11]

To understand how exactly agency costs can impact the different loan terms, it is important to understand the loan contracting process. Using detailed data on German loans, Kirschenmann and Norden (2012) indicate that firms ask for a specific amount and maturity when applying for a loan, then banks negotiate collateral requirements, and both sides eventually agree on the loan rate. Based on this observation and the theoretical results mentioned above, one would expect that as long as the lender can negotiate the adequate collateral and rate such as to limit the impact of asymmetric information, borrowers should not face any constraint on the amount and maturity initially requested.[12] This means that quantity rationing or constraints on the maturity of the loan are more likely to be observed for firms with relatively high agency costs, which cannot be sufficiently attenuated with any combination of interest rate and collateral requirements by the lender. Hence, an increase in agency costs not only has an impact on the probability of being dissatisfied with at least one of the loan terms (i.e. the probability of being constrained), it also has an impact on which exact loan term the firm is most likely to be dissatisfied with. In other words, conditional on being dissatisfied with at least one dimension, riskiest borrowers are more likely to be dissatisfied with the loan amount than safer firms. As a result, we expect firms with different agency costs to face different loan terms, bringing about different financial constraints.

Several papers have studied the impact of quantity rationing on intangible investment, we contribute to this literature by evaluating the effect of other important loan

[10] Stiglitz and Weiss's credit rationing is sometimes referred to as credit rationing of type II, while the other form of rationing, in which agents get a smaller loan than requested, is defined as type I and was initially studied by Jaffee and Russell (1976). The distinction between these two types of rationing was originally made by Keeton (1979).

[11] EIBIS does provide some information on whether a firm was rejected or not when applying for a loan, but it remains scarce. As more waves of the survey become available, comparing the effects of these two types of rationing should become feasible.

[12] Clemenz (1986) formally shows that quantity rationing should not be observed in equilibrium as long as borrowers have enough assets to pledge as collateral.

contract terms. Due to banks' difficulties to cope with asymmetric information in the case of intangible investment, relatively safer firms, which are not quantity constrained, may still be affected by high collateral requirements or higher than expected borrowing rates.[13]

The objective of our study is to evaluate the impact of loan conditions, defined by the degree of firms' satisfaction with their loan terms, on investment in intangible assets. The identification of this causal effect is made difficult by the *endogeneity* of loan conditions. First, as discussed above, it is likely that the nature of investment impacts loan conditions, implying a reverse causality issue. Indeed, firms investing in intangibles are more likely to face inadequate loan conditions due to, among other things, the hardship to properly value intangible assets and the difficulty to pledge these assets. Second, some firm-specific unobservable characteristics can have an impact on both loan conditions and the decision to invest, such as the willingness to undertake investment in intangible assets (i.e. self-selection bias), or the uncertainty associated with the investment output (Savignac 2008).[14] Consequently, we implement an instrumental variable approach to deal with these endogeneity concerns. Following Mancusi and Vezzulli (2014), we use the external finance constraint index developed by Whited and Wu (2006) as an instrument for our survey-based dissatisfaction measures.

Whited and Wu (2006) derive the Euler equation of a standard intertemporal investment model augmented to account for financial frictions. Their model's Euler equation includes the shadow cost of external finance, i.e. the cost associated with raising external finance, which is assumed to be costlier than internal finance. This shadow cost is unobservable. As a result, they parametrize this cost as a function of firm observable characteristics and estimate the resulting complete Euler equation. This allows them to derive the parameters of the external finance cost function, that they define as

[13] The impact of agency costs on *tangible* investment has been studied by many, starting with Bernanke and Gertler (1989).

[14] As more waves of the EIBIS will be conducted, future research will be able to deal with some of these unobservable effects using panel data techniques

a financial constraint index. The final WW index reads as follows:

$$
\begin{aligned}
WW_{it} = & -0.091\,CF_{it} - 0.062\,DIVPOS_{it} + 0.021\,TLTD_{it} \\
& - 0.044\,LNTA_{it} + 0.102\,ISG_{it} - 0.035\,SG_{it}
\end{aligned} \tag{1}
$$

where CF represents the cash flow to total assets ratio; $DIVPOS$ is an indicator that takes the value of one if the firm pays cash dividends[15]; $TLTD$ is the ratio of long-term debt to total assets; $LNTA$ is the logarithm of total assets; ISG is the firm's industry sales growth and SG represents firm sales growth.[16] A higher value of WW implies tighter credit conditions.

Other indices of financial constraints based on financial characteristics have been used in the literature (Silva and Carreira 2012). A popular alternative to the WW index is the index based on the work of Kaplan and Zingales (1997). This index is presented by Lamont and Polk (2001) as the "KZ index". However, Hadlock and Pierce (2010) provide evidence that the latter is not robust. They show that the WW index is not fully robust in their sample, too, but has better predictions than the KZ index.[17] In the following, we are able to show that the WW index is a significant and important determinant of firms' dissatisfaction with loan terms in our sample, strengthening our choice to use it as an instrument.

3 Data and Stylized Facts

Our analysis is based on the data provided by the EIBIS. The EIBIS is an annual survey of non-financial firms in the EU that aims at monitoring investment and investment finance activities in order to capture potential barriers to investment. The survey started in 2016 and includes some 12,500 completed interviews every year.[18] Using

[15]We do not have in the EIBIS the distinction between cash and stock dividends. Therefore we use an indicator variable that indicates whether the firm pays any type of dividend (i.e. cash or stock)

[16]Industry sales growth is defined at the three-digit SIC level in Whited and Wu (2006). The EIBIS provides a more aggregated classification, with four distinct sectors.

[17]Hadlock and Pierce (2010) provide their own indicator of financial constraint based on size and age of the firm. We do not use this index as an instrument, given that both these variables are also used as determinants of intangible investment.

[18]A share of firms are interviewed over several years, which will render possible to use the time dimension in further analyses when more waves will be available.

a stratified sampling methodology, the EIBIS is representative across all 27 EU Member States and the UK. The representativeness relates to four firm size classes (micro, small, medium and large) and four broad sector groupings (manufacturing, services, construction and infrastructure) within countries.[19] EIBIS respondents are sampled from the Orbis database of Bureau van Dijk and, as a result, survey answers can be matched to firm balance sheet and profit-and-loss data provided in Orbis.

In the following analysis, we employ three waves of the survey: 2016, 2017 and 2018. We focus on the sub-sample of firms that declared having used bank financing for their most recent investment.[20] In order to assess firms' credit conditions, we use the information provided in the EIBIS regarding firms' satisfaction with bank finance. Firms are explicitly asked to indicate their degree of satisfaction with four dimensions of the external finance they obtained: amount, cost, maturity and collateral requirements.[21] This is a different measure from the one used in a closely related paper by Mancusi and Vezzulli (2014), which is based on a survey of Italian firms. In the survey they use, respondents are asked whether they desired or not additional bank financing at the agreed interest rate. Consequently, as they explain, their credit constraint variable measures the degree of quantity rationing. The advantage of EIBIS is that it contains information on several other terms of the loan contract, including collateral requirements and maturity, which are key for investment in intangible assets.

In addition to their investment financing, firms are also asked to detail the nature of their investment. Following European Investment Bank (2018), we define as intangible investment the following categories: *i*) research and development - including the acquisition of intellectual property (denoted here as **R&D**); *ii*) software, data, IT networks and website activities (**software**); *iii*) training of employees (**training**) and *iv*) organisation and business process improvements (**organisational capital**).[22] Conse-

[19]The infrastructure sector in EIBIS comprises firms from NACE Rev.2 sectors Electricity, gas, steam and air conditioning supply (D); Water supply; sewerage, waste management and remediation activities (E); Transportation and storage (H); Information and communication (J).

[20]Firms are asked the type of external finance they used and may choose among several types, we keep those that picked "bank loans" and "other types of bank financing".

[21]For each dimension of external finance (i.e. amount, cost, maturity and collateral) firms are asked whether they are *i*) very satisfied, *ii*) fairly satisfied, *iii*) neither satisfied nor dissatisfied, *iv*) fairly dissatisfied or *v*) very dissatisfied.

[22]In the EIBIS, firms are asked about the amount invested in each of these intangible asset categories. They are also asked the amount invested in tangible assets, which comprise land, business buildings,

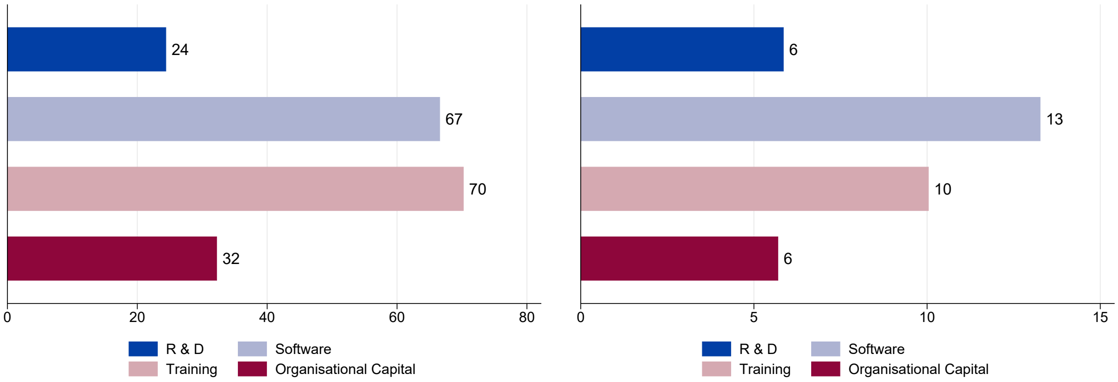
quently, we are able to capture a broad range of intangible investment activities that are not captured in previous studies that usually focus on R&D. One important exception is Popov (2014) who investigates the impact of bank credit conditions on investment in on-the-job training in transition economies. In our analysis, we are able to have a broader view and look at the impact of access to credit on the total amount invested in intangibles, which is important given the complementarities of these assets. Tables 2 and 3 present the main variables and descriptive statistics.

We first investigate the distribution of intangible investment in our sample across the four categories of assets available in the data. In panel (a) of Figure 1 we observe that software and training are the most frequent types of investment with 67% of firms investing in the former and 70% in the latter. On the other hand, 32% of firms invest in organisational capital and 24% in some form of R&D. Panel (b) shows the mean share invested in each intangible in our sample. Investment in software constitutes the highest share, amounting to 13% of total investment, while organisational capital and R&D investments represent 6% of total investment on average. The sum of the shares, 32% in our sample, indicates that investment in intangible assets is around half of investment in tangible assets.

We investigate whether bank loan policies have an effect on both the probability to invest and the amount invested.

infrastructure, machinery and equipment.

Figure 1: **Breakdown of Intangible Investment**



(a) % of firms

(b) Mean % invested

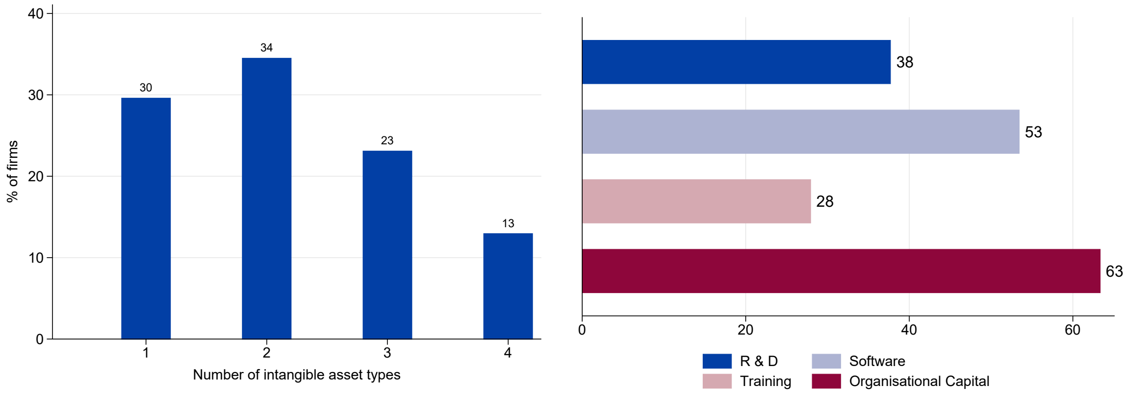
Note: The x-axis in panel (a) represents the share of firms that invest in each intangible category, in per cent. Panel (b) is the mean amount invested in each intangible category as a share of total investment (i.e. tangible and intangible investment), in per cent.

In our sample, only 30% of firms that invest in intangibles assets do so in a single asset type (Figure 2), i.e. most firms use a combination of intangibles to maximize the return on their investment. The idea of complementarities across intangible assets has been discussed in the literature (Crass and Peters 2014, Thum-Thysen et al. 2017). Consequently, we also investigate whether loan terms have a negative impact on the likelihood to invest in a diversified portfolio of intangible assets. Such a negative effect would mean that dissatisfying credit conditions undermine not only the probability to invest in intangibles, but also the possibility to maximize the benefits of synergies across assets.

Considering the breakdown across the different categories of intangibles, we document in panel (b) of Figure 2 that firms using bank lending represent 38% of total R&D spending in the sample, 53% of total software expenditures, 28% of total training expenditures and 63% of total organisational capital investment. These differences suggest that bank credit conditions may differ depending on the type of intangible asset the firm invests in.

Regarding their credit access conditions, firms are questioned about their satisfaction with four dimensions of their loan contract: amount, cost, maturity and collateral requirements. We report in Figure 3 that, among the firms that declare being dissatis-

Figure 2: **Variety of intangible investment and financing**



(a) % of investing firms by number of assets

(b) % of bank finance

Note: Panel (a) represents the percentage of firms that invest in 1,2,3 or 4 different intangible assets. The four categories of intangible investment are *i*) research and development - including the acquisition of intellectual property; *ii*) software, data, IT networks and website activities; *iii*) training of employees and *iv*) organisation and business process improvements. Panel (b) gives the total invested in a given intangible by firms using bank lending as a percentage of the total amount invested in this intangible in the full sample (i.e. firms using bank financing and firms using other forms of financing).

fied with at least one dimension, most firms (64%) are actually dissatisfied with one dimension only. Among these firms, we find that 47% are dissatisfied with collateral requirements, 35% with the cost, 9% with the maturity and 8% with the amount. This suggests that, when granting the loan, banks primarily account for credit risk using collateral and rate, and rarely adjust the amount and maturity requested by borrowers.[23]

Such practicies provide support to agency theories predicting that lenders use both interest rates and collateral requirements to deal with asymmetric information regarding borrowers' credit risk (e.g. Strahan 1999). Looking more closely at these loan terms, we observe a negative relationship between dissatisfaction with collateral requirements and interest rate, indicating some degree of substitutability (Table 1). This substitutability is in line with the predictions of the literature regarding how both terms can be used by lenders to elicit borrowers' type and thus limit adverse selection. In particular, Bester (1987) shows that borrowers with a relatively higher probability of default prefer contracts with higher interest payments and lower collateral requirements than

[23]Kolev et al. (2019) use the EIBIS to analyze how bank financial strength accounts for borrowers' satisfaction with their access to credit.

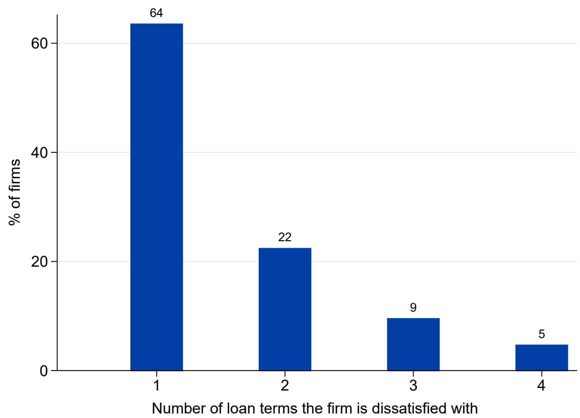
borrowers with lower default risk. The existence of such contracts would explain the negative correlation observed in our data.

Table 1: **Correlation Matrix of Dissatisfaction Indicators**

	AmountD	CostD	MaturityD	CollateralD
AmountD	100			
CostD	9.9***	100		
MaturityD	12.3***	-3.5	100	
CollateralD	-4.1	-33.5***	-6.8**	100

Note: Pairwise Pearson correlation coefficients for the sample of firms that indicates being dissatisfied with at least one dimension of their loan (%). *, **, *** indicate significance at the 10%, 5% and 1% level, respectively.

Figure 3: **Dissatisfaction with Loan Terms**



Note: Percentage of firms that report being dissatisfied with one dimension only, two dimensions, three dimensions or all dimensions (i.e. four) of their external finance; among the firms that declare being dissatisfied with at least one dimension. The four dimensions reported in the EIBIS are: amount, cost, maturity and collateral requirements.

4 Empirical Model

We first develop a model to evaluate the effect of loan conditions on the probability to invest in intangibles. To this end, we define the following system:

$$\begin{cases} \text{intan}D_{it}^{T} = \mathbb{1}[\alpha \cdot \text{dissatisfied}_{it} + X_{it}\beta + u_{it} \geq 0], \\ \text{dissatisfied}_{it} = \mathbb{1}[X_{it}\delta + Z_{it}\gamma + v_{it} \geq 0], \end{cases} \tag{2}$$

where $intanD$ equals one if the firm i invests in intangible asset T. Depending on the analysis, T may represent any type of intangible, i.e. $intanD$ equals one if firm i invests in any intangible, or a specific intangible type among the four categories that we consider: *i*) R&D (including the acquisition of intellectual property); *ii*) software, data, IT networks and website activities; *iii*) training of employees or *iv*) organisation and business process improvements. The variable *dissatisfied* is a dummy that represents the dissatisfaction of firms with loan terms. Hence, *dissatisfied* is equal to one if a firm is "fairly dissatisfied" or "very dissatisfied" with at least one of the dimensions of its bank loan – amount, cost, maturity or collateral.

The vector X includes the variables used in related studies as determinant of corporate investment in intangible assets. Most of these variables come from the literature investigating the determinants of R&D expenditures. Our baseline specification controls for the company's age, which is likely to influence both loan conditions and investment in intangibles. Older firms may benefit from more adequate loan conditions due to longer relationships with banks and lower risk of default (Hadlock and Pierce 2010). On the other hand, the return on intangible assets, such as R&D, may be higher for young firms than older firms with established products in the market (Mancusi and Vezzulli 2014). Similarly, we include in our baseline model a dummy to identify small firms, with less than 50 employees, which do not have the same propensity to invest in intangibles, such as R&D or on-the-job training (Popov 2014), and may face specific financial constraint due to their lack of physical capital (Cook et al. 2003, Jiménez et al. 2017). We include two dummies to identify firms that are independent, i.e. not a subsidiary, and foreign owned, as these characteristics can affect firms' access to credit and their investment strategies. Finally, we include a full set of country, industry and year dummies to control for the operational environment. This aims at accounting for possible heterogeneities in technological opportunities, or technology push, and demand pull (Savignac 2008). It also accounts for the differences in regulatory regimes and local policies that may be relevant for intangible investment, for example R&D tax credits or labor regulations for on-the-job training.

The variable Z is the instrumental variable that we use to address the endogeneity of our main explanatory variable – the credit constraint indicator. Following Savignac (2008) and Mancusi and Vezzulli (2014), we use selected *ex ante* firms' financial ratios to instrument their external finance constraint. More specifically, we compute the index of financial constraint built by Whited and Wu (2006), referred to as the WW index, and use it as an instrument for firms' loan conditions (Mancusi and Vezzulli 2014).

We estimate model 2 using a recursive bivariate probit by specifying that error terms are independently and identically distributed as bivariate normal:

$$\begin{pmatrix} u_{it} \\ v_{it} \end{pmatrix} \sim N \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right].$$

Model 2 is coherent and complete, as defined by Lewbel (2007), and can be estimated using a full-information maximum likelihood approach (Greene 1998).

Having estimated the impact of loan terms on the *likelihood* to invest in intangibles, we evaluate the effect of loan terms on the *amount* invested in intangibles. In order to do so, we define the following Tobit model that includes the binary endogenous regressor *dissatisfied*:

$$\begin{cases} \text{intanA}_{it}^{T*} = \alpha \cdot \text{dissatisfied}_{it} + X_{it}\beta + u_{it}, \\ \text{dissatisfied}_{it} = \mathbb{1}[X_{it}\delta + Z_{it}\gamma + v_{it} \geq 0], \end{cases} \tag{3}$$

where $intanA_{it}^{T*}$ represents the (unobserved) logarithm of the latent amount of the firm's investment in intangibles. The observed variable $intanA_{it}^{T}$ is defined as follows:

$$\text{intanA}_{it}^{T} = \begin{cases} \text{intanA}_{it}^{T*} & \text{if intanA}_{it}^{T*} > 0 \\ 0 & \text{if intanA}_{it}^{T*} \leq 0 \end{cases}, \tag{4}$$

i.e. the firm invests only when the optimal latent amount is positive. As shown in Maddala (1983), this model can be estimated using maximum likelihood when error terms u and v are multivariate normal with mean 0 and covariance:

$$\Sigma = \begin{bmatrix} \sigma_u^2 & \sigma_{uv} \\ \sigma_{uv} & \sigma_v^2 \end{bmatrix}.$$

The next section presents the results of these estimations and discusses their implications.

5 Results

Table 4 displays the results obtained regarding the impact of loan conditions on firms' decision to invest in intangibles. In column 1, we perform a simple probit model, without accounting for the endogeneity of the dissatisfaction indicator. We obtain a positive and significant coefficient of the credit constraint measure (i.e. *dissatisfied*) on the probability to invest in any intangible asset. This result is in line with the findings of previous studies that investigate the effect of financial constraints on R&D investment or innovation (Savignac 2008, Mancusi and Vezzulli 2014), which also find a counterintuitive *positive* effect of different measures of credit constraints on investment. As detailed above, this is due to the endogeneity of the constraint indicator. We tackle this issue by instrumenting the dissatisfaction measure with the WW index. Using this instrument, we estimate the bivariate probit model defined in equation 2. Results are displayed in columns 2 and 3. In column 2, we present the coefficients of the bottom equation of the bivariate probit model, i.e. the determinants of the dissatisfaction index. First, it can be noticed that the instrument, shown at the bottom of the table, is a significant determinant of the likelihood of being dissatisfied with loan conditions (a higher value of the WW index as defined in equation 1 implies tighter financial constraints). Second, the correlation coefficient across residuals from the two equations of the model, i.e. ρ, is positive and significant, confirming the endogeneity of the constraint index. Column 3 displays the average marginal effects obtained for the top equation of the bivariate probit model, which indicates the impact of loan conditions on the probability to invest in intangibles. This time, the impact of the dissatisfaction index is significantly negative, which is in line with theoretical predictions that hampered access to bank credit should hinder the probability to invest in intangibles. We observe that a firm dissatisfied with its loan terms is 12% less likely to invest in intangibles. To test the validity of our instrumental variable, we estimate the same system using the two-stage least squares methodology and compute the effective F statistic developed by Olea and Pflueger (2013). The latter is above the critical value of 10 suggested by Andrews et al. (2018), confirming the validity of our approach (Table A1).

We take full advantage of the EIBIS by investigating whether different loan conditions have different impact on investment. In particular, we are interested in separating the effect of quantity rationing, which has been studied in previous analyses, from the impact of the remaining terms of the contract, usually not available in survey data. As explained previously, lenders might be able to provide loans without quantity rationing by varying interest rates and collateral requirements. We are interested in testing whether the loan terms needed to avoid such rationing can also have a negative impact on firms' investment. In order to do so, we define a new dissatisfaction index, which takes the value 1 if the firm is dissatisfied with the rate, maturity or collateral requirement of the loan, and 0 otherwise. Compared to previous regressions, we do not define as constrained firms that declare that they are unsatisfied with their loan size. We estimate the corresponding bivariate probit model, using the same instrument as before, and present the results in columns 4 and 5. The significant coefficient associated to the WW index in column 4 confirms the relevance of our instrument in this new specification. Column 5 displays the average marginal effects of the determinants of the likelihood to invest in intangibles, when accounting for the endogeneity of the newly defined dissatisfaction index. Interestingly, the impact of the financial constraint in this case turns out to be insignificant. Hence, the comparison of these two models suggests that the amount is a key loan term when it comes to the decision to invest in intangibles.

Having provided new insights on the relative importance of different loan terms, we turn to the relative importance of loan conditions for each type of intangible investment. Table 5 presents the results of the bivariate probit estimates when the dependent variable represents the probability to invest in each class of intangible assets. More precisely, columns 1 and 2 display the coefficients obtained when the dependent variable is defined as an indicator variable that takes the value 1 if the firm invests in R&D (and possibly other intangible categories), and 0 if it does not. Similar indicator variables are built for the decision to invest in software (columns 3-4), training of employees (column 5-6) and organisational capital (7-8). The WW index is a significant determinant of the probability of being dissatisfied with loan conditions in each specification. Results show that unfavorable bank terms affect negatively the firm's probability to invest in most types of intangibles. The detrimental effect of financial constraints on the likelihood to invest in R&D and training of employees confirms previous studies that also use direct measures of financial constraints. Interestingly, we do not detect a significant impact of loan conditions on the likelihood to invest in organisational capital. This result is coherent with the stylized fact presented in panel (c) of Figure 1. Indeed, we show that a significant share of investment in organisational capital (63%) is undertaken by firms that use bank financing. This suggests that firms are able to finance investment in this type of intangible with loans at satisfactory terms. This result is interesting given that organisational capital is thought as a firm-specific intangible asset that is non-tradable and difficult to value.

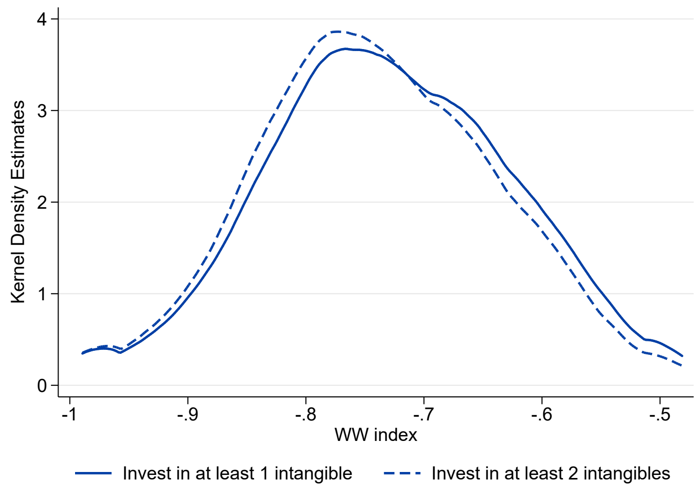
We document an opposite pattern regarding investment in software. Even though a substantial share of investment in this asset category (53%) is financed with bank credit, the effect of the credit constraint indicator is significantly negative. One explanation could simply be that the total amount invested in these two types of assets differ quite significantly. Looking at panel (b) of Figure 1, we document that, while organisational capital represents 6% of firms' total investment on average, investment in software and related assets represents more than twice this share (13%). This difference could partly explain why loan conditions impact more significantly investment in software than in organisational capital. However, further research is needed to fully understand these differences and provide insights on how to relax the financial constraints associated with each asset class.

An important feature of intangible assets is the existence of complementarities, i.e. the productivity of a given intangible asset can be increased through investment in another intangible. In line with this idea, we showed previously that most firms actually invest in at least two categories of intangibles simultaneously. Ballot et al. (2006) provide evidence of a significant positive complementarity effect between training and R&D using micro-level data for France and Sweden. Focusing on German companies, Crass and Peters (2014) also document synergies between training and R&D expenditures, along with significant complementarities between marketing expenditures and R&D. Given these patterns, it is important to have information on the impact of financial constraints not only on the likelihood to invest in intangibles, but also on the probability to invest in *diversified* intangible assets simultaneously.

Our data allow us to provide new insights on this issue. We define a new dependent variable, $IntanDM$, which is a dummy equal to one whenever the firm has invested in two or more intangible assets, and zero otherwise. We estimate the bivariate probit model defined in equation 2 with this new dependent variable. Results are displayed in Table 6. We show in columns 1 and 2 that loan conditions have a significant detrimental impact on the probability of having a diversified portfolio of intangible assets. The average marginal effects, presented in column 2, suggest that firms dissatisfied with the amount, cost, maturity and/or collateral are 30% less likely to invest in multiple intangible assets. In columns 3 and 4, we run the same model but using the previously defined alternative dissatisfaction index that only accounts for dissatisfaction with the cost, maturity and collateral requirements of the loan, excluding the amount. Interestingly, compared to our previous results, we show that in addition to the amount, other loan terms have a significantly negative effect on the probability to invest in diversified intangible assets. This means that restrictive rate, maturity and/or collateral requirements hinder the possibility for firms to benefit from the complementarities of intangibles.

What can explain that the indicator measuring dissatisfaction with cost, maturity and/or collateral requirements only have a significant impact when we focus on investment in diversified assets? According to standard agency theory, quantity rationing is less likely when agency costs are low enough such that lenders can mitigate information asymmetries using different maturities and/or different collateral requirements

Figure 4: **Density Estimates of the Whited-Wu Index**



Note: Density estimates of the Whited-Wu index using the Epanechnikov kernel for firms that invest in at least one intangible (solid line) and firms that invest in at least two intangibles (dotted line).

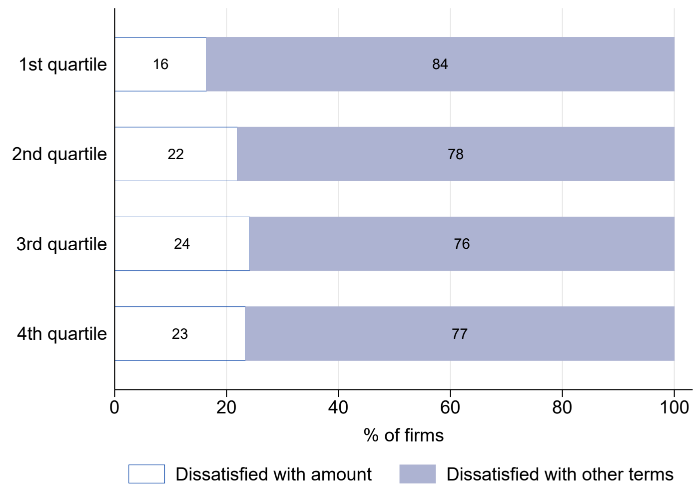
(Ortiz-Molina and Penas 2008, Bester 1987). It simply means that if firms have healthier financials (i.e. agency costs are lower), banks are more likely to be able to offer contracts without having to cut the requested loan size. Hence, when dissatisfied with their loan contract, healthier firms are more likely to be dissatisfied with the cost, maturity and/or collateral requirement than the amount. Consequently, if firms investing in multiple types of intangible assets have typically stronger financials, then we could consider this as an explanation for the more significant impact of dissatisfaction with cost, maturity and/or collateral requirements in this case . To verify this assumption, Figure 4 plots the kernel density estimates of the WW index for different samples of borrowers. The solid line represents the density of the WW index for all firms that invest in at least one intangible and the dotted line represents the density of the index only for the subgroup of firms that invest in at least two intangibles. In line with our initial hypothesis, we observe that the density is shifted to the left for firms that invest in at least two intangible assets, indicating healthier balance sheets.

It remains to verify that borrowers are indeed more likely to be able to avoid quantity rationing when they have stronger financials. To do so, we compute the share of firms dissatisfied with (at least) their loan amount for each quartile of the distribution of the WW index (Figure 5). More precisely, for each quartile of the WW index, we compute the following ratio,

$$R_{WW} = \frac{\text{Number of firms dissatisfied with at least their loan amount}}{\text{Number of firms dissatisfied with at least one dimension of their loan}}. \tag{5}$$

As predicted by theory, we observe that dissatisfaction with loan size increases as the balance sheet weakens. In our sample, 16% of firms with the most robust balance sheets (i.e. the first quartile in Figure 5) are likely to be dissatisfied with their loan amount compared to 23% for the most fragile firms in the fourth quartile. These observations suggest that, borrowers who invest in diversified intangible assets are less likely to be impacted by inadequate loan size than by inadequate cost, maturity and/or collateral requirements due to their healthier balance sheets.

Figure 5: **Dissatisfaction across the Distribution of the Whited-Wu Index**



Note: For each quartile of the distribution of the Whited-Wu index, percentage of firms dissatisfied with (at least) the amount of their loan *vs* the percentage of firms dissatisfied with their loan's interest rate, maturity and/or collateral requirements (see equation 5). The first quartile represents firms with the lowest Whited-Wu index, i.e. the healthiest firms, whereas the fourth quartile groups firms with the highest Whited-Wu index, i.e. the weakest firms in terms of financials.

We next turn to the analysis of the effect of financial constraints on intangible investment intensity. Instead of considering an indicator variable representing the decision to invest or not in a given intangible, i.e. the propensity to invest, we now define as dependent variable the logarithm of the amount invested. This distinction between propensity and intensity was also made by Bond et al. (2005) and Mancusi and Vezzulli (2014) as regards to investment in R&D. The argument for this distinction is that investment in intangibles is geared towards expenditures on skilled workers and tacit knowledge, which cannot be easily adjusted because of suddenly tightened external finance conditions. As a consequence, spending on intangibles (intensity) may not be as sensitive to quantity rationing as the decision to invest or not in intangibles (propensity).

To analyze the effect of loan conditions on investment intensity, we run a Tobit model that accounts for both the left-censoring of the variable representing the log amount invested in intangibles, and the endogeneity of our financial constraint indicators (equation 4). Results are displayed in Table 7. We observe that our instrument is still a significant indicator of loan conditions in this new model (columns 1 and 4). In columns 2 and 3 we report that firms dissatisfied with at least one of the four dimensions of their loan invest significantly less in intangibles. When we look at our alternative variable of financial constraints, which indicates firms dissatisfied with the rate, maturity and/or collateral requirements of their loan, we observe that the effect is virtually unchanged (columns 5 and 6). This is an important difference compared to the results obtained regarding investment propensity where introducing dissatisfaction with the amount was necessary to observe a significant impact. In line with previous studies, this shows that quantity rationing has a more important effect on investment propensity than on investment intensity. Our analysis completes these results by showing that loan terms different from the loan amount do matter for investment intensity. Thus, putting all pieces of the analysis together, we can conclude that obtaining a loan of the requested amount is important for the decision to invest or not in intangibles. In order to be able to grant the full amount however, lenders resort to contracts with interest rate, maturity and/or collateral requirements that have a negative impact on the size of the investment.

From a policy perspective, these results provide new insights regarding the impediments to investment in intangible assets in Europe, which is a bank-based economic area. In particular, we show that lending rates, maturity and/or collateral requirements have a negative effect on investment in multiple intangible assets, undermining the possibility to exploit the complementarities of such assets. This lends support to the existing credit guarantee schemes for firms that are unable to provide sufficient collateral. The state is often the guarantor, which helps alleviate financial constraints and support investment in intangibles.

Another important recent development is intangible-backed lending, especially in Asia where there are initiatives to promote standards and/or good practice for lending against intangible assets (Brassell and Boschmans 2019). Subsidized interest rates are also used in some countries. These policies target the different terms of credit, which according to our results is necessary to unlock investment in knowledge assets. The majority of these policy instruments target R&D. For instance, initiatives regarding intangible-backed lending focus on the role of patents. Our analysis suggests, however, that other intangibles, such as training, represent an important share of the average firm's total investment and is negatively impacted by inadequate loan conditions. Thus, policies to promote intangible investment should target the diversity of existing intangibles in order to foster not only investment but also synergies.

6 Conclusions

Empirical evidence on the impact of bank financing on corporate investment in intangible assets is of critical importance, especially in bank-dominated financial systems such as most European ones. Previous studies show that investment in R&D, the most studied intangible asset, is hampered by inadequate loan terms. Researchers, however, have not been able to fully account for the role of bank loan conditions on total intangible investment, because of the difficulties to measure credit constraints and intangible assets other than R&D. Using new survey data, representative across European countries, we are able to document the impact of four distinct bank loan dimensions – amount, cost, maturity and collateral requirements – on four different categories of intangibles – R&D, including the acquisition of intellectual property, software, data, IT networks and website activities, training of employees and organisation and business process improvements.

Using an instrumental variable approach, we show that the loan amount is a key determinant of the firm's propensity to invest in intangibles. Other possibly unfavorable loan dimensions like cost, maturity or collateral requirements, do not have a significant impact on the likelihood to invest in intangibles as long as the firm is granted a satisfactory loan amount. We further show that a suitable loan amount is not sufficient to ensure that firms will be able to invest in two or more types of intangible assets simultaneously. Diversification of intangibles is important to benefit from the complementarities of these assets, e.g. investment in R&D, coupled with training of employees. This finding gains importance by the fact that in Europe the majority of firms investing in intangible assets do so in more than two types of these simultaneously. This suggests that the negative effect of high lending rates, maturity or collateral requirements on the probability to invest in multiple intangibles prevents firms from maximizing investment return. Finally, we document that a satisfactory loan amount is not sufficient to ensure that firms invest as much as desired in intangible assets. High lending rates, maturity or collateral requirements have a detrimental effect on intangible investment intensity.

From a policy perspective, our results first confirm that tackling the issue of access to finance for investment in intangible assets is important, as suggested by previous studies on financing of R&D expenditures. These studies also show that policies aiming at relaxing other loan terms are necessary in order to fully unlock investment in knowledge assets in Europe. Consequently, policies such as subsidized loans, credit guarantee schemes or intangible-backed lending could remove important impediments to investment.

Table 2: **Variable Definitions**

Variable	Definition
Intangible Investment	
IntanD	=1 if invested in any intangible
Intan2D	=1 if invested in at least two intangible types
IntanA	log amount of intangible investment
R&D	=1 if invested in R&D
Software	=1 if invested in Software
Training	=1 if invested in Training
Organisational Capital	=1 if invested in Organisational Capital
Loan condition indices	
Dissatisfied	=1 if dissatisfied with at least one loan dimension
Dissatisfied alt.	=1 if dissatisfied with cost, maturity or collateral but satisfied with amount
AmountD	=1 if dissatisfied with amount
CostD	=1 if dissatisfied with cost
MaturityD	=1 if dissatisfied with maturity
CollateralD	=1 if dissatisfied with collateral requirements
Instrument	
WW index	Whited and Wu's external finance constraint index
Size	
Small	=1 if less than 50 employees
Ownership	
Independent	=1 if independent
Foreign	=1 if foreign owned
Age	
Less than 2 years	Dummy variable
2 years to less than 5 years	Dummy variable
5 years to less than 10 years	Dummy variable
10 years to less than 20 years	Dummy variable
20 years or more	Dummy variable
Sector	
Manufacturing	Dummy variable
Construction	Dummy variable
Services	Dummy variable
Infrastructure	Dummy variable

Table 3: **Summary Statistics**

	Mean	SD	Min	Max	N
Intangible Investment					
IntanD	0.91	0.29	0.00	1.00	5256
Intan2D	0.71	0.45	0.00	1.00	5256
IntanA	10.78	2.34	1.65	21.08	4762
R&D	0.33	0.47	0.00	1.00	5256
Software	0.72	0.45	0.00	1.00	5256
Training	0.76	0.43	0.00	1.00	5256
Organisational Capital	0.40	0.49	0.00	1.00	5256
Loan condition indices					
Dissatisfied	0.21	0.41	0.00	1.00	5378
Dissatisfied alt.	0.17	0.37	0.00	1.00	5194
AmountD	0.04	0.21	0.00	1.00	5521
CostD	0.10	0.30	0.00	1.00	5494
MaturityD	0.04	0.20	0.00	1.00	5514
CollateralD	0.12	0.33	0.00	1.00	5410
Instrument					
WW index	-0.73	0.10	-0.99	-0.48	5550
Size					
Small	0.41	0.49	0.00	1.00	5550
Ownership					
Independent	0.43	0.49	0.00	1.00	5252
Foreign	0.06	0.24	0.00	1.00	5129
Age					
Less than 2 years	0.00	0.05	0.00	1.00	5550
2 years to less than 5 years	0.03	0.16	0.00	1.00	5550
5 years to less than 10 years	0.10	0.30	0.00	1.00	5550
10 years to less than 20 years	0.24	0.43	0.00	1.00	5550
20 years or more	0.63	0.48	0.00	1.00	5550
Sector					
Manufacturing	0.33	0.47	0.00	1.00	5550
Construction	0.19	0.40	0.00	1.00	5550
Services	0.23	0.42	0.00	1.00	5550
Infrastructure	0.24	0.43	0.00	1.00	5550

Note: Summary statistics of the main variables used in the different empirical models. The sample of banks is described in Section 2.

Table 4: **Impact of Unsatisfying Loan Terms on the Probability to Invest in Intangibles**

	Probit	Bivariate Probit			
	(1) IntanD Coef.	(2) Dissatisfied Coef.	(3) IntanD Marg. Eff.	(4) Dissatisfied Coef.	(5) IntanD Marg. Eff.
Loan condition indices:					
Dissatisfied	0.17**		-0.12**		
	(0.069)		(0.056)		
Dissatisfied alt.					-0.090
					(0.064)
Age:					
2 years to less than 5 years	0.11	-0.12	0.033	-0.20	0.040
	(0.58)	(0.52)	(0.11)	(0.54)	(0.11)
5 years to less than 10 years	0.28	-0.019	0.068	-0.10	0.060
	(0.57)	(0.51)	(0.10)	(0.53)	(0.11)
10 years to less than 20 years	0.26	0.0018	0.065	-0.077	0.060
	(0.57)	(0.51)	(0.10)	(0.53)	(0.11)
20 years or more	0.30	-0.050	0.070	-0.14	0.064
	(0.57)	(0.51)	(0.10)	(0.53)	(0.11)
Size:					
Small	-0.34***	-0.0024	-0.050***	-0.035	-0.053***
	(0.057)	(0.059)	(0.0099)	(0.063)	(0.0099)
Ownership:					
Independent	0.061	-0.071	0.0080	-0.079	0.0059
	(0.061)	(0.047)	(0.010)	(0.051)	(0.0099)
Foreign	0.29**	-0.046	0.038**	-0.12	0.034*
	(0.15)	(0.10)	(0.018)	(0.11)	(0.018)
Sector:					
Construction	0.16**	0.18***	0.032***	0.18***	0.032***
	(0.079)	(0.060)	(0.012)	(0.064)	(0.012)
Services	0.20***	-0.040	0.030***	-0.039	0.029**
	(0.075)	(0.058)	(0.012)	(0.062)	(0.012)
Infrastructure	-0.051	-0.083	-0.011	-0.036	-0.010
	(0.070)	(0.059)	(0.013)	(0.063)	(0.013)
Instrument:					
WW index		1.64***		1.43***	
		(0.31)		(0.34)	
ρ		0.49***		0.39**	
Log Lik	-1332.7	-3646.2		-3273.9	
Country Dummies	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes
Observations	4693	4711	4711	4550	4550

Note: Coef. stands for coefficients and Marg. Eff. indicates the resulting average marginal effects. Log Lik is log likelihood. Standard errors robust to heteroskedasticity. *, **, *** indicate significance at the 10%, 5% and 1% level, respectively.

Table 5: **Impact of Unsatisfying Loan Terms on the Probability to Invest in each Type of Intangible Assets**

	R&D		Software		Training		OrgaCapital	
	(1) Diss Coef.	(2) IntanD Marg. Eff.	(3) Diss Coef.	(4) IntanD Marg. Eff.	(5) Diss Coef.	(6) IntanD Marg. Eff.	(7) Diss Coef.	(8) IntanD Marg. Eff.
Loan condition index:								
Dissatisfied		-0.34***		-0.25***		-0.30***		-0.18
		(0.039)		(0.062)		(0.060)		(0.15)
Age:								
2 years to less than 5 years	-0.093	-0.025	-0.053	-0.065	-0.040	0.044	-0.022	0.067
	(0.51)	(0.13)	(0.54)	(0.13)	(0.54)	(0.13)	(0.54)	(0.15)
5 years to less than 10 years	0.0020	-0.013	0.040	-0.026	0.063	0.083	0.087	0.085
	(0.50)	(0.12)	(0.53)	(0.13)	(0.52)	(0.12)	(0.53)	(0.14)
10 years to less than 20 years	0.011	-0.022	0.057	-0.034	0.087	0.10	0.10	0.053
	(0.49)	(0.12)	(0.53)	(0.13)	(0.52)	(0.12)	(0.53)	(0.14)
20 years or more	-0.021	-0.019	0.018	-0.013	0.039	0.10	0.050	0.055
	(0.49)	(0.12)	(0.52)	(0.12)	(0.52)	(0.12)	(0.52)	(0.14)
Size:								
Small	-0.045	-0.085***	-0.014	-0.099***	-0.0020	-0.075***	0.0073	-0.064***
	(0.057)	(0.016)	(0.059)	(0.016)	(0.057)	(0.015)	(0.059)	(0.020)
Ownership:								
Independent	-0.065	0.017	-0.066	-0.0022	-0.069	0.0049	-0.065	-0.0060
	(0.047)	(0.014)	(0.047)	(0.013)	(0.047)	(0.013)	(0.047)	(0.015)
Foreign	-0.0019	0.018	-0.030	0.0100	-0.037	0.066***	-0.034	0.043
	(0.097)	(0.026)	(0.10)	(0.028)	(0.10)	(0.025)	(0.10)	(0.031)
Instrument:								
WW index	1.98***		1.70***		1.66***		1.55***	
	(0.27)		(0.30)		(0.30)		(0.30)	
ρ	0.72***		0.51***		0.59***		0.38	
Log Lik	-4962.4		-4869.7		-4709.8		-5309.9	
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4711	4711	4711	4711	4711	4711	4711	4711

Note: Bivariate probit models. Coef. stands for coefficients and Marg. Eff. indicates the resulting average marginal effects. Log Lik is log likelihood.Standard errors robust to heteroskedasticity. *, **, *** indicate significance at the 10%, 5% and 1% level, respectively.

Table 6: **Impact of Unsatisfying Loan Terms on the Probability to Invest in Multiple Intangible Assets**

	Baseline		Alternative dissatisfaction index	
	(1) Dissatisfied Coef.	(2) IntanDM Marg.Eff.	(3) Dissatisfied Coef.	(4) IntanDM Marg. Eff.
Loan condition indices:				
Dissatisfied		-0.30***		
		(0.049)		
Dissatisfied alt.				-0.26***
				(0.067)
Age:				
2 years to less than 5 years	-0.14	-0.092	-0.22	-0.098
	(0.52)	(0.12)	(0.54)	(0.12)
5 years to less than 10 years	-0.033	-0.047	-0.12	-0.060
	(0.51)	(0.11)	(0.53)	(0.12)
10 years to less than 20 years	-0.016	-0.055	-0.098	-0.065
	(0.51)	(0.11)	(0.52)	(0.11)
20 years or more	-0.054	-0.042	-0.16	-0.050
	(0.51)	(0.11)	(0.52)	(0.11)
Size:				
Small	-0.031	-0.10***	-0.060	-0.12***
	(0.059)	(0.015)	(0.064)	(0.016)
Ownership:				
Independent	-0.063	-0.00017	-0.075	0.0015
	(0.047)	(0.013)	(0.050)	(0.014)
Foreign	-0.0099	0.012	-0.075	0.0049
	(0.100)	(0.027)	(0.11)	(0.028)
Sector:				
Construction	0.19***	-0.0077	0.18***	-0.011
	(0.059)	(0.017)	(0.064)	(0.018)
Services	-0.036	-0.023	-0.040	-0.021
	(0.057)	(0.016)	(0.062)	(0.017)
Infrastructure	-0.081	-0.062***	-0.036	-0.061***
	(0.058)	(0.016)	(0.062)	(0.017)
Instrument:				
WW index	1.84***		1.60***	
	(0.30)		(0.34)	
ρ	0.60***		0.51***	
Log Lik	-4883.5		-4469.4	
Country Dummies	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
Observations	4711	4711	4550	4550

Note: Bivariate probit models. Coef. stands for coefficients and Marg. Eff. indicates the resulting average marginal effects. Log Lik is log likelihood. Standard errors robust to heteroskedasticity. *, **, *** indicate significance at the 10%, 5% and 1% level, respectively.

Table 7: **Impact of Unsatisfying Loan Terms on the Amount Invested in Intangible Assets**

	Baseline			Alternative dissatisfaction index		
	(1) Dissatisfied Coef.	(2) IntanA Coef.	(3) IntanA E(Y)	(4) Dissatisfied Alt. Coef.	(5) IntanA Coef.	(6) IntanA E(Y)
Loan condition indices:						
Dissatisfied		-5.82***	-5.46***			
		(0.16)	(0.13)			
Dissatisfied Alt.					-5.88***	-5.49***
					(0.16)	(0.13)
Age:						
2 years to less than 5 years	-0.61*	-1.64	-1.62	-0.74**	-1.69	-1.67
	(0.34)	(1.13)	(1.12)	(0.35)	(1.10)	(1.09)
5 years to less than 10 years	-0.53*	-0.95	-0.94	-0.62*	-1.16	-1.14
	(0.32)	(1.07)	(1.06)	(0.33)	(1.04)	(1.03)
10 years to less than 20 years	-0.52*	-0.97	-0.96	-0.62*	-1.14	-1.13
	(0.31)	(1.06)	(1.05)	(0.32)	(1.03)	(1.02)
20 years or more	-0.53*	-0.73	-0.72	-0.63*	-0.92	-0.91
	(0.31)	(1.05)	(1.04)	(0.32)	(1.02)	(1.01)
Size:						
Small	-0.23***	-2.21***	-2.18***	-0.29***	-2.35***	-2.32***
	(0.051)	(0.15)	(0.15)	(0.052)	(0.15)	(0.15)
Ownership:						
Independent	-0.056	-0.053	-0.053	-0.058	-0.060	-0.059
	(0.043)	(0.15)	(0.15)	(0.045)	(0.15)	(0.15)
Foreign	0.035	0.60**	0.60**	0.0094	0.51*	0.51*
	(0.084)	(0.27)	(0.26)	(0.091)	(0.26)	(0.26)
Sector:						
Construction	0.15***	-0.13	-0.13	0.14**	-0.19	-0.18
	(0.056)	(0.19)	(0.19)	(0.058)	(0.19)	(0.19)
Services	-0.016	-0.22	-0.22	-0.015	-0.24	-0.24
	(0.052)	(0.17)	(0.17)	(0.054)	(0.17)	(0.17)
Infrastructure	-0.100*	-0.56***	-0.56***	-0.066	-0.50***	-0.50***
	(0.054)	(0.19)	(0.19)	(0.057)	(0.19)	(0.19)
Instrument:						
WW index	2.91***			2.91***		
	(0.21)			(0.22)		
Log Lik	-14415.7			-13688.0		
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4711	4711	4711	4550	4550	4550

Note: IV-Tobit models. Coef. are the estimated coefficients of model 3 and E(Y) indicates the derived marginal effects of regressors on the actual amount invested, accounting for left-censoring (i.e. equation 4). Log Lik is log likelihood. Standard errors robust to heteroskedasticity. *, **, *** indicate significance at the 10%, 5% and 1% level, respectively.

7 Appendix

Table A1: **Impact of Unsatisfying Loan Terms on the Probability to Invest in Intangibles**

	Baseline		Diss alt. index	
	(1) First Stage	(2) IntanD	(3) First Stage	(4) IntanD
Loan condition indices:				
Dissatisfied		-0.77***		
		(0.22)		
Dissatisfied alt.				-1.00***
				(0.32)
Instrument:				
WW index	0.38***		0.29***	
	(0.079)		(0.074)	
Age:				
2 years to less than 5 years	-0.00073	0.021	-0.019	0.014
	(0.11)	(0.055)	(0.11)	(0.052)
5 years to less than 10 years	0.030	0.088**	0.0060	0.069**
	(0.10)	(0.043)	(0.10)	(0.032)
10 years to less than 20 years	0.032	0.089**	0.0097	0.074***
	(0.10)	(0.039)	(0.10)	(0.025)
20 years or more	0.018	0.081**	-0.0059	0.061***
	(0.100)	(0.036)	(0.10)	(0.019)
Size:				
Small	0.0098	-0.011	-0.0015	-0.022
	(0.016)	(0.018)	(0.015)	(0.019)
Ownership:				
Independent	-0.019	-0.0048	-0.018	-0.011
	(0.013)	(0.014)	(0.012)	(0.017)
Foreign	-0.014	0.011	-0.026	-0.0070
	(0.024)	(0.024)	(0.022)	(0.028)
Sector:				
Construction	0.058***	0.074***	0.050***	0.082***
	(0.018)	(0.023)	(0.017)	(0.027)
Services	-0.0088	0.024	-0.0080	0.021
	(0.016)	(0.017)	(0.015)	(0.019)
Infrastructure	-0.017	-0.029	-0.0053	-0.021
	(0.015)	(0.018)	(0.015)	(0.019)
Effective F (Montiel-Pflueger)		22.8		15.6
Country Dummies	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
Observations	4711	4711	4550	4550

Note: 2SLS estimates. Standard errors robust to heteroskedasticity. *, **, *** indicate significance at the 10%, 5% and 1% level, respectively.

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