Intellectual Property as Loan Collateral

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Abstract

This study provides a first comprehensive picture of the use of intellectual property (IP) rights as loan collateral, its determinants, and its impact on firm trajectories. Using novel administrative data, we exploit the French institutional setting and show that a broad set of firms from various industries uses trademarks (72%), patents (26%), and designs (2%) to secure loans. IP-backed loans entail large positive effects on firms' use of debt and subsequent growth, particularly for financially constrained SMEs. We explore exogenous variation in the pledgeability of alternative collateral to confirm the importance of IP collateral for IP-pledging firms.

JEL Classification: D23; G32; O32; O34

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1 Introduction

The ability to access external financing affects firms' investment strategies and growth (Hall and Lerner, 2010). Firms can provide assets as loan collateral to enhance their debt capacity, and tangible assets have traditionally been the most common type of collateral (Frank and Goyal, 2003; Benmelech and Bergman, 2009; Rampini and Viswanathan, 2013). However, intangible assets have started to dominate the composition of firm value, which significantly dampens the ability of intangible-intensive firms to raise debt (Brynjolfsson *et al.*, 2021; Dell'Ariccia *et al.*, 2021; Falato *et al.*, 2022).

One way for intangible-intensive firms to enhance their access to debt financing is to use their assets, such as intellectual property (IP) rights, as loan collateral. Research on the use of IP collateral is emerging and empirical evidence is still scarce. First studies focus on patents, one type of IP rights, and on firms of specific legal types, sizes, and industries (Hochberg *et al.*, 2018; Mann, 2018). These studies provide a seminal but incomplete picture of IP-backed lending. In fact, other forms of IP rights, such as trademarks or designs, are relevant for a much broader set of firms. For example, 53% of EU firms with at least 250 employees own trademarks, whereas 18% own patents (EPO-EUIPO, 2021).[1] Further, trademarks have lower technical uncertainty and can be more directly linked to revenues compared to patents, both of which is important for debt financing (Hsu *et al.*, 2022). Moreover, using IP to secure debt is unlikely to be relevant only for distinct subsets of firms, since bank financing is also relevant for a large set of firms. More than 80% of firms using external finance in 2022 in the EU and the United States use bank financing (European Investment Bank, 2022). In order to have a comprehensive picture of IP-backed lending, it is therefore crucial to consider all types of IP collateral and all kinds of firms.

In this paper, we provide a full picture on the use of IP as loan collateral, its determinants, and on the effects that such strategies have on firms' trajectory. We present novel insights on previously undisclosed dimensions of external debt financing, contributing to the literature in several ways. To the best of our knowledge, this is the first study examining trademarks,

[1] Across all firms, the prevalence of trademarks exceeds the prevalence of patents by a factor of about nine. This pattern is likely not limited to European countries. To illustrate, Figure IA1 (Appendix B) compares the share of trademark, design, and patent-intensive industries across several economies worldwide. In IP-intensive industries in Europe during the years 2017-2019, trademark-intensive sectors contributed to 82% of GDP and 71% employment, whereas the contribution of patent-intensive industries is 37% for both GDP and employment (EPO-EUIPO, 2022).

patents, and designs in a single empirical setting. Second, it samples all firms using IP collateral from an entire country, hence, including firms across all legal types, sizes, and industries. Third, this study provides evidence on the determinants of IP pledgeability - across and within firms - for different IP types. Fourth, it accounts for the fact that alternative collateral may be used together with IP. Finally, it estimates the heterogeneous effect of IP collateral on the use of debt and subsequent real activities, with respect to several firm characteristics. Taken together, we disclose comprehensive insights on IP as loan collateral and thereby add to the understanding of external debt financing secured by intangibles.

To study this, we create a novel dataset, relying on previously unexploited administrative data from France. The French institutional setting is well-suited for studying the use of IP collateral. Indeed, the country's legal requirements lead to consistent registration of all IP collateral events for different types of IP rights. Our data spans more than two decades from 1995 to 2018, comprises firms from all legal forms, sizes, and industries, and contains information on the use of trademarks, patents, and designs as loan collateral.

First descriptive evidence confirms the importance of non-patent IP collateral. More specifically, we find that 81% of IP pledges involve trademarks, 11% involve patents, and 8% use a combination of IP rights. Design rights are exclusively pledged in combination with other IP rights.[2] These findings advocate for considering not only patent but also other IP rights when examining IP collateral.

Descriptive evidence corroborates the relevance of IP collateral for a broad set of firms. To show this, we link collateral information to firm-level financial data. Borrowers are predominantly well-established, private firms, mostly limited liability companies, dispersed along a variety of sectors and geographic locations within France. In particular, we find that 79% of firms engaging in IP collateralization are SMEs. Such firms are known to have a high dependency on bank financing (Carbo-Valverde *et al.*, 2009). Yet, these firms have received little attention from the existing literature on the use of IP rights as loan collateral. Moreover, we show that the aforementioned IP- and firm-specific patterns seem to be generalizable beyond the French setting.

Next, we highlight that specific assets of firms' IP portfolio are pledged as collateral.

[2]Overall, we observe French firms to pledge 16,354 distinct IP rights between 1995 and 2018, out of which 72% are trademarks, 26% are patents, and 2% are design rights.

French credit law does not allow borrowers to use a general collection of corporate assets, but each asset used as collateral has to be specified individually – an advantage for our empirical analysis. We construct the full IP portfolio of pledging companies at the time of the collateral event and add information on IP quality indicators. In total, 76% of trademark-pledging and 64% of patent-pledging companies do not pledge their full portfolio. IP rights with higher private value to the firms, higher redeployability, and higher valuation capacity (i.e., associated certainty) are more likely to be used as collateral. These findings constitute novel evidence on the determinants of IP pledgeability. As such, our analysis distinguishes IP rights held by pledging and non-pledging entities at the time of the pledge, includes trademarks, and considers a wide range of IP characteristics.[3]

Furthermore, IP-backed loans have meaningful consequences for the debt capacities of firms. We estimate a disproportional increase of 61% in the long-term debt-to-asset ratios of pledging firms in the years after the IP pledge relative to a comparison group. We exploit heterogeneity in firm-level characteristics and find that these effects apply across industries and geographical locations. The impact on debt is stronger for small and private but well-established firms, and firms that have a high dependency on external financing. Moreover, we show that IP collateral events are associated with a subsequent increase in asset growth and employment. Our results extend previous findings on patent pledges of specific subsets of firms (Hochberg *et al.*, 2018; Mann, 2018), by showing that similar effects apply for a broad set of firms that use either trademarks or patents as loan collateral.

Finally, we provide a solution for a concern inherent to firm-level analyses on debt financing. Indeed, in most settings it is not possible to observe every collateral relevant to loan agreements. The systematic use of other assets together with IP collateral would lead to an omitted variable bias, most likely generating an upward bias in the results. In other words, the positive effect on firms' debt and economic activities to IP collateral would be attributed to IP collateral, while it may have been driven by the unobserved collateralization of other types of assets. We mitigate concerns that unobserved alternative collateral is driving our results in a series of tests. First, we show that our baseline results are stable across different levels of asset tangibility, a standard measure of collateral availability (e.g., Frank and Goyal, 2003). Second, we exploit plausibly exogenous variation in the value of tangible collateral

[3]First evidence on IP pledgeability focuses on patents only and does not distinguish between those owned by pledging and non-pledging entities (Mann, 2018; Caviggioli *et al.*, 2020; Zhang *et al.*, 2021).

to study the above effects in more detail. We use a major legislative change in early 2006, the *Ordonnance 2006-346*, as a shock that raised the availability of alternative collateral for a subset of firms (see, Aretz *et al.*, 2020). Our analyses reveal that the positive effect of IP pledges is robust to changes in the availability of alternative collateral.

This study combines three main strands of the literature. First, we relate to studies on the use and implications of collateral in external financing. Prior research highlights the importance of collateral to reduce financing costs and improve the access to debt (Bester, 1985; Stiglitz and Weiss, 1981; Benmelech and Bergman, 2009; Norden and van Kampen, 2013). Securing debt with collateral has important implications for investment decisions, in particular, for financially constrained companies, such as small or innovative firms (Hall and Lerner, 2010; Chaney *et al.*, 2012). Second, we pertain to the literature on the monetization of IP rights. Literature identifies different ways how firms utilize their IP rights to satisfy financing needs, such as IP sales, licensing, and collateralization (Arora *et al.*, 2001, 2004; Serrano, 2010; Mann, 2018). Third, we contribute to studies investigating the role of IP rights in external financing. A large body of research shows that IP rights support young firms in attracting external equity, in the form of venture capital (Hsu and Ziedonis, 2008; Conti *et al.*, 2013; Block *et al.*, 2014; Haeussler *et al.*, 2014). A more nascent stream of the literature provides evidence on the positive relationship between ownership of IP rights and debt financing (Farre-Mensa *et al.*, 2020; Saidi and Žaldokas, 2021; Horsch *et al.*, 2021).

There is a small number of studies at the intersection of these three streams, such as the present study, which specifically investigate how IP rights can be used as collateral to raise debt. The majority of existing work focuses on patents and shows that patent pledges helps firms to raise debt, contributing to future growth.[4] Patent-backed loans have positive effects on savings, R&D investments, and performance, especially for intangible-rich firms (Amable *et al.*, 2010; Mann, 2018; Hochberg *et al.*, 2018; Caviggioli *et al.*, 2020). Evidence on the use of other IP rights is scarce. Prior literature shows that brand equity improves debt financing and trademarks are recorded in security agreements in the US (Graham *et al.*, 2018; Mauer *et al.*, 2022). To the best of our knowledge, this study is the first to provide a comprehensive picture on the use of IP rights as loan collateral and its impact on firm trajectories.

The remainder of the paper is organized as follows. Section 2 outlines the institutional

[4] In the legal literature, the use of non-patent IP collateral is a commonly discussed topic; see Kieninger (2020) for a detailed overview.

background on the monetization of IP rights, in particular, the use IP rights as loan collateral in the French legal system. Section 3 presents the data, displays detailed descriptive evidence on IP collateral in France, and demonstrates external validity of these insights. Section 4 carves out determinants of trademark- and patent pledgeability. Section 5 provides empirical evidence on the effects of IP collateral events. Section 6 concludes.

2 Institutional background

2.1 Collateralization of IP in France: legislative details

Our study is exploiting distinct features of the legislative setting in France that enables us to investigate the use of IP collateral and to make inferences on the relative use of different IP types. In this subsection, we outline the environment governing the use of IP rights as loan collateral in France. There are mainly three features that render the institutional setting very suitable to study the use of IP rights as loan collateral. First, unlike in other jurisdictions, the French legal framework allows for the collateralization of patents, trademarks (except collective trademarks), and designs under the same legal regime. As such, as early as the nineteenth century, the French legislator accepted the passing of statues enabling lenders to acquire certain non-possessory interests in their debtors' property, such as IP rights (Riffard, 2016). Pledges of these kinds are created by a written agreement and are registered at the French national patent and trademark office, INPI.

Second, unlike many other jurisdictions, the French legal system does not allow for blanket liens, i.e., a general collection of corporate assets in security agreements. Instead, each individual asset that is used in a loan agreement has to be specified (see Attal, 2004; Aretz *et al.*, 2020). This is crucial for our empirical analyses, because rules out that the observed IP collateral is merely added to the collateral mass by default.

Third, the French national patent and trademark office (INPI) has a central register that systematically collects, amongst others, information on IP rights that are used as security in loan contracts. Both borrowers and lenders are eligible to make such registrations. Most importantly incentives are aligned such that particularly lenders have very strong incentive for a timely registration of any IP collateral event. This is different in other jurisdictions, for instance, the US does not provide a single, harmonized IP collateral law governing all IP

rights and registration requirements are diffused due to parallel legal regimes, i.e., federal and state law (Jacobs, 2011; Graham *et al.*, 2018). Appendix C contains a detailed description on establishing and resolving IP loan contracts in France.

Recording IP collateral events: The recording of IP collateral events is crucial in this study, as it forms the basis for the empirical analyses. France has long-standing tradition of having relatively strict registration requirements of loan agreements that involve collateral.[5] In the context of IP collateral, the French IP law stipulates the publication of registered IP pledges in the official INPI journal. All of the involved parties are eligible to make the registration, which is necessary in order to enforce rights attached to the collateral against third parties. As such, the French law specifies that "*all security rights encumbering intellectual property rights must have been established in writing and made public in a register* (...) *of the intellectual property in question*" (Séjean and Binctin 2020, pp. 382). These rules are particularly important, for instance, in the case of subsequent changes of ownership, such as subsequent IP collateral events, licensing agreements, and IP transfers or in the case of borrower liquidation. Moreover, the French legal system requires each asset used as collateral to be registered individually. Although the loan transaction would in principle be still formally perfected without registration, the compliance with a public disclosure determines the opposability. For example, lenders that do not register a pledge lose their priority claim over the collateral and the opportunity to enforce any claims in case of changes in ownership rights. Hence, the legal system is structured such that it provides the involved parties with strong incentives registration.[6]

In addition to this, there are important incentives to register IP pledges in France close to the actual date of the contract. The effective date of enforceability against third parties is the publication date of the transaction by the INPI in its official journal. Further, enforceability is also not-retroactive and seniority of the claims is determined by the order of the publication of the pledge.[7] It follows that the lender has a strong incentive for a timely registration,

[5] According to (Riffard, 2016), the French collateral regime has been "*extremely rigorous, particularly with regard to the form*", as creditors can only enforce their rights against third parties if the collateral transaction is "*duly registered, containing the statement of the amount of the secured claim, as well as the species and nature of the encumbered asset*" (p. 371).

[6] In exchanges with IP lawyers in Germany, we confirm that the requirement to public disclosure is of highest importance for lenders. It was stated that German banks are typically reluctant to accept IP rights as loan collateral, particularly because there is no registration requirements of loan transactions secured with IP rights in Germany, leaving the bank without information on any other priority claims.

[7] See for instance, CC 2340 and CA Lyon, 11 février 1999: Ann.prop.ind. 1/2000, p.3

because it assures a superior claim in case of default or non-payment of the debtor over any other parties involved. Moreover, the costs of registration are very low, such that the aforementioned advantages are likely to exceed the administrative costs of registration.[8] Hence, the specific legal setting in France is likely to provide the involved parties with strong incentives to timely register IP collateral used in loan contracts. There is empirical evidence supporting this notion. Changes in the ownership structure have been previously studied in the context of France, documenting that the French legal system provides strong incentives for firms to register IP transfers in a timely manner (see Ciaramella *et al.*, 2017; Gaessler and Harhoff, 2018).

These advantages of studying IP collateral in the context of the French economy are not exclusive to France, per se. Yet, they rarely apply in combination. For example, while similar rules exist in Sweden and the Netherlands, they only apply for patents but not for other types of IP rights (Bracht and Czarnitzki, 2022). Moreover, in the majority of jurisdictions worldwide it is not mandatory to register the use of an IP asset as collateral or they lack a (centralized) registration system (see Heller *et al.*, 2022). As such, legal scholars judge the French IP collateral system to provide relatively high legal certainty to users (see Séjean and Binctin, 2020).

2.2 IP rights and their potential use as collateral

IP rights provide their owners with several options to satisfy financing needs, such as using IP as collateral to secure loans.[9] In principle, any type of IP right can be used as loan collateral unless prohibited by law. The vast majority of jurisdictions worldwide indeed provide the legal basis for using IP rights to secure loan contracts (Heller *et al.*, 2022).[10] In this paper, we focus on the three most common types of IP rights: trademarks, designs, and patents. We specifically do not consider copyrights, since they are personal rights and not obtained via registration but upon creation. Table IA1 (Appendix A) summarizes the most important characteristics of trademarks, designs, and patents including those relevant in the context of

[8] In terms of monetary costs, registering parties have to pay an administrative fee of 7 euros for each individual IP right included in a loan contract, which is, however, capped at 270 Euros. Exceptions can apply, if firms apply for fast track registrations, but fees are still in comparable magnitudes. Further, administrative costs may pose additional non-monetary costs.

[9] Viable monetizing alternatives are the selling, licensing, or collateralizing of IP rights. Appendix D summarizes the key characteristics of these strategies and relates them to another.

[10] See Kieninger (2020) for a detailed country-by-country overview on the legal state of IP collateralization.

IP collateralization.

The central commonality among trademarks, designs, and patents is that they require formal application and, once approved, grant their owner with a temporary monopoly right to use the protected subject matter. These IP rights thereby provide their owner with a potentially significant competitive advantage, implying a high strategic potential of IP rights. Since uncertainty is inherent to intangible values, the standardized and formal procedure of passing the requirements for registration (trademarks and designs) or examination (patent) is key in mitigating issues associated with the probabilistic nature of IP rights (Lemley and Shapiro, 2005; Hegde and Luo, 2018).

Aside of these general commonalities, IP rights differ with respect to several central aspects. Foremost, trademarks, designs, and patents cover three mutually exclusive subject matters. Trademarks protect distinct signs that distinguish companies, products, or services through different brands, words, drawings, or symbols. Designs protect aesthetic forms and non-functional product features. Patents protect technical inventions and must therefore, just like designs, not necessarily relate to specific products. The granting of these rights prohibit any other market participant to use the respective subject matter in commerce.

Differences in the characteristics of the protected subject matter may indeed play a crucial role in its applicability to financing activities. As such, trademarks can be more easily related to actual revenues generated by a specific IP right, as products are typically branded (Hsu *et al.*, 2022). To illustrate, Mathias Schumacher, an expert in business valuation at corporate advisers Duff & Phelps states that trademarks may be accepted as collateral more quickly than patents, since revenue generation "can be proven easily" (Financial Times, 2020). As such, single products may often comprise a large number of patents that can be associated with them and a large share of patents can actually not be associated with product innovation (Argente *et al.*, 2020). Still, this is not unambiguous, as the relatively more rigorous examination process of patents may enhance its strength as a positive signal about a firms abilities and future growth potential, in particular, if firms generate no substantial revenues yet. This shows that firm-level characteristics, such as size, lifecycle stage, and industries, are inherently important for explaining the applicability of IP-backed lending, especially since specific IP types are only relevant for specific firms.

A priori, it appears ambiguous to point out one specific IP right that would be best

suited for the use as loan collateral. Still, there is a set of common characteristics that are likely to raise the probability of IP rights to be used as collateral in loan agreements. First, just like any other assets, IP rights should deliver value to both the lender and the borrower (i.e., market value and private value) in order be a suitable collateral. Literature has shown that the redeployability and, thus, liquidation value of an asset is positively associated with its pledgeability, since it determines the extent to which the lender can compensate the loss given default of a loan (Benmelech and Bergman, 2009). Second, research points out that cash flows associated with firms assets are increasingly used as collateral (Lian and Ma, 2021). Third, asset valuation is important especially from a lender's perspective. It allows to identify the actual collateral value and proper valuation decreases the risk associated with collateralization. This is crucial in the context of IP rights, which are associated with a high degree of asymmetric information and uncertainty of returns (Harhoff *et al.*, 1999; Arora and Gambardella, 2010). Fourth, the private value of the collateral asset to the borrower is important, as it incentivizes repayment. This motive that may be particularly important in the context of IP rights (Heller *et al.*, 2022). To illustrate, a firm will have a strong incentive to repay debt, given that defaulting on a loan would imply, for example, the loss of the exclusive right to use a brand or company name. Summarized, the traceability of the underlying collateral value, the liquidation value for the lender, and the value of the collateral to the borrower are key characteristics that determine the pledgeability of IP rights.

3 Data and descriptive insights

3.1 Construction of the data set

We create a unique and novel dataset combining various sources on IP rights used as loan collateral, detailed patent and trademark portfolio informations, and firm-level financial data. As a key component, we rely on data from the French national IP office, INPI, containing information about key dates on the activation of the IP rights (e.g., application, registration, grant) and the use of the respective IP rights as loan collateral.[11] We retrieve the exact dates of collateralization events for all trademarks, patents, and design rights active in France since 1975. These information come with unique IP-level identifiers, which we exploit to scrape

[11] Figure IA2 (Appendix B) displays the form sheet used by INPI to collect respective information.

further details about the pledged IP rights from the INPI official webpage. For example, this allows us to determine the actual owners at the time of the pledge, other changes in the legal status of the rights, or information about third parties, such as law firms and banks. We complement this by adding detailed bibliographic information, such as renewal information or classification characteristics, on trademarks and patents retrieved from INPI and PATSTAT. By incorporating information regarding both initial and changes in ownership, we ensure that we allocate the actual owner (i.e., pledging firm) and actual bundle of IP rights to respective collateral events.

A useful feature of the INPI data is the inclusion of the so-called Siren number, a unique national identifier of French businesses provided by public authorities. The Siren number allows us to systematically identify and disambiguate the French firms of our dataset. Moreover, the Siren number provides a direct link to other sources of data, in particular, the Orbis database provided by Bureau Van Dijk (BvD), which we use as a source of firm-level, annual financial data. BvD uses the Siren for defining its own unique firm identifier. Hence, using the Siren establishes a 1:1 mapping of the French administrative data and Orbis. To ensure decent data coverage, we collect data from Orbis starting in 1995.

Our final data contains information on the IP- and firm-level spanning the years from 1995 until 2018. To avoid outliers driving our results, we winsorize all continuous variables at the one percent level. We divide this data into two separate parts: one IP-level and one firm-level data set. Table 1 displays the number of IP- and firm-level observations on the collateral event level. First, we aggregate data on the IP-event level. We remove IP-event combinations of foreign firms, individual entrepreneurs, and any other observation with no Siren identifier, resulting in 24,216 IP rights-loan event combinations of French firms between 1995-2018.[12] In total, these IP rights comprise 18,058 trademarks, 5,709 patents, and 449 design rights. Several firms in the sample use their IP rights more than once as collateral. In total, we observe French firms to pledge 16,354 distinct IP rights, corresponding to 11,838 distinct trademarks (72%), 4,186 distinct patents (26%), and 330 distinct design rights (2%).

These IP rights can be attributed to 2,876 individual collateral events, defined as a single or bundle of IP rights pledged at the same date by a given firm. In Section 4, we further

[12]In addition, we exclude information on one particular IP collateral event enacted by Alcatel Lucent in 2013 that - only in itself - including literally hundreds of patents and trademarks. This was an exceptional case, well-documented in the public press (e.g. Reuters, 2012). Plausibly, assessing data on this singular collateral event does not allow to make general claims, as it might systematically bias our results.

Table 1: Sample composition: IP collateral, loan events, and firms by types of IP rights

	IP-level sample			
	Total	Trademarks	Patents	Designs
All IP-events	29,193	20,169	8,055	592
- Foreign firms	4,240	1,614	2,404	143
- Individuals/entrepreneurs	331	125	199	0
- Missing SIREN	406	372	33	0
= IP collateral-event combinations	24,216	18,058	5,419	449
Corresponding IP rights	16,354	11,838	4,150	330
Corresponding collateral events	2,876	2,558	520	38
	Firm-level sample			
	Total	Trademarks	Patents	Designs
Collateral events	2,876	2,558	520	38
Corresponding firms	1,816	1,593	382	25
(with Orbis data)	(1,122)	(1,004)	(249)	(22)
Corresponding firm-year obs.	17,269	15,637	3,950	357

Notes: This table provides an overview on the sample composition and provides counts on the different number of IP rights event (in Panel A) and events by legal entities that use IP collateral (in Panel B) in France between 1995 and 2018. The full sample covers foreign firms, French individuals/entrepreneurs, and French firms (with or without an unambiguous SIREN identifier). The table lists the corresponding numbers of IP collateral and collateral events, distinguishing among trademarks, patents, and designs. The bottom of the Panels display the observations of the IP- and firm-level sample used in our analyses. Note that corresponding firms (and observations) do not add up to the total, since firms may pledge any combination of trademarks, patents, and designs.

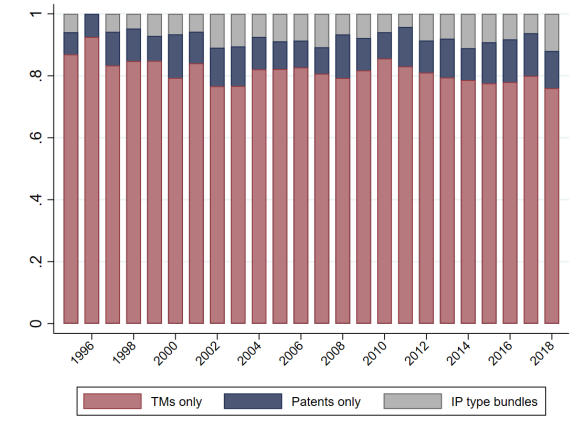
add IP-level information on non-pledged IP rights for supplementary analyses. As a second database, we collapse the IP-level data in an unbalanced firm-year panel using annual balance sheet and profit and loss data from the Orbis database. We remove any observations with zero, negative, or missing total assets. The firm-level dataset includes information on 1,816 individual French firms. For 1,122 out of these firms, we retrieve financial data from Orbis, leading to a sample size of 17,269 firm-year observations. In Section 5, we further utilize financial information on non-pledging, French firms to create a comparison group in the analyses on the effects of IP collateral events.

3.2 Descriptive evidence

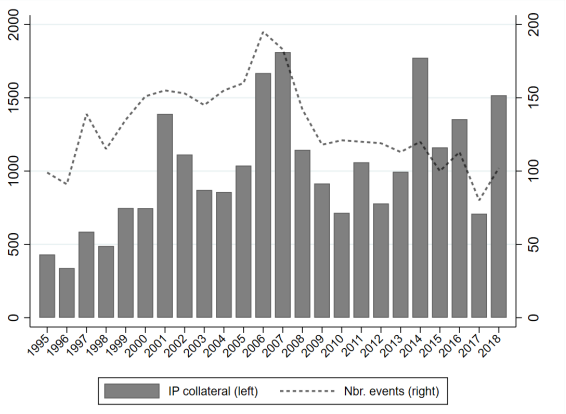
We first provide a broad set of novel descriptive insights on the use of different IP rights and the firms involved. Starting with the IP-level database, Figure 1 displays the composition of IP right types that are used as loan collateral in terms of type of IP right (Panel A) and the annual number of IP collateral events (Panel B). As illustrated in Panel A, with on average 81%, the vast majority of IP collateral events exclusively includes trademarks as loan collateral. In contrast, about 11% of collateral events exclusively rely on patents, whereas designs only pledged in bundles with other types of IP rights. Combined pledges that use at least two out of the three observed types of IP rights, resemble on average 8% of IP loans in France. These patterns are stable over time, while the share of patents slightly increases. Moreover, Panel B shows that the annual number of pledged IP rights is slightly increasing, but remains generally at a relative relatively constant rate over the observed time frame. Figure IA3 (Appendix B) shows that this pattern is consistent when distinguishing between trademarks and patents.

Figure 1: IP right collateral: composition and frequency of collateral events, by year

Panel A: Share of IP types in events



Panel B: IP collateral and event counts



As another important insight, we find that IP-pledging firms are likely to operate in complementary sectors, depending on the type of IP rights used. To show this, we focus on the three categories of IP type bundles pledged in France, i.e., trademarks only, patents only, and combinations of IP rights. First, Panel A of Figure 2 displays the five largest sectors that respective pledgees operate in, accounting for about 86% of pledging firms in our sample. Manufacturing constitutes the sector covering the largest share of IP-pledging

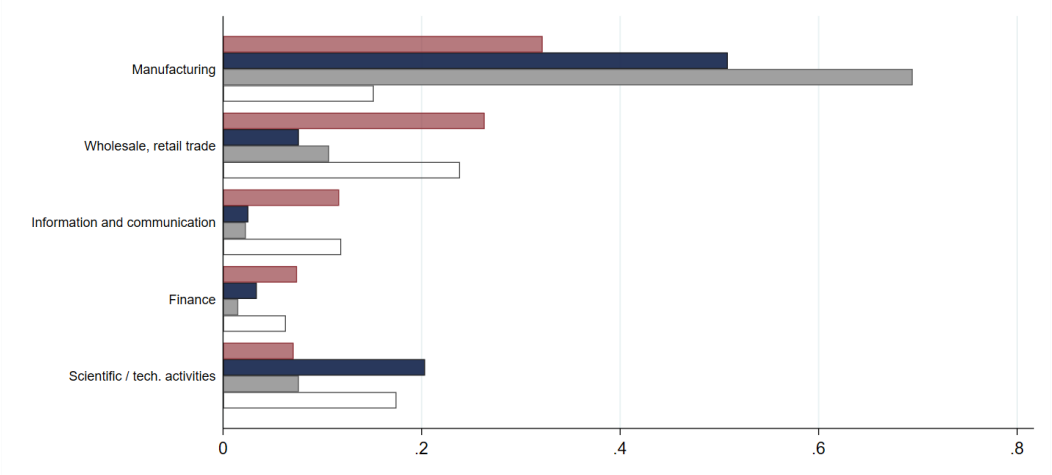
entities, including 32%, 51%, and 69% of firms that pledge trademarks, patents, or any IP right combination, respectively. Further, firms using trademarks as loan collateral rather operate in the sectors of wholesale and retrail trade (26%), information and communications (12%), and finance (7%), whereas firms that deploy patents as loan collateral rather operate in scientific and other technical services (20%). The distribution of IP-pledging firms across these main NACE categories is different of the distribution of all firms that we identify in the Orbis database and which hold at least one trademark of patent during our sample time frame (denoted as "Non-pledgee").

Next, we provide further evidence that, in particular, firms that pledge trademarks are active in complementary business fields compared to firms that use patents as loan collateral. To exemplify this, Panel B disentangles the sectoral distributions on the 2-digit level within manufacturing, which is the most frequent sector overall., manufacturing and patent pledging firms. It shows that trademark pledging manufacturers operate with 48% predominantly in food, wearing apparel, and beverages. In contrast, only 3% of patent pledging manufacturers operate in these industries. Patent pledging manufacturers rather operate in the production of machinery, equipment, computer electronics, or rubber/plastic products (45%). Mirroring the previous example, the share of trademark pledging firms is significantly lower (16%). The two sectors with the greatest overlap are manufacturing of chemical and pharmaceutical products with constitute between 17-18% for both subcategories of firms. These differences in sectoral affiliations highlights the complementary character of the two IP types. Further, these observations are consistent with the idea that IP pledging firms appear to collateralize valuable IP rights, i.e., those that are central for their business activities. Overall, we find IP pledging firm to operate in a broad range of sectors that are - in line with the underlying IP rights - complementary to one another.

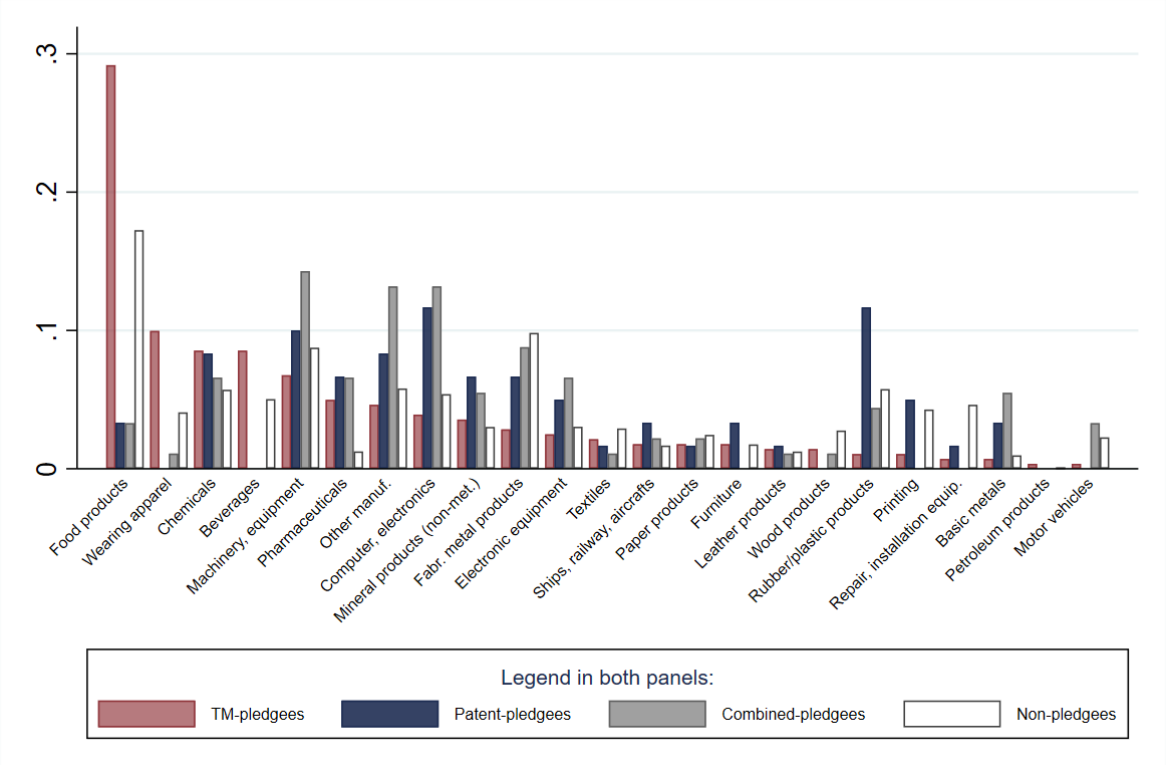
As a next set of descriptive facts, we find that IP-pledging firms constitute a fairly representative set of firms. This is important, because previous literature on patent collateral has mainly focused on large corporations (e.g., Mann, 2018) or young entrepreneurial ventures from specific sectors (e.g., Hochberg *et al.*, 2018). Table 2 displays several key attributes. First, Panel A shows that the majority of pledging entities are SMEs (79%), privately-owned, limited liability firms (58%), and not listed (95%). These patterns are relatively consistent across IP type pledgees, whereby patent-pledging firms are more frequently listed on the stock

Figure 2: Sectoral affiliations across firm types

Panel A: Top five sectors by main NACE class



Panel B: Distribution within the manufacturing sector (NACE class C)



market (10%) compared to trademark pledging firms (4%). In line with this, the median firm that uses IP rights as loan collateral has about 68 employees. Furthermore, the median IP pledging firm is fairly well-established with an age of 15 years at the time of the first IP pledge. Second, Panel B shows the geographical distribution of pledgees, distinguishing trademark- and patent-pledging firms. While firms are concentrated on major cities, there is still a large geographical dispersion across the entire country. For example, 79% of firms

are located outside of Paris, and only 29% of firms are headquartered in the departments that cover the three largest French cities, Paris, Marseille, and Lyon. Third, we show - for a subsample of the collateral events - that common, French savings banks are likely to provide the majority of IP loans in our sample.[13] Specifically, Crédit Agricole, Banque Populaire (BPCE), and Crédit Mutuel - Banque CIC are the top three providers of IP loans, providing more than 40% of all IP loans between 2015-2018. Taken together, these statistics uncover previously undisclosed insights on the use of IP rights as loan collateral: IP loans are used by a representative set of firms (i.e., small, private firms from the entire country) highlighting the broad applicability of IP-backed borrowing.

3.3 External validity

The above descriptives have shown that, in France, IP rights are predominantly used by relatively small, private, but well-established firms to secure debt. Moreover, throughout the years 1995-2018, trademarks are by far the most common type of IP right used as loan collateral. These two insights provide a new perspective on the use of IP collateral. Since the present study constitutes the first assessment on the relative use of different IP types as loan collateral, it is important to understand whether these patterns are specific to the selected institutional framework. Yet, since we specifically chose France, because of its unique legal features that allow us to retrieve all information on IP collateral from one single, administrative source, naturally the prove of external validity on the descriptive findings is hard to establish. In the following we will show, however, that the two patterns are likely to apply in other settings.

First, the fact that SMEs are the most common type of firm that use IP rights as loan collateral is likely to be true outside of France, too. SMEs are particularly bank-dependent types of firms (Berger and Udell, 2006), which make them a prime suspect to engage in these financing transactions. Since, SMEs are typically marked by high informational opacity, it appears plausible that these firms systematically under-report IP collateralization. Considering other legislative settings in which it is (at least partly) mandatory to report IP collateralization allows us for a prove of concept. As such, Bracht and Czarnitzki (2022) analyze Sweden and the Netherlands, as two specific countries which have mandatory reporting

[13] For several pledges that occur in 2015 or later, we observe the lending institution. Unfortunately, these information are not consistently documented such that we chose not to analyze them in more depth.

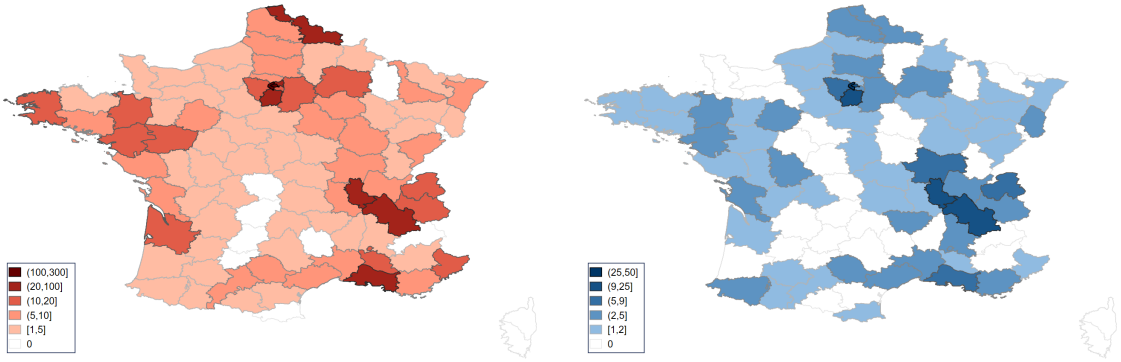
Table 2: Descriptive statistics on the parties involved in IP-backed borrowing activities

Panel A: Firm types by IP collateral types

	IP-pledging firms by type				
	All	Trademarks	Patents	Combined	Non-pledgees
SME	78.5%	80.2%	85%	61.6%	96.5%
Private LLC	57.8%	58.9%	53.4%	55.0%	79.2%
Listed firm	4.8%	3.8%	10.2%	6.1%	0.5%
Median firm age	15	15	11	18	12
Median # empl	68	58	45	170	8

Panel B: Locations of trademark- and patent-pledging firms

Trademark-pledgees: Patent-pledgees:



Panel C: Most frequently involved credit institutions

Credit institutions	Share	Cumulative
Crédit Agricole	16.7%	16.7%
Groupe BPCE	14.9%	31.6%
Crédit Mutuel	8.5%	40.1%
BNP Paribas	6.7%	46.8%
Société Générale	4.7%	51.5%

requirements for one specific type of IP rights, patents. Consistent with our analyses on a set of IP types, they find that SMEs are the main users of patents as loan collateral. For the US, despite analyzing public firms, Mann (2018) also finds that being a public corporation significantly lowers the probability to use a patent as loan collateral.

Second, we explore data from the US to show that the dominance of trademarks as the

most common type of IP right used as collateral in loan contracts is unlikely to exclusively be a French phenomenon. More specifically, we extract the USPTO transfer database and select changes in the legal status of trademarks and patents that are likely to correspond to IP collateral events. Registration of IP collateral events in the US are incomplete and likely to suffer from reporting biases (e.g., Jacobs, 2011; Graham *et al.*, 2018), but still, the USPTO collects data on both trademarks and patents used as loan collateral. Using data for 2000-2020, shows a very similar pattern to the one observed in our analyses. Specifically, in 2018, with 67% the share of trademarks among these two IP types is far exceeding the share of patents. This number is very similar to the 76% observed for France in the same year.[14] As illustrated in Figure IA4 (Appendix B), this pattern is consistent over time. Taken together, the aforementioned aspects mitigate concerns regarding the external validity of the key observed patterns in Section 3.2.

4 IP characteristics as determinants of pledgeability

4.1 Potential determinants of IP pledgeability

In general, collateralization of any asset should positively depend on the collateral value, form the perspective of both, the lender and the borrower. As such, previous literature on patent collateral has shown that more valuable patents have a higher likelihood to be used as loan collateral compared to relatively less valuable patents (e.g. Mann, 2018; Caviggioli *et al.*, 2020). In this section, we first outline the different ways to measure IP right values in order to empirically test the relation of value indicators to both trademarks and patents. On the one hand, this serves as a plausibility check, as more valuable IP rights principally should have a higher probability of being pledged. On the other hand, it is a priori not clear which value dimensions are most relevant. Further, this assessment provides first evidence on trademark characteristics that relate to the probability of being used as loan collateral.

Importantly, only the minority of firms actually pledges their entire portfolio of IP rights. As such, 76% of firms that use their trademarks as collateral do not pledge all trademarks that they own at the time they sign the loan agreement. Similarly, 64% of patent-pledging firms do not use their entire patent portfolio as for securing debt. These observations are

[14] This difference may reflect the fact that share of patenting-intensive sectors to GDP is significantly higher in the US (22%) as compared to France (13%), as illustrated in Figure IA1 (Appendix B).

important for several reasons. First, the fact that firms deliberately chose specific IP rights indicates that the underlying characteristics of IP rights indeed matter for collateralization. Second, it suggests that the use of IP rights as loan collateral is unlikely to merely serve as an add-on asset. Third, large "fire-sale"-type pledges, such as blanket liens which are not allowed by French law (see Section 2.1) typically involve the entire IP portfolio of firms. To illustrate, in 2013, the French-American telecommunication giant Alcatel-Lucent reportedly used large parts of their patent portfolio securing a rescue loan to avoid bankruptcy (Reuters, 2012). However, since in our sample specific IP rights are pledged, it suggests that pledging IP rights cannot be directly associated with these emergency situations.

Against this background, we analyze the specific characteristics of trademarks and patents as determinant for the probability of being used as loan collateral. Existing literature provides us with a rich set of quality- and value-related observable features of IP rights. Consistent with prior literature on patent characteristics as determinant for patent pledgeability (e.g., Caviggioli *et al.*, 2020), we presume that measures of IP quality and value are relevant as determinants of IP rights in general.

More specifically, we consider several underlying characteristics as relevant, all of which relate to asset redeployability and value to the lender or the private value to the borrower, i.e., the IP owner. On the one hand, the liquidation value of collateral is important for the lender, increasing the expected residual value of a loan in case of default. Relatedly, higher valuation capability should lower uncertainty about the expected residual value. On the other hand, the private value of IP for its owner should play a central role in borrower-lender relationships. As such, higher private value may serve as a credible signal of borrower's willingness to repay the debt to the lender.[15] Table 3 summarizes IP characteristics which we describe and investigate in the subsequent analyses.[16]

4.2 Characteristics of collateralized trademarks

For trademarks, to the best of our knowledge, existing literature has not identified specific characteristics that apply as determinants for its use as loan collateral. Yet, Block *et al.* (2014) show that financial markets observe trademark characteristics and evaluate them.

[15] We acknowledge that these categories rather help to conceptualize the different dimensions. We do not propose that these categories are mutually exclusive, nor do we argue that the categories are not interrelated.

[16] Along with all variables used in this study, Table IA2 (Appendix A) lists and defines all IP-related variables described in this section.

Table 3: Measuring pledgeability criteria for trademarks and patents

		Quantification (variables)	
Pledgeability criteria	Measurement concepts	Trademarks	Patents
Private value	Use in commerce	- Renewals - Voluntary register entries as indication of use	- Patent age - International family, family size
Market value	Redeployability, valuation capability	- Renewals - TM breadth (NICE classes) - Previous transactions, externally acquired - TM-product link	- Patent age - Patent scope (IPC classes) - Backward references - Patent grant - Number of applicants
	Non-monetary value	- Corporate mark - Brand-awareness mark	- Technological quality, forward citations

We thus lay out several trademark value indicators as potential determinants for trademark pledgeability. These indicators are relevant - for both borrowers and lenders - in terms of redeployability, valuation capabilities, and the use in commerce - and thus consistent with previous studies on collateral (e.g., Benmelech and Bergman, 2009).

As a key indicator, trademark renewals relate to several of these categories: The protection of a trademark has to renewed every ten years after the initial registration by payment of a small fee; importantly, this is conditional on the trademark still fulfilling the registration requirements of distinctiveness and used in commerce (Nasirov, 2020). Thus renewals serve as a measure for the use in commerce but should also relate to other concepts such as the market value (see, Krasnikov *et al.*, 2009) and the valuation capacity, since a longer track record of a mark should be more easily related to product-specific generated revenues (*Renewal*). As another indicator of the use in commerce, we extract information on any type of adjustment to the legal status of a trademark inferred to from the INPI data, such as change in address of the owner, legal oppositions, or licensing agreements ($IndicationUse$). These register entries provide a good indication on whether the trademark is in use (Sandner and Block, 2011). Yet, we acknowledge that several of these information are not subject to mandatory registration in France and thus are likely to entail biases.

Furthermore, we follow the literature and consider trademark breadth as indicators of the owner's valuation of the trademark. Trademarks are classified in so-called NICE classes, which denote categories of goods or services in which the respective mark is used. The number of NICE classes is commonly referred to as trademark breadth (e.g., Sandner and

Block, 2011). A higher trademark breadth is found to reflect diversification strategies that promote the exploitation of the exclusive right, reflecting a greater value to its owner (Cabral, 2000; Block *et al.*, 2014; Graham *et al.*, 2018; Nasirov, 2020). Additionally, we exploit the fact that INPI data covers transfers of trademarks. This previous transaction is likely to indicate a market price, which again eases the valuation of the mark and also indicates redeployability ($Transfered$).

We also consider two indicators that relate more directly to the valuation capabilities. Trademark classes can be broadly divided into product- or service-related marks. Product-related IP rights can better be linked to generated revenues (see Block *et al.*, 2015). Hence, we consider service trademarks to have weak valuation capabilities as compared to product trademarks ($ServiceMark$).

Finally, we consider generic trademark types to capture the importance of non-monetary values as potential determinants for trademark pledgeability. In France, trademarks can cover a range of aspects, including plain texts, images, but also sounds or scents. As one specific type of trademark, corporate trademarks represent the firm that stands behind the products or services branded by the mark (Sandner, 2009). Since corporate trademarks are intuitively more rare compared to other types of marks, literature finds them to be more valuable to their owners (Agostini *et al.*, 2015). Similar to Agostini *et al.* (2015), we measure corporate trademarks by a string matching between the legal name of a firm and the text of a trademark ($CorporateMark$). Second, we also consider so-called awareness brands as an alternative trademark type. Awareness trademarks convey the meaning of brands to the customers. Krasnikov *et al.* (2009) shows that the stock of awareness trademarks formed by a firm during the previous period significantly is negatively associated with different firm value indicators. Hence, we assume a negative relationship between awareness trademarks and the probability of the trademark to be used as loan collateral. We follow previous literature and flag all trademarks as brand-awareness marks ($AwarenessMark$) if they contain figurative elements only (Nasirov, 2020).[17] Panel A of Table IA3 (Appendix A) displays descriptive statistics on the trademark-related determinants of pledgeability.

In Table 4, we show that more valuable trademarks, both on the market and for its

[17]To illustrate, the trademark "NIKE" would be a corporate trademark of the American sportswear designer and retailer Nike Inc., whereas the famous logo of the company (the Swoosh) would be a awareness trademark.

owner, higher redeployability, and higher valuation capability indeed increase the chances of trademarks to be pledged as collateral. We establish this using trademark-level fixed-effect logit estimations, where the outcome variable is an indicator for an individual trademark ever being pledged as collateral. Across specifications, we deploy registration-year fixed-effects to account for general patterns across time. In Column I, we use the full sample of trademarks that were valid in France at any point between 1995 and 2018 and deploy all value-related variables as regressors. Estimates show that pledged trademarks are more often renewed, are more likely to be used in commerce, are more often transfered, have a higher trademark breadth, and are less likely to be a service trademark.

Table 4: Logit estimations on the determinants of TM collateral

Dep. variable	I(Collateral)				
	I	II	III	IV	V
Renewal	0.824***	0.500***	0.507***	0.952***	0.949***
	(0.013)	(0.019)	(0.019)	(0.104)	(0.103)
log_NiceClasses	0.116***	0.204***	0.128**	0.381***	0.236
	(0.019)	(0.021)	(0.056)	(0.075)	(0.151)
IndicationUse	0.457***	0.367***	0.332***	-0.133	-0.153
	(0.034)	(0.036)	(0.036)	(0.195)	(0.195)
Transfered	0.809***	0.516***	0.502***	-0.087	-0.089
	(0.022)	(0.023)	(0.023)	(0.157)	(0.154)
ServiceMark	-0.988***	-0.882***	-0.575***	-0.056	-0.155
	(0.037)	(0.052)	(0.061)	(0.140)	(0.153)
CorporateMark				1.458***	1.457***
				(0.238)	(0.243)
AwarenessMark				-0.334**	-0.339**
				(0.147)	(0.150)
Sample TMs:	All	Renewed		Pledgee-owned	
Fixed-effects:					
Registration-year	yes	yes	yes	yes	yes
Industry class (NICE)	no	no	yes	no	yes
Firm-event	no	no	no	yes	yes
N	2,307,035	473,065	473,065	69,236	69,236

Notes: The table displays logit regression estimates explaining whether a trademark is pledged in a loan agreement. The dependent variable is an indicator equal to one if a trademark is used as loan collateral. The regressions contain different trademark-level characteristics, outlined in Section 4.2. Column I uses the sample of all trademarks that are active in France between 1995-2018. Columns II and III use a similar sample but exclude trademarks that are never renewed. This includes trademarks registered after 2010. Columns IV and V contain only trademarks that are owned by a trademark-pledging firm at the time of the initial collateral event. Within samples, the specifications use different sets of fixed-effects as indicated in the bottom of the table. The constant is included but not reported. Robust standard errors are displayed in parentheses below coefficients. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

Next, we show that these characteristics are relevant when screening out low quality trademarks. This is important, because literature on IP rights has shown that value distributions are highly skewed with many IP rights having rather little or no value (e.g., Harhoff *et al.*, 1999; Arora and Gambardella, 2010). To account for this, we repeat the first specification but exclude all trademarks that are never renewed. Accounting for this, does not systematically affect the estimates (see Column II). In Column III we additionally include industry-fixed effects to account for heterogeneous pattern across sectors. Again, the results remain comparable.

In Columns III and IV, we assess variation in trademark characteristics within trademark-pledging entities trademark portfolio using conditional logit regressions. We thus consider the trademarks owned by pledging firms at the time of the pledge. Regressions are similar to before but include firm-event fixed-effects. They allow to capture for unobserved characteristics of the pledging firm, of the bank and of the deal, and hence absorb a large share of spurious correlations.

There are four main findings. First, the patterns for renewals and trademark breadth are similar to previous results, suggesting that even within firm trademark portfolio these value indicators are important determinants for the likelihood of trademarks to be pledged. Second, the coefficients on variables that related to previous use in commerce turn negative, but are statistically not significant. This suggests that the use in commerce is a firm-specific determinant for trademark pledges; in other words, firms that actively trade or use their trademark are more likely to use (any of their) trademarks for collateralization. Third, the coefficient for service marks turns insignificant, which likely implying, again, it is a firm-specific factor that product- and not service-related firms use (any of their) trademarks for collateralization. Fourth, we find that specific trademark types determine its use as loan collateral. To study this, we include indicators for corporate and awareness trademarks. In line with literature on the value relevance of the trademark types, we find that firms that chose specific trademarks out of their portfolio as loan collateral are much more likely to chose corporate trademarks, whereas awareness trademarks are less likely to be used. Taken together all of the above insights show that specific firm- and industry-characteristics affect pledgeability. Moreover, firms appear to strategically select certain trademarks for collateralization.

4.3 Characteristics of collateralized patents

We also study the characteristics of French patents used as loan collateral. Unlike with trademarks, relevant determinants for the pledgeability of patents are well documented in the literature (e.g., Caviggioli *et al.*, 2020). Based on common determinants, we suggest several patent measures that are likely to relate to the use of patents as loan collateral. Panel B of Table IA3 (Appendix A) displays descriptive statistics on the these determinants.

Most commonly, studies use the number of patent citations received as a measure of the technological value of a patent (*#FwdCits*), which is found to positively relate to debt financing (Mann, 2018; Caviggioli *et al.*, 2020; Farre-Mensa *et al.*, 2020). We propose that the economic value of a patent rather than its technological value may influence its redeployability, and is thus a key determinant of collateralization. We use the family size of patents (i.e. seeking protection in more jurisdictions) as a measure of market value (*FamilySize*), which is commonly applied in the patent literature (Harhoff *et al.*, 2003). Larger patent families imply higher associated costs and also indicate that the patent is relevant for many markets, both of which reflects higher economic value of a patent. In order for our results to be independent from the specific measurement approach, we include several other patent quality indicators commonly used in the patent literature, such as the number of backward citations (*#BwdCits_pat*) and the number of co-inventors (*#Inventors*) on a patent (e.g. Roach and Cohen, 2013; Kuhn *et al.*, 2020). Moreover, we also consider several variables that affect the ability to assess patent value. We use three patenting measure that should negatively relate to the valuation capabilities: (non-patent) backward citations from scientific sources (*#BwdCits_nopat*), patent breadth measured by and the number of technology classes, so-called IPC classes (*#IPC4Classes*), and the number of applicants (*#Applicants*).[18]

Finally, patent age (*PatentAge*) and the grant status (*Granted*) are two distinct patent characteristics that should relate to patent pledgeability. First, similar to trademarks, patent age should mirror its use and thus value. Patent owners need to actively prolong patent protection on an annual basis by paying maintenance fees that increase over the patent lifespan. Only valuable patents are thus maintained over a long period, implying that patent age positively relates to firms' debt capacities (Gill and Heller, 2022). Second, IP can be

[18] French law specifically prohibits the pledge of co-owned trademarks, so-called community marks. However, there is no law prohibiting the use of co-owned patents as collateral.

used as collateral irrespective of whether it is officially granted or registered – an observation confirmed in our data. However, patent grants mitigate uncertainty associated with the exclusive right to use a patent (Lemley and Shapiro, 2005; Hegde and Luo, 2018). Hence, the legal certainty conferred by granted IP rights is positively associated with collateralization.

We start by comparing the characteristics of pledged patents to French patents owned by French companies. To ensure the best comparison between pledged and non-pledged assets, the dataset focuses on patents filed via the national route and applied for by French companies. Columns I and II of Table 5 present the results of logistic regressions, at the patent-level. The dependent variable is a dummy indicator indicating whether the focal patent has been used as collateral. To compare with previous literature, the regression reported in Column I only includes the number of forward citations together with filing year fixed-effects, and technology sector fixed effects. Our results for French patents are similar to the ones found for US patents, and reveal that patents receiving more citations are more likely to be pledged. The estimation reported in Column II includes the full set of quality indicators as explanatory variables. Patents receiving more citations are still significantly more likely to be collateralized but the coefficient is more than halved when including other quality indicators, compared to Column I. Patents with larger family size, with more inventors, and more patent references are more likely to be pledged. In contrary, the number of non-patent references, IPC classes, co-inventors relates negatively to patents pledgeability, which confirms the notion that these measures relate negatively to the ability of valuing patents.

Next, we compare the features of pledged and non-pledged patents owned by the sub-sample of patent pledging firms. We construct the patent portfolio of firms at the points in time when the patent pledges took place.[19] Table 5 (Columns III to VI) presents the results of conditional logistic regression, which are similar to estimations from Columns I and II but include IP collateral event fixed-effects – equivalent to Table 4. In Column III, we again include the number of received citations as a single regressor. Our results confirm that more cited patents are more likely to be collateralized. In Column IV, we add the other patent

[19]To compute patent portfolios at the time of the IP collateral event, we make use of patent application data shared by INPI and retrieve patents that were applied for by these firms. We are grateful to Carole Pesenti and Franck Dazin for kindly providing us with this data. We complement our data using information on changes of ownership, and hence account for patents sold and acquired by pledging firms, as well as with renewal and lapse information extracted from PATSTAT – Autumn 2021 edition.

Table 5: Conditional logit estimations on the determinants of patent collateral

Dep. variable	I(Collateral)					
	I	II	III	IV	V	VI
#FwdCits, log	0.382***	0.182***	0.188***	0.071		0.047
	(0.018)	(0.024)	(0.051)	(0.054)		(0.051)
FamilySize, log		0.397***		0.302***		0.304***
		(0.024)		(0.089)		(0.091)
#Applicants, log		-1.608***		-2.367***		-2.362**
		(0.227)		(0.693)		(0.768)
#Inventors, log		0.185***		-0.012		0.012
		(0.054)		(0.164)		(0.169)
#BwdCits_pat, log		0.310***		-0.042		-0.035
		(0.040)		(0.131)		(0.121)
#BwdCits_nopat , log		-0.240***		-0.142		-0.088
		(0.054)		(0.139)		(0.157)
#IPC4Classes, log		-0.282***		-0.066		-0.068
		(0.048)		(0.095)		(0.104)
PatentAge					0.287*	0.258*
					(0.114)	(0.125)
Granted					1.586***	1.570***
					(0.253)	(0.269)
Sample patents:	All		Pledgee-owned			
Fixed-effects:						
Filing-year	yes	yes	yes	yes	yes	yes
Technology sector	yes	yes	yes	yes	yes	yes
Firm-event	no	no	yes	yes	yes	yes
N	316,442	316,442	8,082	8,082	8,082	8,082

Notes: The estimation method is a conditional logistic regression. The dependent variable is *I(Collateral)*, a dummy variable indicating whether the corresponding patent is used as loan collateral in the focal event. All variables are specified in Table IA2 (Appendix A). Robust standard errors are clustered at the firm level. If not indicated otherwise, all regressions contain event and filing year fixed-effects. Constant is included but not reported. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

quality measures. Patents with equivalents in more jurisdictions as measured by the family size are more likely to be collateralized. Interestingly, including the patent family size as a regressor causes the coefficient associated with forward citations to turn insignificant. While larger patent families imply higher economic value of a patent forward citations can also, to some extent, capture the economic value of a patent (Hall *et al.*, 2005). However, citations mostly proxy for patents' technological value (Carpenter *et al.*, 1981; Harhoff *et al.*, 2003), which appears to influence its redeployability to a lesser extent than the economic value

of a patent. The coefficients associated with backward citations to patent and non-patent literature, and number of IPC-classes are not statistically significant. Patents with several applicants, which generates administrative complexity offer the associated rights, are less likely to be collateralized.

In Columns V and VI, we investigate the relationship between age, grant, and the likelihood of pledge. We find that granted patents are more likely to be collateralized. This result is in line with the idea that the legal certainty conferred by granted IP rights is positively associated with collateralization. Next, holding the grant information constant, older patents are more likely to be collateralized than younger assets. Finally, we include all quality indicators as regressors in Column VI. Previous results remain unchanged.

Taken together, the above results show that IP rights pledged as loan collateral are more valuable and more likely to be redeployable. This illustrates the consistency of the French IP data, since our results mirror previous findings on the determinants of patent pledgeability in the US. Importantly, we find that IP-pledging entities select distinct IP rights within their portfolio. This emphasizes that IP rights are likely to be an important aspect in respective loan agreements: Borrowers would plausibly not chose specific assets if the collateral quality was of second order relevance.

5 Empirical evidence on pledging firms

5.1 Methodology: Matching approach and model specifications

Generating non-pledging comparison firms and descriptive statistics: We now turn to the firm-level implications of IP collateral events by studying the relationship between IP-collateralization and firms' use of debt as well as other subsequent economic activities. As our main approach, we construct a comparison group of non-pledging firms, which has similar observable characteristics. This accounts for the observed differences between pledging and non-pledging firms documented in Section 3.2 and allows us to deploy a difference-in-difference approach to compare changes in firm-level outcomes after the collateral event. For this, we explicitly consider only the first IP collateral event per firm.

We match firms based on both time-variant and time-invariant firm characteristics observed prior to the initial IP collateral event. We use a combination of exact matching and

Coarsened Exact Matching (CEM).[20] First, we perform an exact match on the industry affiliation, legal type (private versus public corporation), age, and IP ownership (trademarks, patents, or both). Further, we match firms based on whether they have had loans prior to the pledge or not. Second, we match firms using CEM based on their capital structure, firm size, and asset tangibility, all of which are found to be determinants of firms financing behavior (see Frank and Goyal, 2003). Third, CEM assigns firms into groups with similar characteristics, creating an imbalance in the group size of the IP-pledging firms and non-pledging counterparts. We therefore keep the closest matching partner in each strata. For robustness, we show that omitting the last step, does not significantly affect the results. Our matching procedure yields a matched sample containing 1,028 firms from France, resulting in 19,971 firm-year observations for 1995 until 2018. Table Figure IA4 (Appendix A) shows that there are no statistically significant differences in means for several observable firm characteristics comparing pledging and matched non-pledging firms.

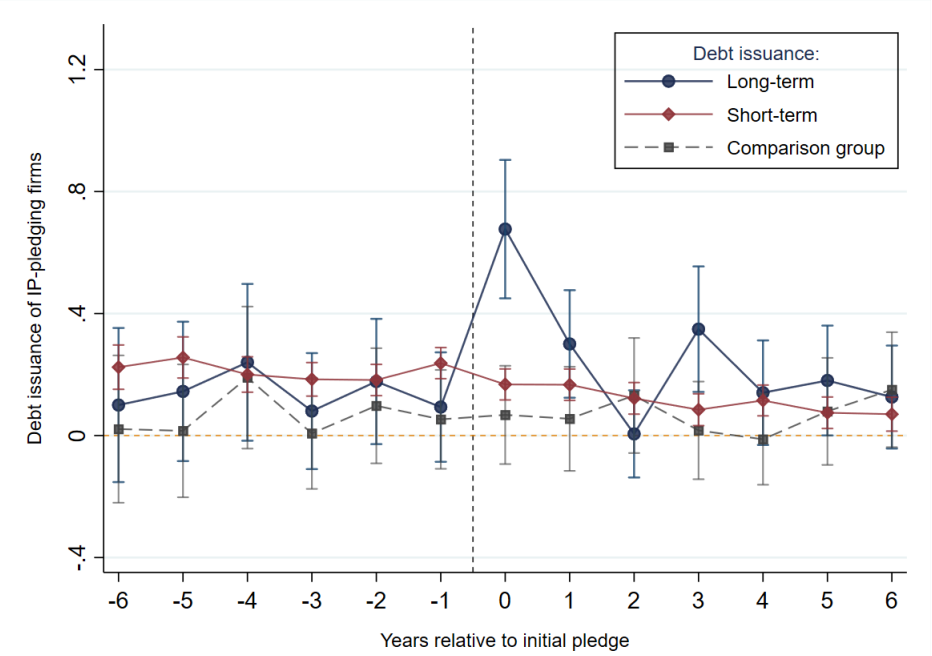
Next we show that IP collateral events are associated with economically significant increases in the use of long-term debt by pledging firms. Specifically, Figure 3 illustrates the average debt-growth rates the six-year time window around for both IP-pledging firms and the matched comparison group. It shows that the long-term debt growth rates spikes in the year of the collateral event, being significantly higher than in any other year of the observed time frame. Further, the short-term debt growth rates are not affected by the collateral event and remain relatively constant. This observation is in line with previous studies showing that patent activities and, in particular, patent pledges are associated with increases in long-term debt-ratios (Mann, 2018; Gill and Heller, 2022). Confirming our matching approach, the debt growth rates of the comparison group remain constant during the year of the collateral event. To quantify these observations in terms of long-term debt-ratios; on average, the debt-ratios of pledging firms increases by 2.15 percentage points (40%) from 5.41 to 7.56% (t-value: 2.94), comparing the year prior to the collateral event with the year of the event. In contrast, there is no statistically significant change in debt ratios for non-pledging firms.[21]

Econometric specification: The matching approach provides us with a well-suited setting

[20] To avoid reverse-causality issues, we match firms based on observed variables in the years prior to the first IP collateral event. Again, all variables are specified in Table IA2 (in Appendix A).

[21] For illustration, Figure IA5 (Appendix B) plots the average long-term debt ratios of pledging firms and the comparison group around the time of the initial IP collateral event of the pledging firm.

Figure 3: IP pledges and debt-issuance



Notes: The figure plots mean values of debt issuance relative to the year of the initial IP collateral event (t=0). Long-term and short-term refer to the year-to-year growth rate in long-term debt ($DebtIssuance$) and short-term debt ($ShortDebtIssuance$) of IP pledging firms. Comparison group refers to the year-to-year growth rate in long-term debt of the matched comparison group. All variables are defined in Table IA2 (Appendix A). Whiskers span the 95 confidence intervals.

to conduct a stacked difference-in-difference (DID) type analyses with two-way fixed-effects. More specifically, we estimate regressions using the year before the initial IP collateral event of each matched pair as a reference point, which splits the time periods relative to this point in time into a pre- and post-pledge period. Using this, we estimate the effect of the IP collateral event on different firm-level outcomes using a symmetrical time window of six years around the IP pledge without binning observations at the borders of the sample. Further, our matching approach yields equally sized groups of IP pledging and non-pledging firms. Following recent literature in empirical corporate finance, these aspect make it very unlikely that our estimation approach would be prone to issues arising from two-way fixed-effect DID estimations with staggered treatments (see Baker *et al.*, 2022). In all estimations, we cluster standard errors at the firm level. Our baseline specification thus reads as:

$$Y_{it} = \alpha_{sj} + \alpha_i + \alpha_t + \phi X_{it} + \beta(IP_i \times Post_{it}) + u_{it} \quad , \tag{1}$$

where Y_{it} is value of the outcome variable of firm i in year t relative to the initial IP col-

lateral event (in $t = 0$); In the main specifications, Y equals the the long-term debt ratio ($LongTermDebt$). X_{it} is a vector of firm-level control variables (i.e., firm size, profitability, tangibility, liquidity, cash flow); IP_i is a dummy variable, which is equal to one for firms that use their IP as loan collateral and zero otherwise; $Post_{it}$ is a firm-pair specific indicator, which equals one for pairs of firms (pledging and matched counterpart) in all years after the first collateral event of the pledging firm. α_{sj} denote industry-calender year fixed effects that account for aggregate economic fluctuations, α_i are firm fixed-effects controlling for time-invariant firm-specific features, and α_t are (stacked) panel year fixed-effects capturing unobserved factors associated with the relative timing to the initial collateral event. This set of fixed-effects in combination with our matched sample, controls for industry, time, and firm size effects, which allows us to control for demand effects (see Degryse *et al.*, 2019). u_{it} is the idiosyncratic error term.

The parameter of interest in Equation 1 is β, which captures the change in debt-ratios at the time of the IP collateral event relative to firms in the comparison group that do not obtain a loan. While it seems intuitive that $\beta > 0$, this is a priori not clear. As such, in the case that firms extend their outstanding debt but add IP as loan collateral, the coefficient would be zero. Alternatively, if the collateral event was to occur in the context of reorganization or liquidation processes (i.e., to serve as measure of last resort) as documented in anecdotal evidence, this effect may even be negative. Importantly, this estimation also allows us to assess heterogeneity in the effects across IP-pledging firms.

5.2 IP collateralization and firms' use of debt

Table 6 shows the change in the long-term debt ratio for IP-pledging firms after their initial IP collateral events and relative to a matched comparison group. In Column I, we estimate DID regression similar to the one defined in Equation (1), but without fixed-effects. The coefficients $Post$ and IP are statistically not significant (Column I) suggesting no differences in debt use between IP pledging firms and their matched counterparts before the IP pledge. Most importantly, the interaction on the interaction $Post \times IP$ is positive and statistically significant on the one percent level. Column II estimates our baseline specification from Equation (1). The coefficient of interest is again large, positive, and highly significant. The coefficient (0.033) suggests an economically significant increase of debt-ratios for the average

IP-pledging firm of about 61% relative to the comparison group after the treatment. The single components of the interaction term are dropped because of perfect multicollinearity.

Table 6: High dimensional fixed-effect regressions explaining firms' use of debt

Dep. variable	*LongTermDebt*						
	I	II	III	IV	V	VI	VII
IP × Post	0.027***	0.033***	0.023***	0.034***	0.030***	0.044***	0.029***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.013)	(0.006)
Post	-0.001						
	(0.004)						
IP	0.006						
	(0.005)						
$IP^{pat.}$ × Post							0.018
							(0.015)
Constant	-0.008	-0.048	0.025	-0.050	-0.072	0.156	-0.047
	(0.023)	(0.057)	(0.056)	(0.058)	(0.056)	(0.140)	(0.057)
Sample:	Full	Full	Zero loans pre-pledge	Excl. crises years	Trademark pledgee	Patent pledgee	Full
Additional controls:							
Firm-level	yes	yes	yes	yes	yes	yes	yes
Industry FE	yes	no	no	no	no	no	no
Industry-Year FE	no	yes	yes	yes	yes	yes	yes
Panel-Year FE	no	yes	yes	yes	yes	yes	yes
Firm FE	no	yes	yes	yes	yes	yes	yes
R^2	0.064	0.479	0.351	0.492	0.485	0.511	0.480
N	10,856	10,856	6,317	9,077	9,947	2,187	10,856

Notes: The table displays estimates from fixed effect-regressions similar as specified in Equation (1); all variables are specified accordingly. The dependent variable is firms' long-term debt to asset ratio (*LongTermDebt*). The sample is truncated to a symmetric time window of six years around the initial pledge of IP-pledging firms and the corresponding years for their counterfactual in the comparison group. Column I estimates Equation (1) but omits any fixed-effects. Hence, the base variables of the interaction term ($Post \times IP$) are not omitted in this specification. Columns II-VI include multi-leveled fixed-effects in accordance to Equation (1). Column II uses the full matched sample; Column III uses only those firms which had zero loans outstanding in the year prior to the initial collateral event; Column IV excludes years of recession, i.e., those with declining GDP growth and a growth rate of less than 1% (2003, 2008, 2009). The next two columns distinguish collateral events that include trademarks (Column V) or patents (Column VI), respectively. Note that these two categories are not mutually exclusive. Column VII adds is similar to Column II but adds an interaction term $IP^{pat.} \times Post$, capturing any additional effects of patent pledge ($IP^{pat.}$) on *LongTermDebt*. Standard errors (in parentheses below coefficients) are clustered at the firm level. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

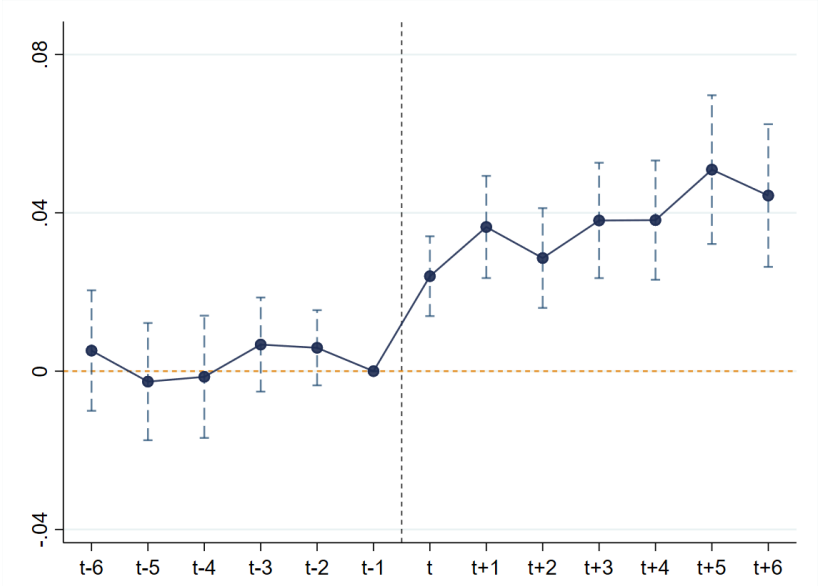
Repeating the baseline regression from Column II for different subsets reveals further important details. First, Column III uses only those firms that did not have any long-term debt outstanding at the end of the year prior to the initial IP collateral pledge. The coefficient of interest is slightly smaller but remains highly significant. This suggest that IP pledges do not only affect debt ratios when credit lines are extended but also helps firms to tap new debt financing. Second, Column IV excludes years during which France suffered from economic slowdowns (i.e., 2003, 2008, and 2009). The coefficient of interest is again

very similar to the baseline estimation. Given that we already account for macroeconomic fluctuations by including industry-year fixed-effects, this reassures that IP loans do not only provide benefits under certain economic (and thus lending-) conditions. Third, the last two columns distinguish between IP pledges that include trademarks (Column V) and those that include patents (Column VI). Both coefficients are large, positive, and highly significant. Since the coefficient on the patent-pledging sample is larger (0.044) than the one of the trademark pledging sample (0.030) in nominal terms, we test as a last step, whether this difference is statistically significant. In Column VII, we therefore repeat the baseline estimation from Column II but include an additional interaction term, indicating the additional effect of patent pledges (relative to trademark pledges), $IP^{\text{pat.}} \times Post$. The coefficient on this estimator is positive but insignificant, illustrating that the baseline results are not driven by one specific IP type.

To assess the timing of the effects in more detail, we study the pledge effect in an event-study type approach. We decompose the pledge-indicator into $Post_{it}^{S}$ and Pre_{it}^{S}, which are equal to one for all observations in S years after (Post) and prior to (Pre) the IP collateral event, where $S = [0, 6]$ ($S =$ [-6,-2]), such that the last year prior to the IP collateral event is the reference time period. Figure 4 plots the year-dummy variables interacted with the indicator IP_i and displays the regression equation. The graph confirms the baseline estimations in that there is a positive shift in the use of long-term debt by IP pledging firms in the year of the pledge. Moreover, the insignificant and small coefficients during the pre-pledge period suggest that IP pledging firms and their non-pledging counterparts move in parallel trends prior to IP collateral event. Hence, the patterns of debt financing of IP pledging firms and the comparison group move in parallel trends prior to the initial collateral event, while significantly deviating afterwards. In fact, the positive effect on firms' use of long-term debt is persistent over the medium term. Panel A of Figure IA6 (Appendix B), shows that these effects are comparable for both types of IP pledges.

To illustrate that the above estimations do not depend on the exact specification of the matching approach, we show that the estimations from Table 6 are robust to omitting the last step of the matching procedure in which we condition the comparison group to only consist of the closest neighbor of the pledging firm (see Table IA5, Appendix A). Further, Panel B of Figure IA6 (Appendix B) plots coefficients of event-study regression designs equivalent to

Figure 4: Event-study regression design: baseline effect of IP pledges on debt financing



Notes: The graph plots coefficients of event-study type regressions that explain the effect of IP colltaral events on the use of debt financing of pledging firm relative to a comparison group and over time. Specifically, the graph plots β-coefficients from the following estimation equation: $LongTermDebt_{it} = \alpha_t + \gamma_i + \phi X_{it} + \sum_{S=-6}^{-2} \beta_1^S (IP_i \times Pre_{it}^S) + \sum_{S=0}^{6} \beta_2^S (IP_i \times Post_{it}^S) + u_{it}$, where all variables are defined as in the baseline regression from Equation (1). Only here, the *Post*-dummy indicating the years after the initial IP collateral event is split into individual regressors, each of which are dummy variables that indicate the relative year (t) prior to (Pre_{it}^S) and after ($Post_{it}^S$) the initial pledge. The year before the initial pledge ($t = -1$) serves as the reference year. Standard errors are clustered at the firm level. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

Figure but using the alternative definition of the comparison group. Overall, our analyses thoroughly document the positive effect of IP pledges on firms' use of debt. To the best of our knowledge, we are first to show these effects using different IP types as loan collateral, i.e., both patents and trademarks.

5.3 The role of alternative collateral in IP loan contracts

Despite the high detail and informational value of our data, it does not allow us to disentangle whether IP-pledging firms add alternative collateral to the investigated loan events. To control for differences in other forms of collateral, the matched sample regressions include time varying controls for asset tangibility, which is often used for measuring the availability of collateral in corporate finance literature (see, Frank and Goyal, 2003; Benmelech and Bergman, 2009). In general, IP-pledging firms typically hold very little tangible assets (e.g., with a median tangibility-ratio of 5.5%). Furthermore, descriptive statistics in Section 4 show that the vast majority of IP pledging firms does not pledge their entire IP portfolio,

suggesting that the inclusion of IP rights is indeed a conscious and, thus, meaningful decision of the firm.

To mitigate remaining concerns on the role of IP rights in loan contracts, i.e., to show that IP rights serve an important function to secure a debt financing, we conduct a series of additional tests which analyze the role of alternative sources of collateral that firms deploy in addition to IP rights. In particular, we investigate alternative collateral in the form of tangible assets in multiple steps.[22] Table 7 contains estimations that repeat our baseline analyses using different model specifications.

High- and low-tangibility: First, we show that having very low levels of tangible assets does not rule out the positive effects of IP pledges on firms' use of debt but results in very similar estimates as in the baseline setting. Column I estimates the baseline regression for the subsample of firms with a tangible fixed-assets-to-total asset ratio in the bottom half, bottom tercile, and bottom decile, respectively. Across specifications, the coefficients are positive, sizable, and significant, ranging between 0.024 and 0.036. Only for the lower percentiles the estimates become less precise in terms of statistical significance, which might be related to the smaller sample sizes.

Second, we show that IP pledges have similar effects when comparing high and low availability of tangibles. Specifically, in Column IV, we first estimate the baseline regression on the subsample with above median levels of tangible assets. Results are very similar to before. To assess this in greater detail, we repeat the baseline specification on the full sample but add a triple interaction term $IP \times Post \times Tan^{\text{high}}$ in Columns V and VI. In Column V, Tan^{high} is equal to one if a firm (or its matched comparison group partner) has above median levels of tangible assets. The triple interaction term thus captures the additional effect of high tangibility on the IP pledging firm. The coefficient on this interaction term is small and insignificant indicating no disproportional effect of IP pledges on these firms' debt ratios. For robustness, in Column VI, Tan^{high} is a continuous variable of asset tangibility, measured in the year prior the IP collateral event. Again, the coefficient on the triple interaction is insignificant. In sum, these estimates strongly suggest that the baseline results are

[22] Studying tangible assets is beneficial not only because literature commonly uses variables based on tangible assets as measure for firms' collateral, but also since tangible assets are a standard balance sheet item and thus available for all of our sample firms. We measure relative availability of tangible assets by firms level of fixed assets-to-total-assets ratios in the year prior to the IP collateral event.

Table 7: The role of alternative collateral available at the time of IP collateral events

Dep. variable	*LongTermDebt*					
	I	II	III	IV	V	VI
IP × Post	0.033***	0.024**	0.036*	0.031***	0.034***	0.030***
	(0.008)	(0.010)	(0.020)	(0.008)	(0.008)	(0.008)
Post × Tan^{high}					0.003	0.029
					(0.007)	(0.029)
IP × Post × Tan^{high}					-0.002	0.021
					(0.011)	(0.047)
Constant	-0.077	-0.093	-0.095	-0.001	-0.049	-0.051
	(0.063	(0.085)	(0.098)	(0.106)	(0.057)	(0.057)
Sample: Tangibility	$< P50$	$< P33$	$< P10$	$> P50$	all	all
Tan^{high} definition:	-	-	-	-	binary	continuous
Additional controls:						
Firm-level	yes	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes	yes
Panel-Year FE	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes
R^2	0.491	0.520	0.534	0.491	0.480	0.480
N	5,294	3,377	893	5,551	10,856	10,856

Notes: The table displays estimates from fixed effect-regressions explaining firms' use of debt. The specifications estimate Equation (1) but are run separately on split samples, distinguishing different firms by the level of collateral available when pledging IP as collateral. Columns I-IV use the subsample of firms with a tangible fixed-assets-to-total asset ratio in the bottom half, bottom tercile, bottom decile, and top half respectively. Column V is run on the full sample but adds two variables: i) a triple interaction term $IP \times Post \times Tan^{\text{high}}$ in which Tan^{high} is equal to one if a firm has above median levels of i assets and zero otherwise and ii) the base value of $Post \times Tan^{\text{high}}$. The level variables are dropped because of perfect multicollinearity due to the inclusion of the fixed-effects. Column VI repeats Column V but here Tan^{high} is a time-invariant, continuous measure, of firms' fixed asset ratio. In all specifications, asset ratios are measured in the year prior to the collateral event. All regressions include controls equivalent to those specified before; for consistency, only the first four columns do not additionally control for asset tangibility. Standard errors (in parentheses below coefficients) are clustered at the firm level. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

not sensitive to the specific levels of available alternative collateral, thus supporting the idea that the IP rights are an important component in the collateral provided by IP-pledging firms.

The Ordonnance: As a next step, we exploit exogenous variation in the collateral value of tangible assets to explore its implications for IP loan contracts in more detail. More specifically, we assess the *Ordonnance 2006-346*, a major legislative amendment in France that significantly enlarged the number assets that firms could pledge in loan agreements, particularly hard movable assets, such as machinery and equipment. The change in law and its implications on firm-level debt financing are well-documented in Aretz *et al.* (2020). The

authors show that the 2006 change in law provided firms with new opportunities to pledge assets in credit transactions, significantly raising the ability to pledge tangible fixed assets.

Overall, this setting provides an ideal testing ground for our previous results. In particular, the Ordonnance is relevant in our context, because it can help us to causally disentangle the importance of other forms of collateral in IP loan contracts. Since the change in law significantly raised the potential of fixed tangible assets to be used as loan collateral, we can formulate two competing hypothesis to test the importance of IP collateral in IP-backed loans. First, we hypothesize that IP rights do not play a first order role in the transactions in which they are used as loan collateral, once our baseline results are driven by pledges in the period after the implementation of the Ordonnance in 2006. Second, we hypothesize that tangible-rich, IP-pledging firms disproportionally change their debt financing after 2006, if IP collateral is not a key feature in IP-backed loans.

To test this, we again distinguish firms with high and low stakes of alternative collateral in the year prior to the initial IP pledge. As a helpful feature, our analysis is based on the same data source for firm-level financials (Orbis) as used in data sample used by Aretz *et al.* (2020). We distinguish IP collateral events that took place *before* and *after* the implementation of the Ordonnance in 2006. For consistency, we follow Aretz *et al.* (2020) by using observations for the years 2001 until 2009 and distinguishing among firms with a fixed assets-to-total assets ratio in the top quartile of the pre-pledge distribution and those below ("treated" versus "control" firms). In particular, we estimate variants of the following fixed-effect regression specification:

$$\begin{aligned} LongTermDebt_{it} &= \alpha_{sj} + \alpha_i + \alpha_t + \phi X_{it} + \delta(IP_i \times Post_{it}) + \\ &\quad \delta'(IP_i \times Post_{it} \times Ordonnance_i^{Post}) + \delta''(Post_{it} \times Ordonnance_i^{Post}) + \varepsilon_{it} \quad , \end{aligned} \tag{2}$$

which is similar to Equation 1 but includes the interaction of the DID-estimator with a post-Ordonnance indicator ($IP_i \times Post_{it} \times Ordonnance_i^{Post}$) and the interaction term of the base variables ($Post_{it} \times Ordonnance_i^{Post}$). $Ordonnance_i^{Post}$ is a dummy equal to one for firms (and their matched partner from the comparison group) whose first IP collateral event is after the adoption of the Ordonnance in France in 2006 and zero otherwise. The remaining base variables are captured by the inclusion of fixed-effects.

The three coefficients of interest capture i) the baseline effect of IP collateral events on the long-term debt ratio of IP-pledging firms (δ), ii) the additional effect of these IP pledges after the adoption of the Ordonnance in 2006 (δ'), and the general effect of the Ordonnance on firms' long-term debt to asset ratios (δ''). By estimating Equation (2) on different subsamples, these coefficients allow us to assess the causal effect of fixed tangible assets, i.e. alternative collateral, in the context of IP collateral events. More specifically, we estimate this specification for the full sample and separately for firms with high and low shares of tangible assets, i.e., treated and control group firms as defined in Aretz *et al.* (2020).

Table 8 summarizes the main results. In Column I, we reestimate the baseline regression from Equation (1) to confirm that restricting the timeframe to 2001-2009 does not affect our baseline results on IP pledges. The DID estimator is significant, positive, and comparable in magnitude to our baseline estimation (0.038 versus 0.033). More importantly, estimates in Column II show that the inclusion of the two additional interaction terms in Equation (2) results in very similar estimates compared to the baseline with respect to the sign, size, and significance of the DID estimator. Moreover, the insignificant coefficient of the triple interaction, δ', shows that the baseline effect is *not* more pronounced for IP pledges that occurred after the implementation of the Ordonnance. Similarly, the coefficient δ'' is insignificant. Taken together, these results show that the average firm in the matched sample does not adjust their debt financing in response to the implementation of the Ordonnance. This is in line, with Aretz *et al.* (2020) who show that the Ordonnance was only relevant for firms with an abundant stock of fixed assets, since the average firm in the matched sample holds only few tangible assets. Central for our analysis, the result reject the first hypothesis formulated, mitigating concerns that IP rights do not play a first order role in the transactions in which they are used as loan collateral .

To test the second hypothesis, we investigate differential effects of the Ordonnance on firms that should have been affected by the adoption of the change in law, i.e., firms with high asset tangibility. Column III uses the subsample of firms outside the top quartile of the tangible asset distribution. Results are very similar to those in Column II, and thus, confirm our previous results. Column IV repeats the previous estimation for the subsample of firms with a fixed assets-to-total assets ratio in the top quartile of the pre-pledge distribution. The DID estimator is again positive remains unchanged in terms of size, while it is less precisely

Table 8: IP collateral events with increased alternative collateral available: The Ordonnance

Dep. variable	*LongTermDebt*				
	I	II	III	IV	V
IP × Post	0.038***	0.030***	0.035***	0.029*	0.031***
	(0.008)	(0.010)	(0.011)	(0.016)	(0.012)
IP × Post × $\text{Ordonnance}^{\text{Post}}$		0.023	0.026	-0.003	0.029
		(0.018)	(0.021)	(0.032)	(0.021)
Post × $\text{Ordonnance}^{\text{Post}}$		0.012	0.010	0.040*	0.002
		(0.015)	(0.018)	(0.023)	(0.018)
Post × Tan^{high}					-0.008
					(0.012)
IP × Post × Tan^{high}					-0.003
					(0.021)
Post × $\text{Ordonnance}^{\text{Post}}$ × Tan^{high}					0.045**
					(0.020)
IP × Post × $\text{Ordonnance}^{\text{Post}}$ × Tan^{high}					-0.039
					(0.039)
Constant	-0.093	-0.093	-0.098	-0.043	-0.093
	(0.081)	(0.081)	(0.085)	(0.179)	(0.081)
Sample: Tangibility	Full	Full	<P75	>P75	Full
Additional controls:					
Firm-level	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes
Panel-Year FE	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes
R^2	0.431	0.432	0.444	0.483	0.433
N	5,288	5,288	3,766	1,512	5,288

Notes: The table displays estimates from fixed effect-regressions explaining firms' use. The sample is all matched firms from the main part during the years 2001 until 2009. Column I repeats the baseline specification (Equation 1 and Column II in Table 6) for this sample. Columns II-IV estimate Equation (2) for different subsamples. Column II uses the full sample; Column III uses firms with a fixed assets-to-total assets ratio in the bottom three quartiles in the year prior to the IP pledge. Column IV uses firms that with a fixed assets-to-total assets ratio in the top quartile in respective years. Column V repeats the Column II but adds interactions with Tan^{high}, an indicator as defined in Aretz *et al.* (2020) and equal to one for all firms with a fixed assets-to-total assets ratio in the top quartile and zero otherwise. All regressions include controls equivalent to those specified before. Standard errors (in parentheses below coefficients) are clustered at the firm level. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

estimated but significant at the ten percent level.The coefficient on the triple interaction term is small and insignificant, which shows that the positive effect of IP-pledges does not change after the implementation the Ordonnance, even for firms with the relatively largest stock of tangible assets. In contrast to before, here the coefficient of the interaction term $Post_{it} \times Ordonnance_i^{post}$ is large positive and significant at the 10 percent level. This finding is important as it confirms the finding of Aretz *et al.* (2020), who show that tangible-rich firm

benefit from the Ordonnance leading to increased use of debt. For robustness, we confirm this finding in Column V. Here we uses the full sample and interacts all terms with an indicator ($> P75$) that is equal to one for firms in the top quartile of the tangibility distribution, i.e., firms that should be affected by the Ordonnance. Our results show that these results apply for all firms (and not only for IP-pledging firms) and thus are independent from IP collateral events. For robustness, we repeat the estimation on the subsample of firms that should not be treated by the Ordonnance. In sum, these findings allow us to reject the second hypothesis and emphasize that alternative collateral is unlikely to drive our main results.

In sum, the above results show that the Ordonnance did not affect the magnitude to which IP loans enhance the debt capacity of IP-pledging firms. Consistent with recent evidence on the legal amendment, we find that the change in law affected firms, conditional on having high levels of tangible assets but irrespective of the IP collateral events. These results are crucial, since they emphasize the importance of IP rights as loan collateral for firms. Moreover, the results mitigate concerns that IP rights may just serve as add-on collateral. Tangible assets, as one prominent form of alternative collateral, is unlikely to be a decisive factor for our baseline results.

5.4 Implications - Real effects of IP-backed borrowing

Previous results suggest a strong positive effect of IP collateral events on the debt-ratios of the average IP-pledging firm. As another important aspect, we want to understand what type of firms particularly benefit form pledging their IP and what are the implications thereof.

We start by showing that effects are homogeneous across several important dimensions. In particular, the effect of IP pledges on the use of debt is fairly homogeneous across sectors and the geographic locations of firms. To show this, Panel A of Figure IA7 (Appendix B) plots the DID estimators (β in Equation 1) estimated for subsample of firms in high-tech, all tech, high-tech knowledge-intensive (KIS), all KIS, and other sectors. Coefficients in KIS-sectors are larger, whereas the coefficient of other sectors is smallest. Even though these differences are not very large, they may still suggest that firms benefit most, if IP rights are likely to relate to their core business strategy, as it is the case in high-tech sectors. Regarding the geographical location, the homogeneity of the baseline effects applies even clearer. Panel B of Figure IA7 displays DID estimators for subsamples of firms located in the three largest

French cities (Paris, Lyon, and Marseille - all of which have at least one million inhabitants), the Greater Paris area, or in none of the two. The coefficients are very similar across these subsamples. In sum, these analyses support the notion on the broad applicability of using IP rights as loan collateral.

Next, we show firm-specific dimensions along which IP collateral events have heterogeneous effects on firms' use of debt. Figure 5 plots coefficients of the DID estimator obtained from split sample regressions distinguishing among different firm-level categories. In Panel A, the sample is split according to different firm size categories. Following the common definition of micro, small, and medium-sized firms, the first categories comprise firms with less than 50, 50 to 100, and 101 to 250 employees. All coefficients are in magnitude similar to our baseline estimate (0.033) and statistically significant at the one percent level. This underlines that IP collateral events have strong positive effects on the debt capacity of SMEs. This is different for larger firms. For firms with 251 to 1,000 and those large corporates with more than 1,000 employees, the DID estimators are smaller and estimated less precise, such that coefficients are insignificant. Hence, on average IP collateral pledges of large firms is not positive, which is in line with previously discussed anecdotal evidence, which showed that large corporates, which typically have other (cheaper) ways to obtained external financing, pledge IP rights when they face economic hardship, as illustrated by the case of Alcatel-Lucent. Taken together, these findings are consistent with the idea that debt is a more relevant source of financing and that SMEs are more dependent on monetizing their IP rights as compared to larger firms (Freixas and Rochet, 2008; De Rassenfosse, 2012). Further, the results highlight the potential of IP to help these firms to attract debt.

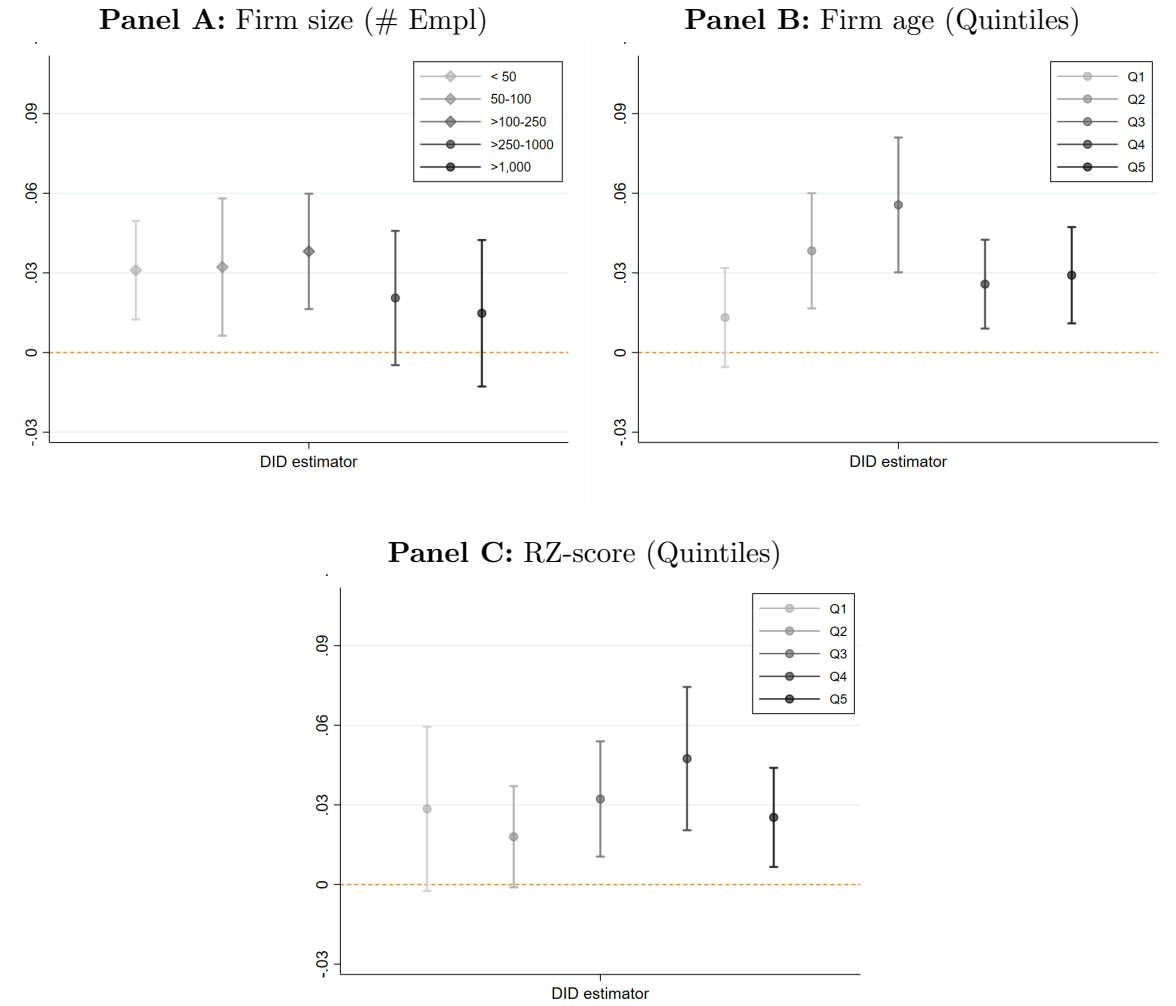
Panel B of Figure 5 shows differential effects according to firm age. To study this, we split the firm age distribution into quintiles and estimate the baseline regression for these subsets separately. As discussed in Section 3.2, with 15 years of age, the median IP-pledging firm is well-established. The pattern in Panel B shows an inverted U-shape in the size of the effect of IP collateral pledges on firms debt and firm age. For firms in the bottom quintile of the age distribution the DID estimators are positive but insignificant. For firms in the two two quintiles of the age distribution, the DID estimators are positive, but relatively small and weakly significant. In contrast, for firms in the second and third quintile, corresponding to an age of 12-28 years, the effects are largest. These effects are consistent with several

propositions discussed in this paper. First, it is plausible that the use of IP collateral is more feasible, once firms have already established a track-record that helps both borrowers and lenders to approximate the returns associated with specific IP rights, which helps to understand why the coefficient of very young firms is insignificant. At the same time, older firms may have already access to other non-bank sources of financing.

Firm age and size are considered to be key determinants of financing constraints (Hadlock and Pierce, 2010), suggesting that more constrained (i.e., smaller and younger) firms benefit disproportionally from IP collateral pledges. Further, Section 5.3 has shown that firms with fewer alternative collateral are largely benefiting from IP collateralization, which again is a feature of firms that are typically considered as being financially constraint (Benmelech and Bergman, 2009; Norden and van Kampen, 2013). To confirm this notion, we further assess heterogeneity with respect to firms' ex ante dependence on external financing. We measure dependence on external finance using the RZ score as proposed by Rajan and Zingales (1998), relating the capital expenses to the cash flows within a year. Higher RZ-scores imply that capital expenses exceed generated cash flows, that is, a higher dependence on external financing. Consistent with before, we split the sample into quintiles along the RZ-score of firms measured in the year prior to the IP collateral pledge. As illustrated in Panel C of Figure 5, across the distribution all coefficients of the DID estimators are positive. However, in the bottom two quintiles of the distribution, the coefficients are not significant at the ten percent level. This is different to the subsamples with higher ex ante RZ scores, which are significant at the one percent level. Again, these estimates suggest that IP collateralization particularly helps financially constrained firms and those more dependent on external financing to increase their debt financing. Overall, these findings are in line with literature on the importance of collateral for attracting external financing and, in particular, emphasize the strategic importance of IP collateral for intangible-rich firms with limited access to financing.

As a final step, we provide suggestive evidence that the increased use of debt associated with IP collateral events has real economic implications. To this end, we first assess year-to-year asset growth mean values of both IP pledging and comparison group firms. Notably, we distinguish IP pledging firms according to whether they raise their debt ratios after the

Figure 5: Differential effects of of IP pledges across firm-types



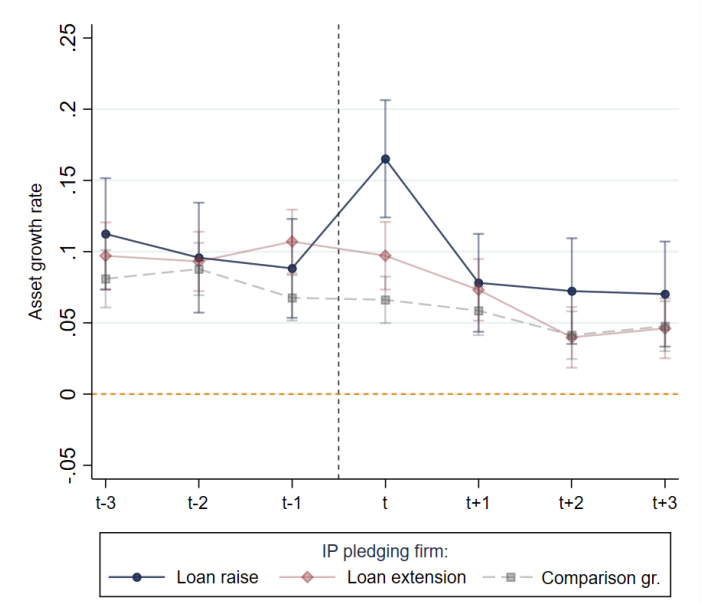
Notes: The figures plot DID estimator of the baseline regressions estimated for different subsamples. Subsamples are created based on three firm-level categories: size (measured as the number of employees), age (splitting the age distribution into quintiles), and dependence on external finance (splitting the RZ-score distribution into quintiles); all of which are measured in the year prior to the initial IP collateral event. The RZ-score is defined in Rajan and Zingales (1998) measuring the wedge between total capital expenditures and total net cash flow in the year before its first IP collateral event (or of its counterfactual firm). All variables are defined in Table IA2. In all panels, whiskers span the 90 percent confidence intervals.

IP collateral event or not.[23] Figure 6 plots mean values for these three categories of firms and shows that IP pledging firms which raise their debt financing exhibit significantly higher growth rates in the year of the IP collateral event in a six year time window. In contrast,

[23]Specifically, we consider firms to raise their debt financing if they either increase long-term debt holdings from zero to a positive number of debt exceeding 2% of assets (the mean increase in debt, see Section 5.1) or if they hold long-term debt prior to the IP collateral event and increase their debt holdings by at least 20%. We keep these thresholds to conservatively flag firms that increase their debt holdings. For robustness we check several combinations of these thresholds, which does not significantly affect the main conclusions drawn from this part of the analysis. IP-pledging firms that did not raise their debt financing are considered to renew existing levels of debt.

this pattern is not observable for IP pledging firms which do not extend debt levels and non-IP-pledging firms from the comparison group. This could be interpreted such that IP loans that raise debt levels are deployed to finance firm-level growth.

Figure 6: Asset growth rates relative to the pledge event



Note: This figure plots average values of firm-level year-to-year asset growth rates, *AssetGrowth* as defined in Table IA2 (Appendix A. It distinguishes firms that pledged IP collateral and increased their debt ratios ("loan raise") as well as those that did not increase their debt ratios ("loan renewal") and the matched control group of non-IP pledging firms ("comparison group"). Whiskers span the 95 percent confidence intervals.

To assess this in more detail, we reestimate the baseline regression but use three alternative dependent variables as measures for firm size, that is total assets, total sales, and the number of employees (each measured in logs). Again, we distinguish IP pledging firms by whether their raise additional debt financing or whether they do not enhance their use of debt. Table 9 plots DID estimators from estimating Equation (1) for respective subsamples. Results are consistent across the firm size measures and show large positive and statistically significant growth effects of IP collateral events on IP pledging firms, conditional on raising additional debt financing. As such, for IP pledging firms that did not enhance their use of debt, the DID coefficients are also positive but much smaller and partly lack significance. Taken together, these findings show that firms which significantly raise debt in IP collateral events are associated with an significantly high asset growth rates in the year of the pledge, which translate to larger growth in terms of firm size and employment in the subsequent years, relative to the comparison group.

Table 9: Estimates relating IP pledge to firm growth, sales, and employment

Dep. variable	Log (assets)		Log (sales)		Log (employees)	
	I	II	III	IV	V	VI
IP × Post	0.231**	0.085*	0.435**	0.136	0.231**	0.019
	(0.084)	(0.051)	(0.204)	(0.145)	(0.110)	(0.145)
IP collateral raising/renewing debt:	Raising	Renewing	Raising	Renewing	Raising	Renewing
Additional controls:						
Firm-level	yes	yes	yes	yes	yes	yes
Industry-Year FE	yes	no	yes	no	yes	no
Panel-Year FE	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes
R^2	0.941	0.947	0.752	0.751	0.890	0.922
N	3,096	7,728	3,096	7,728	2,120	5,661

Notes: The table displays estimates of Equations (1) using a set of dependent variables related to firm-level growth, namely total assets (Columns I and II), total sales (Columns III-IV), and the number of employees (Columns V-VI) measured using the natural logarithm. Further regressions are estimated for IP pledging firms which significantly raise their debt financing in the IP collateral event (Columns I, III, and V) and those that do not extend their debt financing (Columns II, IV, and VI). Standard errors (in parentheses below coefficients) are clustered at the firm level. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

6 Conclusion

Over the past decades, firm value has shifted towards intangible capital. In such a context, exploring intangibles for financing purposes seems appropriate. Even more so, the use of intangibles in external debt financing is needed. As such, the rise of intangibles can be attributed to a secular decline in commercial bank lending, suggesting that the reliance on tangible assets as collateral in firm-bank relationships is hitting its limits (see Dell'Ariccia *et al.*, 2021). Covered by legally conferred rights, using intellectual property as loan collateral could be one solution for intangible-rich, bank-dependent firms.

This study provides a comprehensive picture on the use of IP rights as collateral in loan contracts and thereby discloses several novel facts about IP collateralization. The French legal setting allows us to generate a unique dataset on the use of trademarks, patents, and designs as loan collateral. We exploit this data to addresses the fundamental questions: What different types of IP are used as loan collateral, what determines their use as collateral, and what are the implications of IP loans on a firm level.

Our analysis carves out important descriptive facts that redraw the conventional view of the use of IP rights as loan collateral. With 81%, the vast majority of IP-backed loans in France between 1995 and 2018 exclusively include trademarks. Further, with 79%, well-

established SMEs are by far the most common type of firms that use IP rights as collateral. Prior literature on IP-backed loans has hardly addressed these two dimensions, i.e., trademarks and small firms. Our descriptive results underline the relevance of IP collateralization for a wide range of firms.

Furthermore, IP pledges significantly increase firms' debt capacities. Relative to firms with comparable observable features, IP-pledges increase firms' use of debt by on average 61% (3.3 percentage points). Importantly, we show that it is indeed IP rights that are important part of firms pledged collateral. First, IP-backed loans mostly contain specific subsets from firms' IP portfolios. In particular, the redeployability, valuation capacity, but also the private value of the IP to its owner are determinants for IP pledgeability. Second, we utilize plausibly exogenous variation in the value of alternative, tangible collateral arising from the adoption of a major legislative change, the *Ordonnance 2006-346*, to analyze the role of IP in loan contracts that contain IP as collateral. The overall effect of IP pledges is not affected by changes in the availability of alternative collateral, highlighting the importance of the pledged IP rights. Finally, we provide evidence that IP pledges can be associated with increased growth and employment for firms that use IP-backed loans to raise their use of debt. In sum our results shed light on previously undisclosed dimensions of debt financing and emphasize the large economic potential of IP pledges, especially for financially constrained, intangible-rich, and small firms.

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Internet Appendix A : Tables

Table IA1 : Definition of IP rights: Trademarks, patents, and designs

IP right	**Trademark**	**Patent**	**Design**
Subject matter	Disinct signs that distinguish companies (i.e., brands, words, drawings, and/or symbols)	Technical invention	Aesthetic creative forms and non-functional product features
Conferred rights	Exclusive right to use the trademark and prevent use for similar goods/services	Exclusive right to make, use, and sell the patented invention	Exclusive right to use the design
Requirement	Distinctiveness, use in commerce	Novelty, material, non-obviousness, industrial application	Similar to patents (lower threshold)
Protection length	10 years	1 year	1 year
Max. protection	indefinite	20 years	25 years
Maintenance/ activation costs	low	high	high
Benefits	Promotes quality and competition; information provider	Incentive to innovate; Knowledge protection and diffusion	Provides means for product differentiation

Notes: The table defines the three most common IP right types, i.e., trademarks, patents, and designs. For comparison, uniformly applicable definition criteria are displayed, such as the object which is subject to protection, the basic requirements that need to be fulfilled to obtain the right, the actual procedural steps needed for activation, the protection length without renewals after grant, the maximum protection length, and a qualitative assessment of the average costs to activate and maintain the IP right. These definitions comprise IP rights filed and registered in Europe, i.e., at the EPO, EUIPO, or national IP offices. Most features also apply in other main IP jurisdictions, such as the US, Japan, or Korea.

Table IA2: List of variables

Main regressors:	
IP	Dummy = 1 if firm pledges an IP right at any point in time and zero for matched comparison group firms
Post	Dummy = 1 for any firm-specific year t after the initial IP collateral event (within matched strata) and zero otherwise
$Post^S$	Dummy = 1 for any firm-specific year S ($\in$ [1,6]) after the initial IP collateral event (within matched strata) and zero otherwise
Pre^S	Dummy = 1 for any firm-specific year S ($\in$ [-6,-1]) before the initial IP collateral event (within matched strata) and zero otherwise
$IP^{pat.}$	Dummy = 1 if firm pledges a patent at any point in time and zero for matched comparison group firms
$Ordonnance^{Post}$	Dummy = 1 for firms (and their matched partner) whose first IP collateral event is in 2006 or later and zero otherwise
Firm-level variables (Orbis `code`):	
SME	Dummy = 1 for firms with less than 250 employees (`empl`), and a maxiumum turnover (`turn`) of 50 million Euro or a maxiumum balance sheet total (`toas`) of 43 million Euro.
Private LLC	Dummy = 1 for with `Standardised_legal_form` equal to "Private limited companies" and zero otherwise.
Listed firm	Dummy = 1 for firms listed on the stock market (`Listed`="Listed") and zero otherwise.
FirmAge	Time (full years) since incorporation date (`Date_of_incorporation`) and the balance sheet reporting date (`Closing_date`)
TotalDebt	Total liabilities (`culi`+`ncli`) divided by total assets (`toas`)
*LongTermDebt**	Long-term debt (`ltdb`) divided by total assets (`toas`)
DebtIssuance	Year-to-year growth in long-term debt (`D.ltdb`/`L.ltdb`)
ShortTermDebt	Total short-term debt (`loan`+`cred`) divided by total assets (`toas`)
ShortDebtIssuance	Year-to-year short-term debt growth (*D.ShortTermDebt*/*L.ShortTermDebt*)
*FirmSize***	Logarithm of total assets (`toas`)
*Profitability***	Return on assets; earnings before interest and taxes (`ebit`) divided by total assets (`toas`)
*Tangibility***	Share of fixed tangible assets (`tfas`) over total assets (`toas`)
*CashFlow***	Total cash flow (`cf`) scaled by total assets (`toas`)
*CurrentRatio***	Liquidity risk; total current assets (`cuas`) over current liabilities (`culi`)
RZscore	The wedge between capital expenditures (`exp_mat`) and firms' cash flows (`cf`) measured as `exp_mat-cf`)/`cf`.

(*Continued on next page*)

Table IA2: List of variables (*continued*)

# Empl	Number of employees at end of period (`empl`)
AssetGrowth	Year-to-year growth in total assets (`D.toas/L.toas`)
Tan^{high}	Dummy = 1 for firms with high levels of *Tangibility*; with varying thresholds as defined in the text and indicated with P*threshold*.
*Log (sales)**	Logarithm of total sales (`sale`)
*Log (employees)**	Logarithm of the number of employees at end of period (`empl`)

IP-level variables:

*I(Collateral)**	Dummy = 1, if IP right is pledged as loan collateral

Trademark-specific variables:

Renewal	Count of trademark renewals (due every 10 years)
# NiceClasses	Trademark-breadth; Count of different registered trademark classes
Transfered	Dummy = 1, if trademark is transfered prior to its first use as collateral
IndicationUse	Dummy = 1, if there are any notes in the trademark file listed as legal change prior to its first use as collateral
ServiceMark	Dummy = 1, if mark is registered in any of the services classes (NICE 35-45)
AwarenessMark	Dummy = 1, if trademark includes a figurative element
CorporateMark	Dummy = 1, if trademark represents the company name

Patent-specific variables:

#FwdCits	Number of forward citations received by a patent
FamilySize	Number of jurisdictions a patent is active in
#Applicants	Number of applicants in the patent filing (i.e., patent owners)
#Inventors	Number of different inventors in the patent application
#BwdCits_pat	Number of backward citatations made to patent literature
#BwdCits_nopat	Number of backward citatations made to non-patent literature
#IPC4Classes	Count of different main patent IPC technology classes (4-digit level)
PatentAge	Count of patent renewals (due every year); years the patent has been active
Granted	Dummy = 1, if patent is (already) granted

Notes: The table lists and defines all variables used in this paper. * indicate variables used as dependent variables and ** indicate firm-level controls that are included in all regressions (unless explicitly stated otherwise). Firm-level variables are obtained from ORBIS; IP-level data is obtained from INPI and PATSTAT.

Table IA3: Descriptive statistics on the characteristics of IP rights

Panel A: Trademark characteristics

Variable	min.	max.	Mean		Difference
			Pledged	Not-pledged	
Renewal	0	3	1.136	0.293	0.843***
#NiceClasses	1	45	2.996	2.843	0.154***
Transfered	0	1	0.106	0.031	0.075***
IndicationUse	0	1	0.419	0.117	0.302***
ServiceMark	0	1	0.069	0.238	-0.169***
AwarenessMark	0	1	0.018	0.048	-0.030***
CorporateMark	0	1	0.031	0.020	0.011***

*$(p < 0.10)$, **$(p < 0.05)$, ***$(p < 0.01)$

	P5	P25	P50	P75	P95	Mean
Size of the TM portfolio	1	3	8	25	140	36.733
Share of pledged TMs	0.0189	0.1111	.3868	0.9211	1	0.4696

Panel B: Patent characteristics

Variable	min.	max.	Mean		Difference
			Pledged	Not-pledged	
#FwdCits	0	237	10.624	8.437	2.187***
PatentAge	0	20	5.371	6.195	-0.824***
Granted	0	1	0.670	0.789	-0.119***
FamilySize	1	59	5.046	5.341	-0.295***
#Applicants	1	5	1.075	1.018	0.057***
#BwdCits_pat	0	20	3.889	4.298	-0.409***
#BwdCits_nopat	0	30	0.779	0.384	0.395***
#IPC4Classes	1	11	1.908	1.658	0.250***

*$(p < 0.10)$, **$(p < 0.05)$, ***$(p < 0.01)$

	P5	P25	P50	P75	P95	Mean
Size of the patent portfolio	1	2	6	14	78	27.301
Share of pledged patents	0.0556	0.3334	0.7500	1	1	0.6536

Table IA4: Comparison of sample means for pleading and comparison group firms

	Mean			
	IP-pledging firm	Matched firm	Differences in means	*t-values*
FirmSize	16.649	16.521	0.128	(1.068)
FirmAge	23.427	24.454	-1.027	(-1.086)
TotalDebt	0.663	0.647	0.016	(0.641)
LongTermDebt	0.054	0.052	0.002	(0.251)
Tangibility	0.109	0.116	-0.007	(-0.768)
Profitability	0.081	0.084	0.003	(0.324)
CurrentRatio	1.916	2.015	-0.099	(-0.427)
CashFlow	0.055	0.065	-0.011	(-1.136)

Notes: This table displays statistics on observable key financial variables using the matched sample described in Section 5.1. It compares mean values, distinguishing IP-pledging firms with the firms from the matched comparison group, and differences in means. The corresponding t-values are displayed in parentheses in the last column. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

Table IA5: Baseline regression using alternative specification of the comparison group

Dep. variable	Long-term debt-ratio					
	I	II	III	IV	V	VI
IP × Post	0.029*** (0.005)	0.027*** (0.005)	0.017** (0.005)	0.028*** (0.005)	0.027*** (0.005)	0.038*** (0.011)
Post	-0.002*** (0.001)					
IP	0.007* (0.004)					
Constant	0.032*** (0.004)	-0.083*** (0.014)	-0.055*** (0.015)	-0.071*** (0.015)	-0.086*** (0.014)	0.055 (0.050)
Sample:	Full	Full	Zero loans pre-pledge	Excl. crises years	Trademark pledgee	Patent pledgee
Additional controls:						
Firm-level	yes	yes	yes	yes	yes	yes
Industry FE	yes	no	no	no	no	no
Industry-Year FE	no	yes	yes	yes	yes	yes
Panel-Year FE	no	yes	yes	yes	yes	yes
Firm FE	no	yes	yes	yes	yes	yes
R^2	0.048	0.486	0.283	0.505	0.489	0.427
N	277,933	277,933	166,004	236,128	266,793	21,065

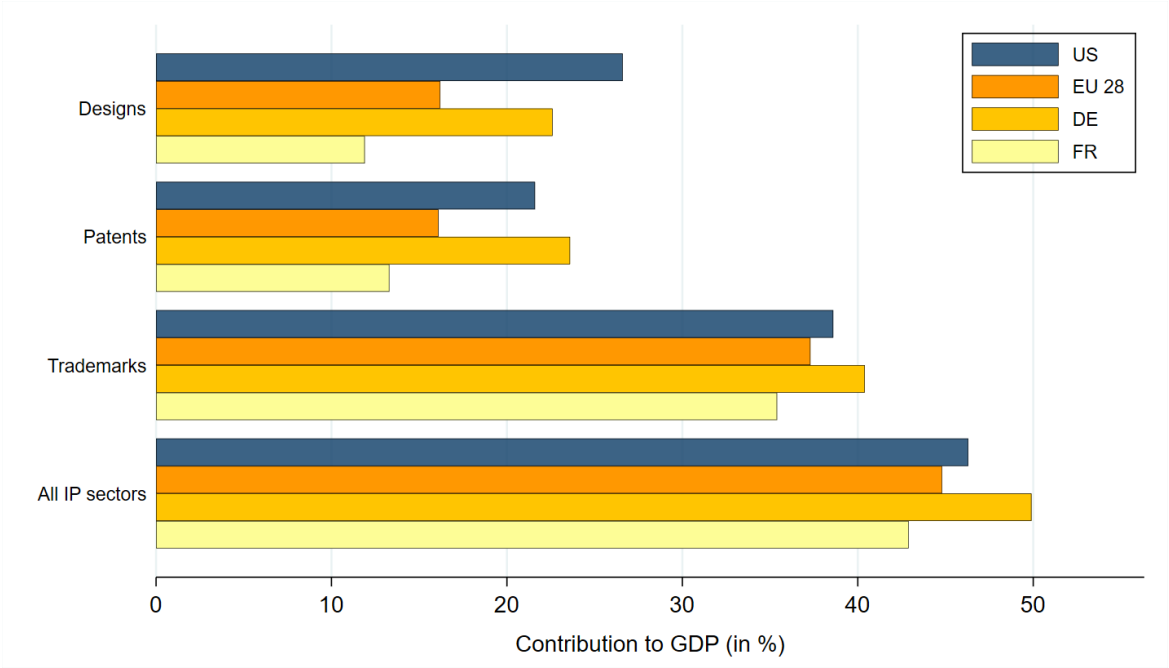
Notes: The table displays high dimensional fixed-effect regressions equivalent to Table 6, only here the comparison group of non-pledging firms is specified differently. In the matching procedure, we omit the selection on the closest neighbors of the IP pledging firms but instead keep all firms that satisfy the matching criteria defined in Section 5.1. Standard errors (in parentheses below coefficients) are clustered at the firm level. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

Table IA6: Options to exploit IP rights for financing purposes

	Monetizing strategy		
	Selling/transfer	**Licensing**	**Collateral**
Form of payment	Selling price	Royalty payment	External debt
Contracting partner	Competitor/partner	Competitor/partner	Loan provider (unlikely competitor)
Contracting term	Permanent	Temporally	Temporally (typically long-term)
Main costs	Loss of ownership	Loss of tacit knowledge	Interest payment
Main advantage	Lump sum payment	Maintain ownership, no repayment	Preserve tacit knowledge, lump sum payment

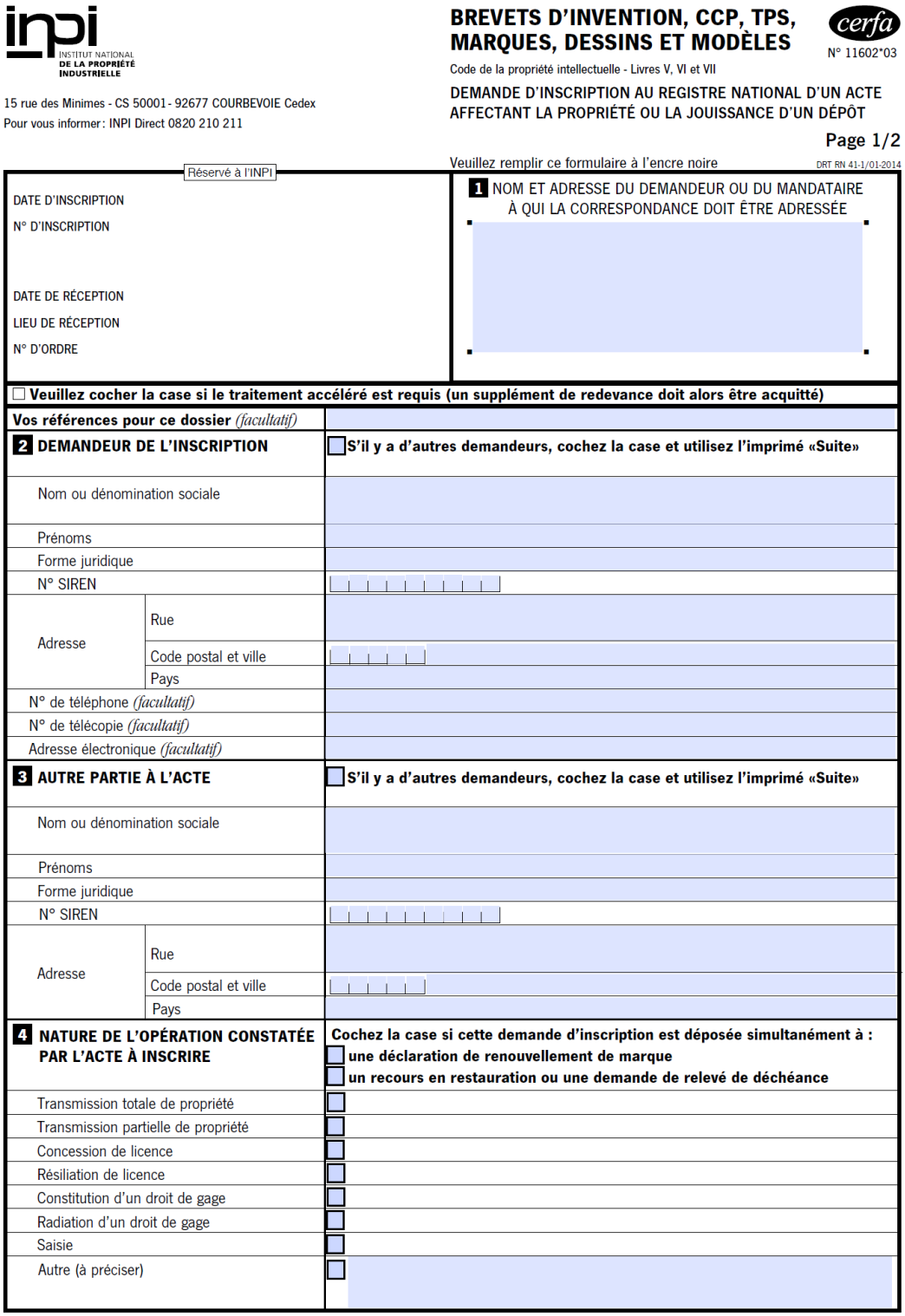
Internet Appendix B: Figures

Figure IA1: IP-intensive sectors contribution to GDP in selected economies



Notes: The graph shows the contribution of IP-intensive sectors (designs, patents, trademarks and overall) to the overall GDP in the US, the EU, Germany, and France in 2016. Inustries are classified as IP-intensive, if the industry average of IP rights per employee exceeds the overall average. We obtain information on the industry-classifications from USPTO (2016) and EPO-EUIPO (2022) for the US and European countries, respectively.

Figure IA2: Form sheet of IP-related legal changes at INPI



INSTITUT NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE

15 rue des Minimes - CS 50001 - 92677 COURBEVOIE Cedex
Pour vous informer : INPI Direct 0820 210 211

BREVETS D'INVENTION, CCP, TPS, MARQUES, DESSINS ET MODÈLES

cerfa N° 11602*03

Code de la propriété intellectuelle - Livres V, VI et VII

DEMANDE D'INSCRIPTION AU REGISTRE NATIONAL D'UN ACTE AFFECTANT LA PROPRIÉTÉ OU LA JOUISSANCE D'UN DÉPÔT

Page 1/2

Veuillez remplir ce formulaire à l'encre noire

DRT RN 41-1/01-2014

Réservé à l'INPI

DATE D'INSCRIPTION
N° D'INSCRIPTION

DATE DE RÉCEPTION
LIEU DE RÉCEPTION
N° D'ORDRE

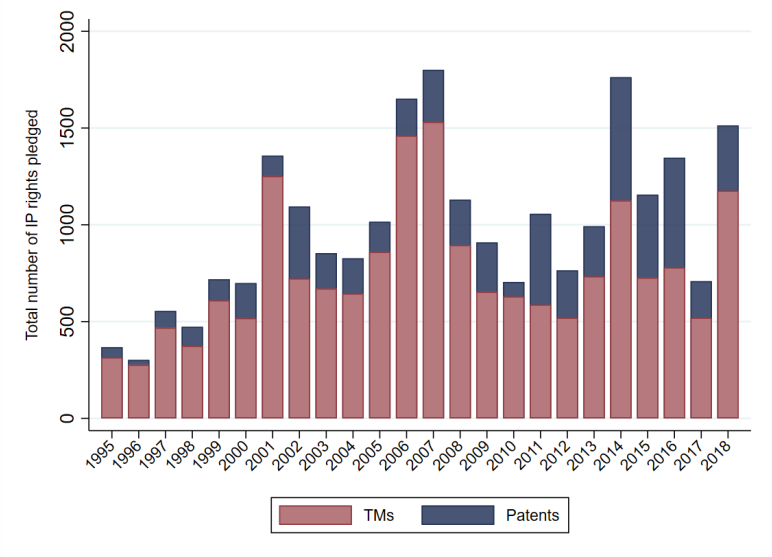
1 NOM ET ADRESSE DU DEMANDEUR OU DU MANDATAIRE À QUI LA CORRESPONDANCE DOIT ÊTRE ADRESSÉE

☐ **Veuillez cocher la case si le traitement accéléré est requis (un supplément de redevance doit alors être acquitté)**

Vos références pour ce dossier *(facultatif)*		
2 DEMANDEUR DE L'INSCRIPTION		☐ **S'il y a d'autres demandeurs, cochez la case et utilisez l'imprimé «Suite»**
Nom ou dénomination sociale		
Prénoms		
Forme juridique		
N° SIREN		
Adresse	Rue	
	Code postal et ville	
	Pays	
N° de téléphone *(facultatif)*		
N° de télécopie *(facultatif)*		
Adresse électronique *(facultatif)*		
3 AUTRE PARTIE À L'ACTE		☐ **S'il y a d'autres demandeurs, cochez la case et utilisez l'imprimé «Suite»**
Nom ou dénomination sociale		
Prénoms		
Forme juridique		
N° SIREN		
Adresse	Rue	
	Code postal et ville	
	Pays	
4 NATURE DE L'OPÉRATION CONSTATÉE PAR L'ACTE À INSCRIRE		**Cochez la case si cette demande d'inscription est déposée simultanément à :** ☐ **une déclaration de renouvellement de marque** ☐ **un recours en restauration ou une demande de relevé de déchéance**
Transmission totale de propriété		☐
Transmission partielle de propriété		☐
Concession de licence		☐
Résiliation de licence		☐
Constitution d'un droit de gage		☐
Radiation d'un droit de gage		☐
Saisie		☐
Autre (à préciser)		☐

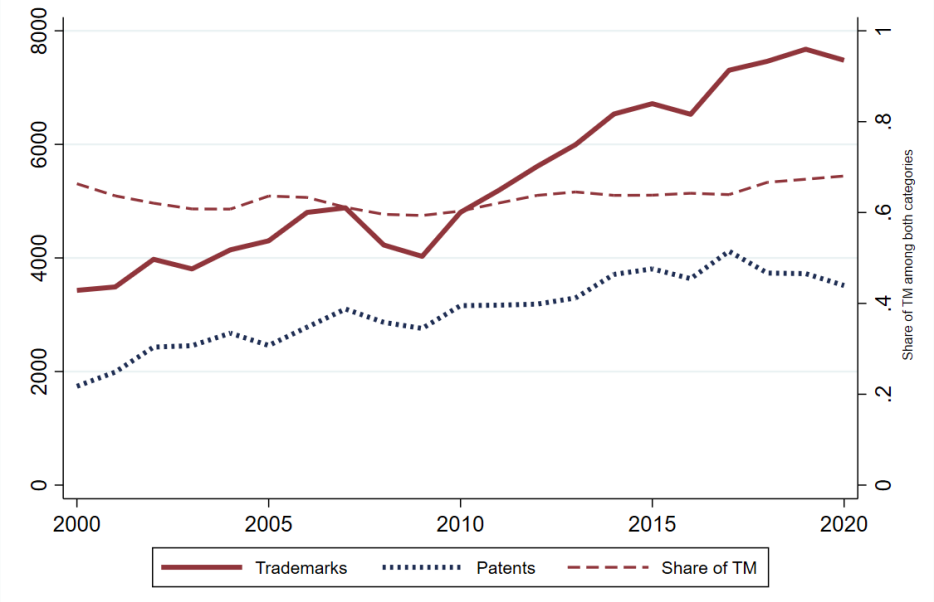
Notes: The figure displays the first page of the form sheet for IP-related legal changes at the French IP office (INPI). IP owners are asked to indicate any changes in ownership, which are specified under point 4. Specifically, pledges of trademarks, patents, and designs are indicated by '*Constitution d'un droit de gage*'.

Figure IA3: The use of IP loan collateral in France: Trademarks vs. patents



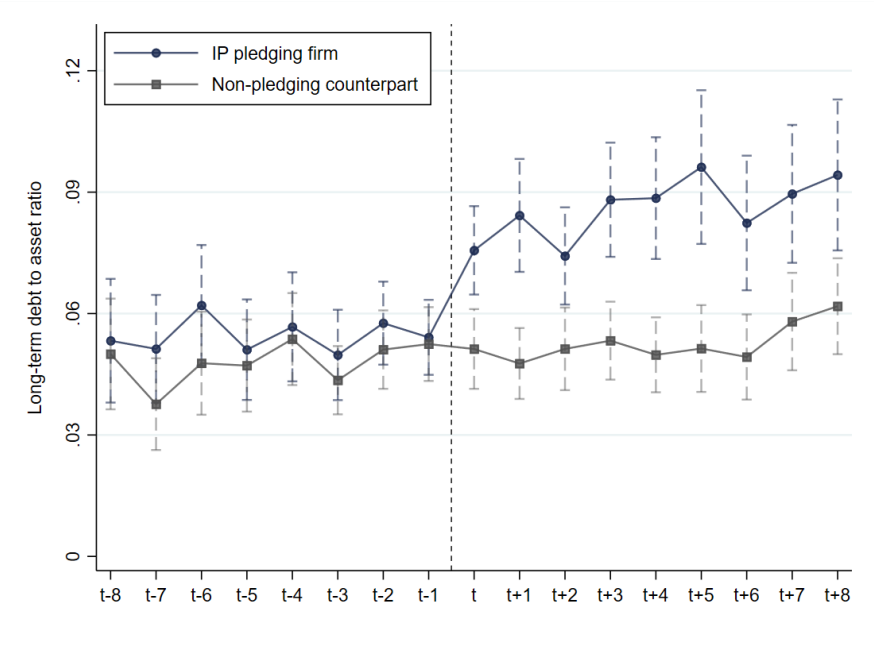
Notes: The graph redraws Panel B of Figure 1. Only here, the graph on the count of pledged IP rights per year distinguishes trademarks and patents used as loan collateral.

Figure IA4: External validity: Trademark and patent collateral in the US



Notes: The graph displays the use of IP rights as loan collateral in the US for the years 2000-2020, distinguishing among trademarks and patents. Data is obtained from the USPTO patent transfer database. For the sake of illustration, observations are marked as collateral events whenever the convey text indicates the establishment of either a "security agreement" or a "security interest". The share of TM indicates the share of trademarks among all IP collateral events, i.e., the sum of patent and trademark events, and is indexed on the right y-axis.

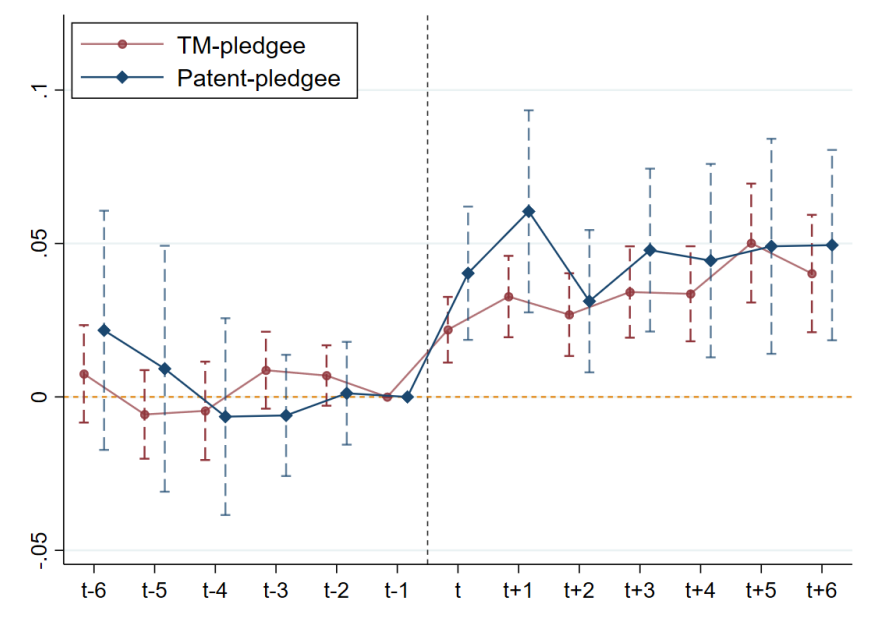
Figure IA5: Mean plots on debt financing activities relative to pledge year



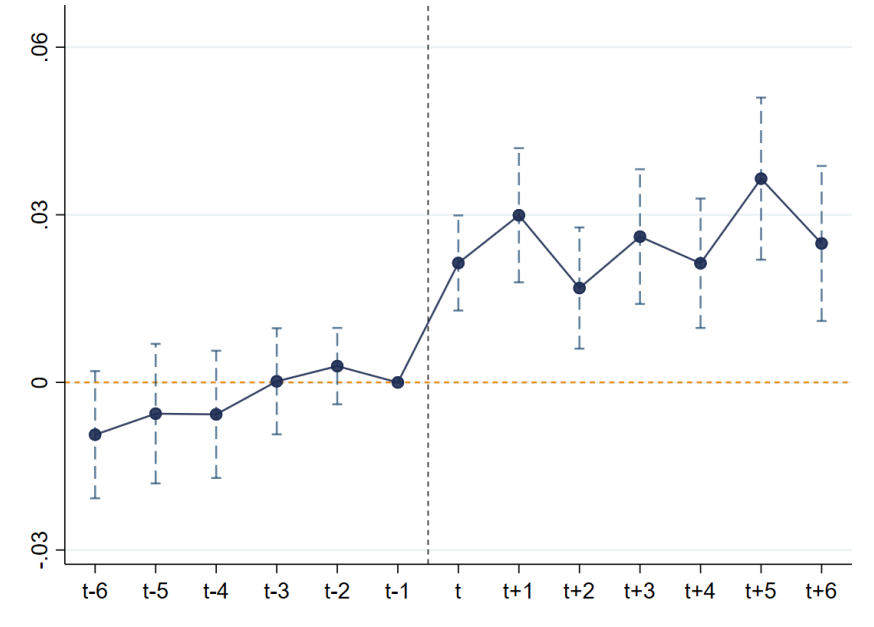
Notes: The graphs display mean plots of total debt to asset rations (Panel A) and short-term debt to asset ratios (Panel B) in a symmetric time window of 8 years around the initial pledge. The graphs differentiate between IP pledging firms and their non-pledging counterparts. Short term debt is defined as any debt with a maturity of less than one year. Whiskers span the 95 percent confidence intervals.

Figure IA6: Robustness test on the baseline specifications - coefficient plots

Panel A: Event-study regression design: distinguishing trademark and patent pledges

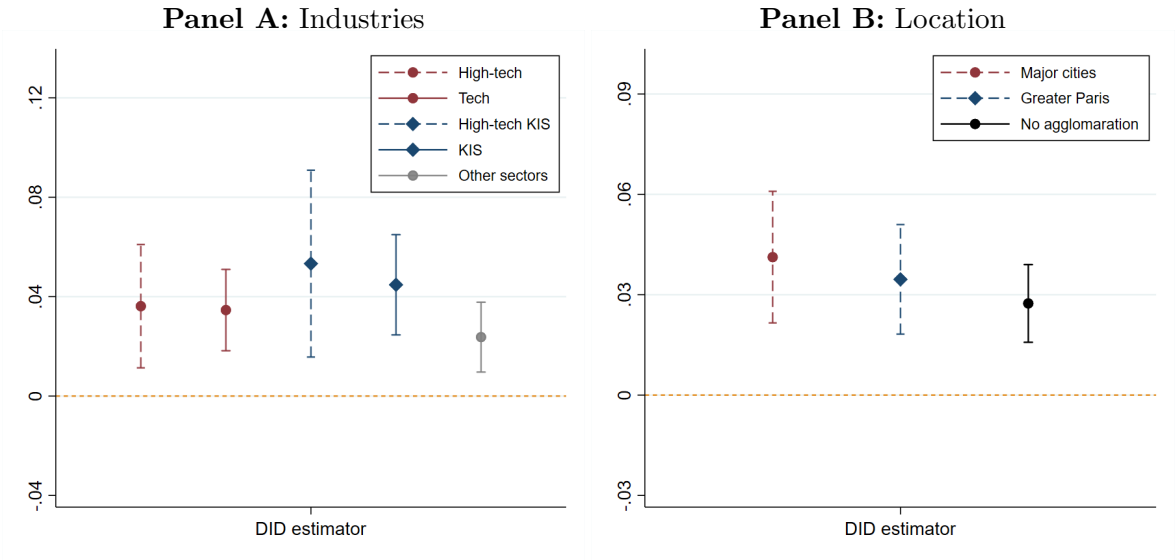


Panel B: Event-study regression design: alternative specification of the comparison group



Notes: The figures provide results from complementary analyses on the baseline estimations in Section 5.2. Panel A redraws Figure 4, only here, the estimation is separately run for i) firms that pledge at least one trademark and those that pledge at least one patent. These groups are not mutually exclusive. Panel B plots coefficients of the baseline specification similar to Figure 4, only here the comparison group of non-pledging firms is specified differently. In the matching procedure, we omit the selection on the closest neighbors of the IP pledging firms but instead keep all firms that satisfy the matching criteria defined in Section 5.1. In both panels, whiskers span the 90 percent confidence intervals.

Figure IA7: Sectoral and geographical differences in the baseline results



Notes: The figures plot DID estimator of the baseline regressions. Here, regressions are run on subsamples according to the sectoral affiliation of firms and the location of their headquarters. In Panel A, we distinguish five different groups of sectors, following the classification scheme of industries as proposed by the European Statistical Office, Eurostat; 1) High-tech sectors, 2) Tech sectors, 3) High-tech knowledge intensive services, 4) Knowledge intensive services, and 5) all sectors not classified in 1-4. In Panel B, we distinguish firms according to the location of their headquarter, dinstinguishing three groups: Firms located in 1) Paris, Lyon, or Marseille, 2) the Greater Paris area, and 3) locations not classified in 1-2. In both panels, whiskers span the 90 percent confidence intervals.

Internet Appendix C: Perfecting IP loans in France

Establishing the contract: In France, IP pledges are governed by the combination of the general security law concerning incorporeal property in the Code Civil (CC) and the Intellectual Property Code (IPC). A pledge of IP rights is defined by CC article 2355 as the allocation of a movable or of a set of movable properties as security for an obligation. It provides the lender, who accepts the respective IP rights as collateral, the right to receive payment on the collateral in case of default (Séjean and Binctin, 2020). In this context, it is explicitly stated by law that it is possible to pledge different types of IP as collateral, including patents (L. 613-8 CPI), trademarks (L. 714-1, CPI), designs (L. 513-2 and L. 513-3, CPI), and copyrights (L. 131-2, CPI). Excluded from pledgable IP are collective trademarks, that is trademarks owned by a group of associated firms indicating the belonging of the firms to respective associations, such as alliances in the airline industries.

For all loan agreements, irrespective of its kind, the contract must contain written description on the quantity, type, designation and nature of the collateral in order to legally establish the loan agreement (CC 2336). In the explicit context of IP-backed loans, it is further necessary to include a detailed description of the IP collateral. Unless otherwise specified, the borrower is obliged to carry out due maintenance of the IP collateral. For example, this entails the obligation to pay the annual renewal fees at the respective IP offices as long as the loan agreement is not terminated. Further, in case of right infringement, the original owner of the IP right has to defend its right in court.

Resolving the contract: There are generally three possible scenarios ending a loan agreement, each with different implications in the case of IP-backed loan contracts. First, the loan is repaid in full resulting in a release of any obligations attached to the IP collateral for the original owner. Second, default of a loan without insolvency. In this case, the lender has the right for obtaining a court order allowing the sale at auction (CC 2346) or to keep the respective IP right as a form of payment (CC 2347). In practice, the latter case is unlikely, since the lender is typically a bank and, hence, with an unrelated business field compared to the borrower. Once the selling value in case of default exceeds the amount of the required, outstanding repayments, the borrower will receive the excess amount. In the third scenario, the default caused by an insolvency of the borrower, a collective proceeding is opened aiming

to satisfy the claims of all affected debtors, including the lender of the respective IP collateral agreement. Depending on the seniority, the lender will be repaid or has to write-off the loan. In any case, the lender can no longer claim the exclusive IP ownership (Code de Commerce L.641-3), which is very similar to common other loan agreement resolutions.

Internet Appendix D: Monetization strategies of IP rights

There are three main strategies on how firms can monetize their IP rights, which are summarized in Table IA6 (Appendix A). First, selling IP rights has the benefit of obtaining a lump sum fee that may help firms to cover financing demands on the spot. However, only if the transfer price exceeds the expected private return to its owner, selling IP rights is a feasible option. Moreover, selling comes at particular costs, all of which are based on the loss of ownership of the IP right. In this context, the key disadvantage is that owners forgo the option to use the subject matter protected by the respective IP right. Moreover, buyers are likely competitors, since IP rights typically do not provide owners with a particular advantage unless they can utilize them for operations.[24] As a notable exception, buyers may also be non-practicing entities (NPEs), whose operations focus exclusively on monetization of IP rights themselves (see, Cohen *et al.*, 2019). A strategy to maintain the opportunity to use the IP right even after transfer would be a sale-and-license back clause. Yet, even in this case, tacit knowledge would have to be displayed and control rights are lost.

Second, in a licensing contract, the original IP right owner, the licensor, grants a licensee the right to use the respective IP right in exchange for payment. Hence, the original owner does not lose ownership rights to satisfy financing needs. Licensing of IP rights is well-documented in the economic literature, in particular, regarding the licensing of patents (e.g., Arora *et al.*, 2004). The obvious benefit for the licensor is to maintain the monopoly right of exploiting the IP right. At the same time, in licensing agreements, the licensor often obtain royalty payments that accrue only over time and thus may not satisfy ad-hoc financing demands. Still, even if lump-sum royalties would be negotiated, disclosure of tacit knowledge as one key disadvantage of licensing remains. As such, licensing is explicitly not limited to grant the use of an IP right, but on top of this tacit knowledge that is required for proper utilization of the right is transferred as well (Arora *et al.*, 2001). Hence, similar to IP right transfers, in licensing contracts the original IP right owner obtains financing at the cost of displaying tacit knowledge, potentially of strategic importance. This is crucial, once licensees and licensors are competitors.[25]

[24] See Serrano (2010) for more details on IP right transfers, in the context of patents.

[25] For example, licensees can be expected to pay royalties only for the actual use of the subject matter protected by IP rights and NPEs can only effectively exploit IP rights if they are actual owners. In fact, in a personal interviews the head of the R&D department of a large German multinational corporate revealed to us that his company does not sell or license their IP, since they "do not want to display strategic knowledge"

In IP right collateralization, the original IP right owner use respective rights as a security to obtain payment in form of a loan from a creditor, typically a bank. Just like in any other form of loans, IP collateral may serve the classical functions to mitigate adverse selection issues in external financing transactions by both providing asset values that can be liquidated in case of loan default and to act as signaling device for borrowers' willingness and capability to repay the debt (Holmstrom and Tirole, 1997; Jimenez *et al.*, 2006). Further, any loan agreement comes at the cost of paying interest on the granted loan, including a full repayment of debt upon loan maturity. Unlike IP transfers and licensing, however, using IP rights as collateral in loan contracts combines the benefits of receiving lump-sum financing without suffering from the aforementioned costs of loss of ownership or tacit knowledge. More specifically, IP collateral does not require the borrower to display any tacit knowledge to other market participants, nor does it imply losing control and ownership rights. From this perspective, collateralization appears as a particularly promising strategy to monetize IP rights.[26]

to competitors. We acknowledge, however, that licensing to competitors may even be beneficial for generating knowledge spillovers, as shown in the case of pharmaceutical patents Kelchtermans *et al.* (2022).

[26]Further, firms may exploit IP rights (via signaling) to obtain external equity financing, such as, venture capital investments. Typically, this strategy is relevant only for very young ventures and implies a dilution of the equity stake of the firm. In contrast, debt financing is a potential financing strategy for all firms (see Robb and Robinson, 2014) and does not affect the firms ownership structure.