Debt Financing in the Knowledge Economy: Evidence from Intellectual Property as Loan Collateral

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Abstract

The evolution towards an increasingly knowledge-based economy causes financing gaps worldwide, especially for intangible-rich, bank-dependent firms. This study investigates an exhaustive set of trademarks, patents, and design rights pledged as collateral in loan agreements to provide new evidence on the use of intellectual property (IP) as loan collateral. Our setting allows us to detail the relevance, implications, and determinants of IP assets for secured debt financing. In a quasi-natural experiment, we exploit exogenous variation in the menu of pledgeable assets and show that IP rights do not just serve as an add-on in the overall collateral mass but can be an integral part of loan agreements. Our analyses further disclose that firms deploy distinct IP assets as collateral, mostly trademarks. Granular IP-level analyses show that cash flow attribution is the key determinant for pledgeability irrespective of the IP type. From a managerial perspective, the findings suggest that IP collateralization is a promising strategy, widening the financing opportunities of financially constrained small firms.

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1 Introduction

External debt financing is a key source to fund investments and growth, especially for small, private firms (Carbo-Valverde *et al.*, 2009; Robb and Robinson, 2014; Kerr and Nanda, 2015). Over the past decades, debt financing activities have been severely affected by economies becoming increasingly knowledge-intensive (Falato *et al.*, 2022; Crouzet *et al.*, 2022). The rising prevalence of intangible capital reduces the availability of pledgeable assets and causes financing gaps, most severely for small and medium-sized enterprises (SMEs) that are highly dependent on external financing (Dell'Ariccia *et al.*, 2021). While the rise of intangible assets is considered a reason for the secular stagnation in bank lending (see, Falato *et al.*, 2022), intangibles may as well help to close such financing gaps. Once protected by an intellectual property (IP) right, intangible assets become fungible for financing activities (Levitas and McFadyen, 2009; Somaya, 2012; Hegde and Luo, 2018). Most directly, IP rights can be used as loan collateral for debt financing (Mann, 2018; Graham *et al.*, 2018). Deploying IP assets as collateral seems promising to curb the stagnation in bank lending as the provision of securities is most beneficial for risky and small firms, which are most vulnerable to this trend (Luck and Santos, 2023).

Yet, there are many unresolved questions regarding the potential of IP collateralization to solve financing issues. A fundament question is whether IP assets are a relevant component in loan agreements at all. In particular, the use of non-IP assets as collateral in IP-backed loans pose a significant empirical challenge: One may associate the full effects on firm-level outcomes to IP, even if these effects are partially or fully attributable to non-IP assets. Further, it is not clear which firms benefit most from IP collateralization and what firm- and IP-level characteristics determine the use of (different) IP assets. This paper provides answers to these central questions investigating a novel empirical setting, including trademarks, patents, and design rights used as loan collateral.

Our study exploits unique and previously unexplored data from France, which enables us to overcome common obstacles in studying IP collateral. First, our setting allows us to identify the relevance of IP collateral by studying a major reform to the French legal system as a quasi-natural experiment, the *Ordonnance 2006-346*. The amendment introduces exogenous variation in the menu of assets that firms can use as loan collateral (Aretz *et al.*, 2020). Second, French law stipulates consistent registration of any IP pledge, which is typically not the case in other settings. For example, in the US, consistent IP collateral registration is not warranted (Jacobs, 2011; Graham *et al.*, 2018) and security agreements are often filed under blanket liens (Kermani and Ma, 2020; Luck and Santos, 2023), requiring debtors to add IP rights as collateral by default and not by choice. Third, these thorough registration requirements yield detailed

administrative data covering all trademarks, patents, and design rights used as loan collateral in France since the 1980s. We augment this data by adding firm-level financial data from Orbis and IP-level data from the French IP Office (INPI) and the Worldwide Patent Statistical Database (PATSTAT). Overall, this setting enables us to provide a new and likely more complete picture of IP collateralization.

Our main analyses reveal that IP collateral can be a decisive component in loan agreements for a wide range of intangible-rich borrowers. To show this, we establish as a baseline that IP collateralization disproportionally increases the long-term debt-to-asset ratios of firms in the years after their IP pledges relative to a matched sample of non-pledging firms. The positive effects on debt financing are strongest for small and private but well-established firms and firms with a high dependence on external financing. IP loans are either used to roll over or to raise additional debt, the latter being associated with higher growth rates in assets and employment. Based on these findings, we carve out the importance of IP assets in respective loans. We find that the baseline findings are stable across firms with different levels of tangible assets (i.e., the most common form of collateral), including firms with close to zero tangible assets. We then study the *Ordonnance 2006-346* as a legal shock that exogenously raised the availability of collateral by allowing firms to use a wide range of tangible fixed assets as collateral (see, Aretz *et al.*, 2020). Using a difference-in-differences design that distinguishes firms' ex-ante endowment of (non-IP) collateralizable assets, we find that the positive effects of IP collateral on debt financing and subsequent growth are not attenuated comparing the pre- and post-Ordonnance years. These results underscore the relevance of IP collateral in respective loan contracts, particularly for intangible-rich firms.

We provide further new insights on IP collateral by answering the questions of what types of IP assets are most commonly pledged and what type of firms benefit most from IP collateralization. Trademarks are the most frequent type of collateralized IP asset, which is consistent with the high frequency of trademarks in use compared to other types of IP, but it questions the strong focus of the prior literature on patents.[1] More specifically, 81% of IP-backed loans include trademarks, 11% involve patents, and 8% use a combination of different IP types. Design rights comprise 2% of all pledged IP assets, suggesting that trademarks and patents better fulfill the necessary conditions to serve as collateral. Moreover, the users of IP collateral are predominantly well-established private SMEs (79%) dispersed along various sectors and geographic

[1] In the EU, 53% of firms with at least 250 employees own trademarks while 18% own patents during the years 2017-2019 (EPO-EUIPO, 2021). Among IP-intensive industries, trademark sectors contributed 82% to GDP and 71% to employment, while patent sectors contributed 37% to both GDP and employment (EPO-EUIPO, 2022). These patterns are not specific to Europe but also apply, e.g., in the US (see Figure IA1 in Appendix B). Similarly, our analyses show that the described IP- and firm-specific patterns apply most likely outside France.

locations within France. IP-pledging firms generally feature low asset tangibility, limiting their ability to deploy traditional tangible collateral.

Against this background, we answer the question of whether and how the pledgeability of IP differs across the different IP assets and characteristics. Specifically, we test a set of hypotheses regarding the main determining features that facilitate IP collateralization. To this end, we map firms' full IP portfolio at the time of the pledge, including granular qualitative and legal features. We exploit the fact that IP rights can be pledged before the rights are legally conferred. Hazard analyses show that the instantaneous probability of being pledged significantly rises after IP rights are granted, which emphasizes the fundamental role of obtaining IP protection for collateralization. As key determinants, IP assets with closer links to firms' cash flows and higher redeployability are more likely to be used as collateral, both within and across firms. IP assets with limited standalone capacity, such as design rights, are typically pledged in combination with other assets. These characteristics are relevant irrespective of the asset type. Still, cash flow attribution is particularly important for trademarks. While the cash flow channel is an established determinant for debt financing (e.g., Lian and Ma, 2021; Ivashina *et al.*, 2022; Kermani and Ma, 2023), these results disclose the central role of expected future cash flows in the context of IP-backed loans, in particular, when using trademarks as collateral.

Our findings have important implications. Most fundamentally, they advance the understanding of IP rights as critical assets for external debt financing in an increasingly intangible-rich knowledge economy. To the best of our knowledge, our study is the first to explore exogenous variation in the availability of alternative collateral in order to examine the relevance of IP in loan agreements. In addition, we explore IP collateralization within and across a wide range of firms without focusing on specific segments of the economy or specific IP rights. Indeed, most of what is known about IP collateralization comes from certain firm types, such as public corporations or VC-backed startups, and one distinct IP right, i.e., patents (e.g., Hochberg *et al.*, 2018; Mann, 2018). This focus might be problematic since providing collateral is most valuable for private SMEs (Luck and Santos, 2023) and not for large corporations or nascent startups. Similarly, firms are much more likely to own other types of IP, such as trademarks, than patents, while non-patent IP is equally viable for financial transactions (Giuri *et al.*, 2007; Graham *et al.*, 2018; Hsu *et al.*, 2022). In their overview on the USPTO database, Graham *et al.* (2018) document that trademarks and design patents are frequently transferred or recorded in security agreements. Anecdotal evidence even indicates a superior potential of non-patent IP assets for collateralization: According to Mathias Schumacher, a business analyst at Duff & Phelps, trademarks may be accepted as collateral more quickly than patents since cash flows

"*can be proven easily*" (Financial Times, 2020).

Hence, our results shed light on the underlying workings of IP collateralizations, entailing relevant insights from a managerial and research perspective. For example, the cash-flow channel may be one key mechanism to facilitate the use of trademarks as loan collateral, enlarging firms' available menu of pledgeable assets. Using trademarks as collateral can be an effectuive solution to meet financing demands since firms frequently own trademarks, especially if they are intangible-rich. More generally, our results extend findings on the collateralization of tangible assets (e.g., Campello and Giambona, 2013), arguing that pledgeability does not depend on the asset type but on its characteristics. We show that this is likely the case for intangibles. Overall, our findings encourage companies to consider different IP types for collateralization to improve their access to financing and highlight the potential of strategically managing IP for debt financing.

This study integrates three main strands of the literature. First, we relate to studies on the use and the implications of collateral in external financing. Prior research highlights the importance of collateral in reducing financing costs and improving access to debt (Stiglitz and Weiss, 1981; Benmelech and Bergman, 2009; Norden and van Kampen, 2013). The ability to secure debt with collateral has significant implications for the investment decisions of financially constrained firms, such as small or innovative firms (Hall and Lerner, 2010; Kim and Kung, 2017). Second, this study pertains to the literature on the monetization of IP rights. Prior studies examine the different ways in which firms use their IP to satisfy financing needs, such as sales, licensing, and collateralization (Arora *et al.*, 2001, 2004; Serrano, 2010; Mann, 2018). Third, we contribute to studies that investigate the role of IP in external financing. While one large body of research focuses on external equity financing, such as venture capital (Hsu and Ziedonis, 2008; Conti *et al.*, 2013; Block *et al.*, 2014; Haeussler *et al.*, 2014), a nascent stream identifies the positive relationship between IP provisions and debt financing (Farre-Mensa *et al.*, 2020; Saidi and Žaldokas, 2021; Horsch *et al.*, 2021; Mauer *et al.*, 2022; Suh, 2023).

There is a small number of studies at the intersection of these three streams, such as our study, which investigates how IP can be used as collateral to raise debt. Most existing work focuses on patents and investigates the effect of patent-backed loans on financing and innovative activities (Amable *et al.*, 2010; De Rassenfosse and Fischer, 2016; Mann, 2018; Hochberg *et al.*, 2018; Zhang *et al.*, 2021). Patent-backed loans have positive effects on savings, R&D investments, and performance for both venture-backed startups and publicly listed firms. We incorporate this perspective but do not restrict our analysis to specific firms and move beyond the use of patents as collateral. This is important for gaining a better understanding of the

potential of non-patent IP collateral.[2] Importantly, the existing literature is agnostic about the actual relevance of collateralized IP assets in the underlying loan agreements. This aspect is particularly crucial because most studies focus on IP pledges in the US, where blanket liens are a common practice. Blanket liens entitle the creditor to seize all assets owned by a borrower in the event of default. For IP-owning firms, this implies that IP assets enter the collateral mass by definition. In our setting, such practices are prohibited by law such that IP assets have to be explicitly listed in loan agreements.

Finally, our analyses extend prior work on the determinants of IP characteristics for financing purposes along two distinct angles. We provide the first evidence of the determinants of trademark collateralization using a rich set of IP-level characteristics. When analyzing IP-backed loans, it is essential to consider trademarks since they are the most commonly used IP collateral type, e.g., in France and the US. Further, we provide new insights on the determinants of IP pledgeability by studying variation across and *within* firms. Existing studies (on patents) merely distinguish IP owned by pledging and non-pledging firms without considering pledged and non-pledged IP rights within firms (e.g., Mann, 2018; Caviggioli *et al.*, 2020; Zhang *et al.*, 2021). Our analyses show that considering within-firm variation is important for establishing determinants for IP pledgeability.

The remainder of the paper is organized as follows. Section 2 develops our key hypotheses. Section 3 provides the institutional background and presents the data, including detailed descriptive insights on IP collateralization in France. Section 4 provides empirical evidence on the relevance of IP collateral in loan agreements and its real effects. Section 5 examines the determinants of trademark- and patent-pledgeability. Section 6 concludes.

2 Theoretical framework and background

This section develops hypotheses on the relevance of IP as loan collateral and on the determinants of its use. The empirical analysis covers the three most common types of industrial property rights: trademarks, patents, and designs.[3] All three IP types require a formal application, following a standardized route via national or international IP offices. Once approved, they grant their owner a temporary monopoly over the protected subject matter. Central for

[2] In legal sciences (see Kieninger (2020) for a comprehensive overview), the use of non-patent IP collateral is a common topic, but quantitative analyses are scarce and focus on stylized facts (e.g., Nguyen and Hille, 2018).

[3] Table IA1 (Appendix A) summarizes the key characteristics of these IP types. Trademarks protect distinct signs that distinguish companies, products, and services through different brands, words, drawings, or symbols. Patents protect technical inventions and should be novel, encompass an inventive step, and offer an industrial application. In Europe, design rights are not patented but are registered IP rights that protect the whole or part of a product and may arise from aesthetic forms and non-functional product features. Our analyses do not cover personal rights, such as copyrights, since these rights arise without formal registration but *qua existence*.

our analysis is that conferred IP rights can provide value to their owners beyond granting exclusive ownership rights on the technology, service, or product: The provision of rights makes intangible capital fungible for market transactions, such as financing activities. Appendix D compares the most common ways to utilize IP for financing purposes, i.e., sales, licensing, and collateralization.

From a legal perspective, most forms of intellectual capital can be used as loan collateral as long as they are protected by a proprietary right (Kieninger, 2020). Certain intangibles are highly value-relevant but still suffer from low pledgeability once they cannot be protected or are not yet protected by a right, such as goodwill, trade secrets, or an unregistered company name, which are marketable only to a limited extent. However, even after formal granting, IP rights have properties that adversely affect their pledgeability. As a central attribute, it is difficult to define the legal boundaries associated with intangible assets and, in particular, IP assets (Gans *et al.*, 2008; Serrano, 2010; Hegde and Luo, 2018). Yet, clearly defined property rights are the basis for the well-functioning of market transactions. The ambiguities in the legal boundaries of IP rights may thus introduce agency issues related to imperfect contracting. Additionally, the high degree of asymmetric information and uncertainty associated with IP assets hampers an accurate estimate of their value (Harhoff *et al.*, 1999; Hall and Lerner, 2010). For prudential reasons, international banking regulation thus classifies loans secured by IP assets as non-secured loans (Heller *et al.*, 2024). The potential inability to determine asset values is crucial in the context of asset-based lending: Expected liquidation values can be decisive for lender's decision to provide debt and allow them to set borrowing limits accordingly (Kermani and Ma, 2020).

Despite these considerations, empirical evidence shows that IP assets feature several characteristics that make them suitable as collateral, just like tangible assets. In fact, lenders are found to quickly resell debtors' patents to other market participants in case of default, suggesting that IP (secondary) markets do work (Serrano and Ziedonis, 2019; Ma *et al.*, 2022). Moreover, patents can signal firms' ability to meet debt obligations, even for firms that do not yet generate revenues. The rigorous and lengthy examination process of patents and the considerable sourcing and maintenance costs can serve as an effective signal for expected revenues (Saidi and Žaldokas, 2021). Similarly, trademarks carry substantial firm value and are linked to revenues even more directly: Products are typically branded, facilitating the mapping of cash flows to specific trademarks (Heath and Mace, 2020; Hsu *et al.*, 2022). Corroborating these findings, statistics provided in Graham *et al.* (2018) show that trademarks, patents, and design rights are frequently traded – and pledged.

Still, the mere occurrence of IP pledges, as illustrated in Graham *et al.* (2018), does not answer the question about the relevance of the IP collateral in respective loan agreements. An alternative explanation of high pledge rates can be, e.g., contractual reasons. In the US, where IP collateralization rates are high, one-quarter of loans to non-financial firms are blanket liens (Luck and Santos, 2023). These contracts require debtors to pledge all (or most) of their assets such that IP assets enter the collateral mass without being explicitly chosen as security.

A priori, it is thus not clear whether IP assets are a relevant component of loan agreements. While IP rights feature characteristics rendering them more or less favorable for collateralization, they are frequently used as collateral. To work out the role of IP collateral, we hypothesize:

Hypothesis 1: *IP rights can be a central component of IP-backed loan agreements.*

The above arguments already indicate underlying properties that relate to the pledgeability of assets. They implicitly suggest that pledgeability may not be specific to the type of assets (e.g., tangible versus intangible assets). Instead, it may rather be a matter of degree, varying according to assets' underlying characteristics – just like with tangible assets (Campello and Giambona, 2013). In the following, we detail specific IP characteristics as determinants of IP pledgeability.[4]

As a fundamental determinant, we consider the degree of asset identifiability. In any legal agreement, referenced assets must be identifiable by ownership rights. Once protected by a property right, IP assets generally meet the minimum requirement of identifiability so that they can be included in loan agreements. However, as a specific feature of IP rights, the degree of identifiability varies over their lifecycle. IP applications already comprise certain legal rights such that they fulfill the identifiability criterion to some extent. Hence, it is possible to use pending IP applications in contractual agreements, as evidence on patent licensing suggests (e.g., Hegde and Luo, 2018). Again, from a legal perspective, this also applies to IP collateralization (Kieninger, 2020). Nevertheless, the registration and grant events ultimately validate the status of trademarks, designs, and patents as identifiable assets. Therefore, pendency periods are associated with high uncertainty regarding the scope and validity of the associated rights (Lemley and Shapiro, 2005; Hegde and Luo, 2018). Accordingly, banks' willingness to accept a pending application should be lower than a fully conferred IP right. Consistent with this notion, prior research shows that exogenous variation in IP right strength shapes the debt financing of IP-holding firms (Horsch *et al.*, 2021; Suh, 2023). We thus hypothesize that:

[4]See Marquez *et al.* (2023) for further theoretical considerations on this topic. Further, we acknowledge that institutional features are relevant determinants for IP collateralization (Heller *et al.*, 2024). Institutional differences are less relevant in our analysis since we consider IP pledges within one jurisdiction.

Hypothesis 2: *The identifiability of an IP asset is positively related to the probability that the IP right is used as loan collateral.*

While identifiability is arguably a prerequisite for collateralization, other attributes affect IP pledgeability. As outlined above, secondary market liquidity and asset valuation are inherent considerations in the context of asset-backed debt financing. We, therefore, consider the degrees of redeployability and cash flow attribution as potential determinants of IP pledgeability.

In general, redeployability reflects the liquidation value of assets on the secondary market and thus defines the extent to which a lender can compensate the loss given default of a loan (Benmelech and Bergman, 2009; Kim and Kung, 2017). Liquidation values are thus essential to banks' lending decisions and determine their funding limits (Kermani and Ma, 2020). Hence, if the redeployability of an IP asset is low, creditors will be reluctant to accept it as collateral. Literature initially showed this relationship for tangible assets (e.g., Campello and Giambona, 2013), but similar effects apply for patents (Hochberg *et al.*, 2018; Zhang *et al.*, 2021). Hence, we hypothesize:

Hypothesis 3: *Asset redeployability is a key determinant for IP pledgeability that is positively related to the probability of an IP to be used as loan collateral.*

Moreover, firms' ability to meet their debt obligations is likely a pivotal factor for IP pledgeability. Typically, only a small fraction of bank loans default, and banks apply risk-adjusted pricing for the loans they provide, while asset liquidation recovery rates are generally low (Kermani and Ma, 2023). Consistently, the ability of firms to make interest payments and repay the debt are likely decisive attributes for lending decisions. Cash flow attribution may thus be an even more relevant determinant for IP pledgeability than redeployability. Cash flows give the lender a strong indication of the ability of a potential borrower to serve the debt (Lian and Ma, 2021). Relatedly, a more precise link to the underlying cash flows allows the lender to better monitor the value of the IP collateral during the loan period, e.g., lowering the risk of potential fire sales (as described in Shleifer and Vishny, 2010). By definition, the more accurately the cash flows can be associated with an asset, the easier it is to estimate firm value (i.e., the net present value of its future cash flows). Against this background, we posit that:

Hypothesis 4: *The ability to link IP to cash flows is a key determinant for IP pledgeability that is positively related to the probability of an IP to be used as loan collateral.*

3 Institutional background, data, and descriptive insights

3.1 IP collateralization in France: legislative features

Several characteristics render the French legislative system particularly suitable for our analyses. Under French law, lenders have the right to seize non-possessory interests in their debtors' property, which allows patents, trademarks, and designs to be collateralized (Riffard, 2016). As a key feature, France has a long-standing tradition of strict registration requirements for loan collateral.[5] The French legal regime 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). Consistently, French law does not authorize a general collection of corporate assets in security agreements, so-called blanket liens, but requires each collateralized asset to be specified in the corresponding loan agreement (Attal, 2004; Aretz *et al.*, 2020). This specification rules out the possibility that an asset is added to the collateral mass by default.

Furthermore, French law stipulates the publication of registered pledges of IP in the official journal of the French National Patent and Trademark Office – the Institut National de la Propriété Industrielle (INPI). The opposability to third parties is conditional on this publication, providing strong incentives for registering IP collateralization in the central register. Only an official registration allows lenders to enforce their priority claims. In addition, the French setting provides incentives for registrations close to the date of the actual pledge. The law stipulates that the effective date of enforceability against third parties is the publication date of the pledge in the official INPI journal. Enforceability is not retroactive such that the order of the publication of the pledge determines the seniority of the claims.[6] Legal scholars attest that the French provisions ensure high legal certainty to users (e.g., Séjean and Binctin, 2020). These factors mitigate concerns, for example, that the registration of IP pledges is correlated with firm-specific factors, such as performance or financing activities.

The above-described institutional features are not exclusive to France per se, but they rarely exist in combination in other jurisdictions. For example, legal regimes in most European countries, such as Belgium, Sweden, or the Netherlands, allow IP collateralization but do not

[5] According to Riffard (2016), the French system is "*extremely rigorous, particularly with regard to the form*", as creditors can only enforce their rights 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). Appendix C contains more details on establishing and resolving IP loan contracts in France.

[6] Literature confirms that the French legal regime provides strong incentives to register ownership changes of IP on time (Ciaramella *et al.*, 2017). In interviews with IP lawyers, we confirmed that lenders perceive incomplete registrations as a central issue, making them reluctant to accept IP collateral. The incentives for timely registration likely exceed their costs. As such, monetary and administrative costs are low, with 270 Euros for orderly registrations that are collected using a simple form sheet (see Figure IA2, Appendix B).

have centralized registers for different IP types (Heller *et al.*, 2024). Other European countries, such as Germany, have no mandatory registries at all. In the US, the law on IP collateral governs IP types separately and defines registration requirements according to parallel legal regimes, i.e., federal and state laws (Jacobs, 2011; Graham *et al.*, 2018).

3.2 Construction of the data set

We create a unique dataset that combines information on IP collateral, detailed IP characteristics, and firm-level financial data. As a key component, it contains data from the INPI register, including 1) the effective dates for loan agreements that use trademarks, patents, and designs as collateral, 2) an IP-level identifier, which we use to add bibliographic information about respective IP rights, and 3) the pledging firms' SIREN, a unique national identifier of French businesses. The SIREN allows us to ensure that we allocate the owner and actual bundle of IP assets to respective loan events. Further, we use the SIREN to systematically identify firms and to link the IP-level data to firm-level financial data from the Orbis database. Orbis is provided by Bureau Van Dijk and contains annual balance sheet and profit and loss data. It uses the combination of "FR" and the SIREN as unique firm identifiers, allowing for a 1:1 linkage of the data. We augment this data with detailed trademark- and patent-level characteristics both for pledged and non-pledged IP rights, using INPI's FTP server and the worldwide patent database, PATSTAT Spring 2021 edition. This information is collected for all firms that registered IP-backed loans in France between 1995 and 2018. We divide the data into two separate parts: one firm-level dataset and one IP-level dataset, as presented in Table 1.

- Insert Table 1 here -

The initial IP-level dataset contains 29,193 IP-event combinations. Removing foreign firms, individual entrepreneurs, and observations with missing SIREN results in 24,216 IP-(loan) event combinations, comprising 18,058 trademarks, 5,709 patents, and 449 design rights.[7] IP rights can be repeatedly used as collateral, i.e., appear in more than one event. In total, 16,354 individual IP rights are pledged at least once in 2,876 distinct events. They include 11,838 trademarks (72%), 4,186 patents (26%), and 330 design rights (2%). For the analysis of IP pledgeability determinants in Section 5, we compute the IP portfolio of firms at the time of collateralization, utilizing data on (non-pledged) trademark and patent applications from INPI.

[7] To mitigate selection concerns, we focus on patents filed via the national route and by French firms. We also exclude information on one specific IP loan event enacted by Alcatel Lucent in 2013. This exceptional case included several thousand patents and hundreds of trademarks (see Reuters, 2012). Excluding these observations ensures that this singular event does not bias our results.

For the firm-level data, we aggregate the IP-level data and collapse it in an unbalanced firm-year panel. The original dataset contains 1,816 unique French firms, out of which not all firms have Orbis data. Further, observations with zero, negative, or missing total assets are removed. We winsorize all continuous variables at the one-percent level to avoid confounding effects from outliers. The final firm-level sample comprises 1,122 firms, corresponding to 17,269 firm-year observations.

3.3 Descriptive evidence

Collateral statistics: This subsection provides several descriptive insights into the use of IP collateral on different levels of aggregation. As a starting point, we consider the composition of loans by IP types. Panel A of Figure 1 shows that the vast majority (81%) of IP-backed loans in France include trademarks but no patents or design rights as collateral. About 11% of loans exclusively contain patents, while designs are only pledged in bundles with other IP types. Combined pledges that use at least two out of the three types of IP represent, on average, 8% of the IP-backed loans. These patterns are mostly stable over time, although the share of patents moderately increases. Panel B of Figure 1 shows the annual number of pledged IP assets (left-axis) and the number of corresponding events (right-axis). The yearly number of collateralized assets oscillates between 800 and 1,800 since the early 2000s.

- Insert Figure 1 here -

The presence of trademarks, patents, and design rights suggests that, in principle, all three IP types meet the identifiability criteria. A potential explanation for why design rights are only pledged in combination could be that such rights protect the appearance of specific products or product parts. This direct tie may impair the ability to reassign design rights without transferring complementary assets and only allow its use as collateral in IP bundles.[8] The descriptive statistics suggest that the lack of separability does not apply to trademarks and patents, implying that they can be valued more easily on a standalone basis.

Firm statistics: Table 2 displays several firm-level characteristics. The majority of pledging entities are SMEs (79%), privately-owned limited liability firms (58%), and not listed (95%). These features generally hold for all firms regardless of the type of pledged IP, although firms that pledge patents are more frequently listed on the stock market (10%) than those with pledge

[8] Another limiting factor of design rights is that industrial designs can also be protected by copyright, as long as it is an original work from an author. Copyrights exist without a formal procedure and under the condition of proof of authorship or ownership, enhancing uncertainty about the prior art of a design right.

trademarks (4%). The median firm that uses IP as loan collateral has about 68 employees and is 15 years old. Firms pledging combinations of IP types are the oldest and largest among pledging firms. In general, firms that pledge IP are larger and older than the average firm that owns IP but does not pledge it.

- Insert Table 2 here -

Notably, firms pledge specific rights rather than using their entire IP portfolio (see Panel B of Table 2). Conditional on pledging IP assets, 24% and 36% of firms that pledge trademarks and patents collateralize their entire portfolio, respectively. The average portfolio of firms that pledge trademarks contains 37 trademarks, of which 47% are used as collateral. Patent-pledging firms own, on average, 25 patents and use 64% of their portfolio as loan collateral. Hence, firms seem to choose specific IP assets as collateral, supporting the view that IP assets are relevant components in the loan agreement and that certain IP characteristics are favorable for collateralization.

Moreover, the data shows that small and private firms from the entire country use IP rights to back loans provided by ordinary French banks (see Figure IA3, Appendix B). The French economy is heavily centralized around Paris, with 31% of total GDP and 40% of R&D expenditures accrued in the Île-de-France region in 2019 (L'Institute Paris Region, 2022). Consistently, 44% of IP-pledging firms in our sample are located in this region. Apart from this clustering, only 29% of IP-pledging firms are located in the departments that comprise the three largest French cities of Paris, Marseille, and Lyon. As another feature, French savings banks represent the majority of lenders in our sample. Specifically, Crédit Agricole, Banque Populaire (BPCE), and Crédit Mutuel - Banque CIC are the top three providers from 2015 to 2018, accounting for more than 40% of IP-backed loans.[9]

As a last step, we assess the sectoral affiliations of firms that pledge IP using NACE industry codes. Panel A of Figure 2 displays the five largest sectors in which these firms operate and which comprise about 86% of the sample. Manufacturing constitutes the sector covering the largest share of IP-pledging firms, including 32%, 51%, and 69% of firms that pledge respectively trademarks, patents, or any combination thereof. Further, firms using trademarks as loan collateral operate in the sectors of wholesale and retail trade (26%), information and communications (12%), and finance (7%), while firms that use patents as loan collateral operate in scientific and other technical services (20%).

[9]We observe the lending institution for several pledges from 2015 onwards. Unfortunately, this information is not consistently documented, so we chose not to analyze it in more depth. Panel A of Figure IA3 (Appendix B) illustrates the firms' locations graphically; Panel B presents the credit institutions most frequently involved in IP-backed loans from 2015 to 2018.

- Insert Figure 2 here -

Since manufacturing firms are such a dominant group, we also consider the manufacturing sub-sectors in Panel B of Figure 2. This differentiated view shows that firms tend to operate in different business fields depending on what IP type they pledge. For example, manufacturers that pledge trademarks operate predominantly in the food, wearing apparel, and beverages industries (48%). In contrast, only 3% of patent-pledging manufacturers operate in these industries. Instead, they are active in the production of machinery, equipment (10%), or computer electronics (12%) sectors. Manufacturing of chemical and pharmaceutical products constitutes the largest intra-sectoral overlap between firms that pledge patents or trademarks. These patterns suggest that firms pledge IP assets at the core of their business activities.

3.4 IP collateral patterns outside of France

This subsection demonstrates that the key observations from Section 3.3 are likely to apply also outside of France. First, we assess the prevalence of trademarks among different IP types that are used as collateral in the US using the USPTO Trademark and Patent Assignment Datasets. We select changes in the legal status of trademarks and patents that likely correspond to IP collateralization. Figure IA4 (Appendix B) plots the number of respective events per year between 2000 and 2020. Over this timespan, the dominance of trademark-backed loans (67%) is similar to the prevalence of trademark collateral observed for France.

Second, SMEs are likely the most common type of firm that uses IP as loan collateral also outside of France, as documented in related literature. Bracht and Czarnitzki (2022) find that SMEs are the main users of patents as loan collateral in Sweden and the Netherlands. Mann (2018) provides cross-sectional evidence that US public corporations have a significantly lower probability of using patents as loan collateral than private firms. These statistics are likely to be downward biased due to the different registration requirements in the US. As such, underreporting is likely stronger for SMEs that are also more bank-dependent and subject to high informational opacity (Berger and Udell, 2006; Carbo-Valverde *et al.*, 2009) than for large firms. Overall, the presented aspects are consistent with the descriptive evidence in Section 3.3.

4 IP collateralization, debt financing, and firm performance

This section examines the relevance of IP assets collateral in line with Hypothesis 1. To do so, we proceed in two distinct steps. We start by analyzing the financing and other real economic activities of firms that pledge IP over time. More specifically, we create a matched sample

that allows us to compare IP-pledging firms to those that do not pledge IP but have similar time-variant and time-invariant characteristics before the first pledge. These analyses serve as the baseline for the second step, which is the assessment of the relevance of IP collateral in loan agreements. Here, we investigate how differences in the availability of alternative collateral matter for the effect of IP pledges. Amongst others, we explore exogenous variation in the availability of (non-IP) collateral using a quasi-experimental setting. In this context, we examine how IP pledges affect firms and, in particular, whether and how such effects vary across firms.

4.1 Creating a comparison group – a matching approach

We use a combination of exact matching and Coarsened Exact Matching (CEM) to obtain a suitable comparison group for IP-pledging firms. We draw potential matching partners from the full set of French firms in Orbis. The exact matching step requires matching partners to share the same industry affiliation, legal type (private versus public corporation), age, IP ownership (trademarks, patents, or both), and loan demand (zero loans or non-zero loans). The subsequent CEM matching identifies the closest matching partners out of the set of potential matching partners that fulfill the exact matching criteria. The matching parameters are firm size, capital structure, and asset tangibility, all of which are determinants of firms financing behavior (see Frank and Goyal, 2003). They are measured prior to the first IP collateralization to avoid reverse causality issues. CEM then assigns firms into strata in which all firms share similar characteristics. We keep the closest matching partner in each stratum to avoid issues associated with DID estimations that use largely imbalanced numbers of treated and control units (Baker *et al.*, 2022). This procedure yields a sample containing 1,028 firms, resulting in 19,971 firm-year observations from 1995 to 2018. Table IA2 (Appendix A) shows that there are no statistically significant differences in the means for several observable firm characteristics when comparing the two groups.

To further validate the matching approach, Figure 3 illustrates debt financing dynamics in the six-year time window around the firms' initial use of IP as collateral and those for the matched group. The year-to-year long-term debt growth rate for pledging firms ($DebtIssuance$) jumps in the year of the pledge and is significantly higher than in any other year of the observed time frame. This increase is significant in economic terms. On average, the relative increase in debt ratios is 2.15 percentage points (40%) from 5.41 to 7.56% (t-value: 2.94) in the year of the collateral event relative to the year before (see also Figure IA5 in Appendix B). Short-term debt issuances of IP-pledging firms remain unchanged around the pledge date. These results are in line with related studies, showing that IP-backed lending is associated with increases in

long-term debt ratios (e.g., Mann, 2018; Gill and Heller, 2024). Consistent with the matching approach, long-term debt issuance in the control group does not change.

- Insert Figure 3 here -

4.2 IP collateral and debt financing: Baseline model and results

For our baseline estimations, we use the matched sample and conduct a difference-in-differences (DID) analysis with two-way fixed effects. For each matched pair, the year before firms' first IP collateralization is our reference point, delineating the pre- and post-pledge period. The baseline specification thus reads as:

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

where Y_{ijst} is the value of the outcome variable for firm i operating in industry j in calendar year s, relative to the initial IP collateralization (in $t = 0$). In the main specifications, Y_{ijst} equals the long-term debt-to-asset ratio ($LongTermDebt$). X_{it} is a vector of firm-level control variables containing size, profitability, tangibility, liquidity, and cash flow; u_{ijst} is the idiosyncratic error term. We cluster the standard errors at the firm level. IP_i is a dummy variable equal to one for firms that use their IP as loan collateral and zero otherwise. $Post_{it}$ is a dummy variable equal to one for pairs in all years after the first use of IP collateral, both for pledging firms and the matched comparison group. α_{js} denotes the industry-calendar year fixed effects that account for aggregate economic fluctuations at the industry level, α_i are firm fixed effects that control for time-invariant firm-specific features, and α_t are (stacked) panel-year fixed effects that capture the unobserved factors associated with the relative timing to the initial loan event.[10] In a matched sample, these multi-level fixed effects control for loan demand (see Degryse *et al.*, 2019). The parameter of interest in Equation (1) is β. It captures the change in $LongTermDebt$ after the first use of IP as collateral relative to firms in the matched group. Table IA3 (Appendix A) contains detailed variable descriptions.

Table 3 presents the estimates of different variants of Equation (1). In Column I, we estimate a basic specification without fixed effects. The coefficients associated with IP and $Post$ are statistically insignificant, corroborating the matching approach. The coefficient for $Post \times IP$ is positive and statistically significant at the one-percent level, indicating that the long-term

[10] This estimation approach unlikely suffers from issues related to two-way fixed effect DID estimations with staggered treatments (see Baker *et al.*, 2022). First, we use a symmetrical time window of six years around the IP pledge without binning observations at the borders of the sample. Second, we use a stacked panel that measures time in years relative to the pledge and not calendar years. Third, the data contains equally sized groups of firms that do or do not pledge IP ("treated" versus "never-treated" units).

debt-to-asset ratios of pledging firms significantly increase after the initial IP pledge relative to non-pledging firms. The baseline specification displayed in Column II emphasizes this finding. The highly significant point estimate of 0.033 implies a rise in debt ratios of about 61%.[11]

Repeating the baseline estimation for different subsamples provides important nuances to this finding. Column III shows that IP pledges help firms to raise new debt financing. Specifically, the DID coefficient remains highly significant when we condition our sample on firms without any long-term debt outstanding at the end of the year prior to an IP pledge. Results in Column IV demonstrate that the baseline effects are robust to excluding years during which France faced economic recessions (i.e., 2003, 2008, and 2009) and, thus, are not sensitive to the specific market conditions. Furthermore, trademark (Column V) and patent pledges (Column VI) have comparable effects on firms' debt ratios. Both coefficients are positive and significant at the one percent level, while the coefficient for patent-pledging firms (0.044) is moderately larger than for trademark-pledging firms (0.030). However, estimates in Column VII show that there is no statistically significant additional effect of patent pledges (relative to trademark pledges) as captured by the interaction term $IP^{\text{pat.}} \times Post$.

- Insert Table 3 here -

We confirm these results using an event study design specification. In this setting, the pledge-indicator $Post$ is decomposed into a set of dummy variables, $Post^S$ and Pre^S, that are equal to one for all observations S years after ($Post^S \in [0, 6]$) and before ($Pre^S \in [-6, -2]$) the initial IP collateral pledge, respectively. These dummy variables are inteacted with the indicator IP. The reference year is $t = -1$. Figure 4 plots the associated coefficients for the full sample (Panel A) and split samples of trademark and patent pledges (Panel B). The results confirm the positive shift in the use of long-term debt by firms in the year of the pledge that persists over time. The insignificant small coefficients for the pre-pledge period suggest that pledging and matched non-pledging firms move in parallel trends prior to the initial use of IP collateral. Consistent with the previous findings, the effect sizes of patent and trademark pledges are comparable. These results are robust to omitting the last step of the matching procedure, in which we condition the matched group to only consist of the closest neighbor of the pledging firm (see Table IA4 in Appendix A).

- Insert Figure 4 here -

Next, we test how these effects vary along specific firm characteristics employing split sample

[11] This effect size equals the β-coefficient divided by the average pre-pledge debt ratio of IP-pledging firms (0.054). The interaction term components drop due to perfect multicollinearity caused by the fixed effects.

regressions. Financially constrained firms respond disproportionally to the use of IP collateralization, as illustrated in Figure 5. The graph plots the DID coefficients obtained from regressions that distinguish firms with respect to their size (employee count) and age. In terms of the magnitude and significance, the coefficients for SMEs (i.e., firms with less than 250 employees) are largest, while they are smaller and insignificant for larger firms. These findings are consistent with the idea that asset-backed debt financing is most relevant for SMEs (De Rassenfosse, 2012; Luck and Santos, 2023). Further, the effects are largest for firms in the second and third quintile of the age distribution, corresponding to ages of 12 to 28 years. For firms in the bottom quintile and the top two quintiles of the age distribution, the DID coefficients are positive but insignificant or at least smaller, resembling an inverted U-shape relationship. These findings may reflect that younger firms lack an established track record to approximate the returns associated with their IP to effectively use it as collateral. At the same time, older firms may already have access to other non-bank sources of financing and, hence, rely less on IP to raise debt.[12] We confirm these ideas by examining differences in the firms' ex-ante dependence on external financing, using the RZ index as proposed by Rajan and Zingales (1998). The results in Panel C of Figure 5 show that IP collateralization disproportionally raises the debt ratios of firms most dependent on external financing.

- Insert Figure 5 here -

4.3 The role of IP assets as collateral in loan contracts

This section uses the previous results as the reference to investigate whether IP assets are a relevant component in loan agreements, in line with Hypothesis 1. Specifically, we examine variation in *tangible* assets to draw inferences on the relevance of IP assets as loan collateral. The intuition is that the effects on firms' debt ratios are fully attributed to IP collateral, whereas they potentially arise (in part) from other unobserved collateral. Such an omitted variable issue would imply that we overestimate the relevance of IP collateral. In the following, we consider tangible assets as the observable part of firms' potential loan collateral. Tangibles are conventionally used to measure the availability of collateral on the firm level (see Frank and Goyal, 2003; Benmelech and Bergman, 2009), e.g., as in Equation (1). In the spirit of a pecking order, uncertainty about IP ownership rights may induce firms with relatively more tangible assets to pledge them instead of IP rights. In turn, if IP assets are a relevant component,

[12]The results are also in line with the idea that large established corporates rather pledge IP when facing economic hardship, as illustrated by the case of Alcatel-Lucent (see, e.g., Reuters, 2012). In separate regressions, we find that the effects of IP collateralization on debt financing do not vary across industries or geographical regions. To show this, we distinguish between firms active in different high-tech and knowledge-intensive industries as well as firms located in different urban or rural areas across France (see Figure IA6, Appendix B).

changes in the availability of tangible collateral should not lead to significantly different effects of IP loans on firms' debt ratios.

High and low tangibility: As a starting point, we examine whether the baseline effects of IP pledges vary depending on the availability of tangible assets. In general, IP-pledging sample firms are highly intangible-intensive. For example, intangibles account for about 90% of their firm value, as can be inferred from the mean tangible-assets-to-total-assets ratio of 10.3% (see Table IA2, Appendix A). In turn, for firms with relatively low shares of tangible assets, the relevance of IP collateral is likely higher.

Table 4 presents estimates on the baseline specification, comparing firms with different ex-ante levels of asset tangibility. The regressions displayed in Columns I to IV estimate Equation (1) for different subsamples that distinguish firms according to the share of tangible assets among total assets in the year prior to the initial use of IP as collateral ($Tangibility$). Subsamples delineate firms in the bottom half, bottom tercile, bottom decile, and top half of the tangibility distribution. The coefficient associated with the effect of IP pledges on debt is similar in magnitude and significance across specifications, indicating that the level of tangible assets does not qualitatively affect the associated effect of IP collateral on debt financing. Notably, the main effects also apply to firms with (close to) zero tangible assets (see Column III).

- Insert Table 4 here -

For robustness, we use an alternative approach in which we repeat the baseline specification for the full sample but add a triple interaction term $IP \times Post \times Tan^{\text{high}}$. In Column V, Tan^{high} is equal to one if the firm has above median levels of tangible assets, while in Column VI it is a continuous variable of asset tangibility. In both specifications, the coefficient of the triple interaction term is small and insignificant. Again, this finding indicates that IP pledges have no additional effect on the debt ratios of firms that own many tangible assets. The level of alternative collateral, as measured by tangible assets, is unlikely to drive our previous findings. Hence, these results *cannot reject* Hypothesis 1.

Quasi-natural experiment – Legal change in the pledgeability of tangible assets: Next, we augment the previous approach and exploit exogenous variation in the collateral value of tangible assets. The analyses showed that the level of tangible assets is unrelated to the baseline outcomes. However, it does not preclude that tangible assets are important in IP loan contracts, per se. We thus explore how exogenous variation in the availability of tangible assets for collateralization affects the baseline results.

Specifically, we investigate IP pledges in the context of the implementation of the *Ordonnance 2006-346* (hereafter the Ordonnance) in France in 2006. This major legislative change significantly enlarged the number of assets firms could pledge in loan agreements. In particular, it enabled the use of hard movable assets such as machinery and equipment. Aretz *et al.* (2020) show that this amendment offered firms new opportunities to pledge *tangible* fixed assets as collateral in loan agreements. The Ordonnance provides an ideal testing ground, as it allows us to causally infer the importance of alternative forms of collateral in IP-backed loans. The intuition is that a systematic use of tangible assets alongside IP assets as collateral would lead to stronger effects of IP-backed loans *after* the adoption of the Ordonnance, i.e., an omitted variable bias would be stronger from 2006 onward.

As an additional benefit, our analysis is based on the same data source for firm-level financials (Orbis) as Aretz *et al.* (2020). For consistency, we closely follow their empirical approach: We use the same time frame from 2001 to 2009 and adopt their classification procedure of treated and control group firms, which exploits cross-sectional variation in firms' pre-Ordonnance tangibility level to identify the effect of the Ordonnance on IP pledges. Specifically, we distinguish between firms with a tangible fixed assets-to-total assets ratio in the top quartile of the pre-pledge distribution and those below ("treated" high-tangible versus "control" low-tangible firms). As Aretz *et al.* (2020) document, the change in law disproportionally affected firms with a large amount of tangible fixed assets. We estimate variants of the following fixed effect regression specification:

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

which is a variant of Equation (1). The indicator $Ordonnance^{Post}$ equals one for firms (and their matched partner) whose IP collateral event was after the adoption of the Ordonnance and zero otherwise. Equation (2) includes the interaction of the DID-estimator with a post-Ordonnance indicator ($IP \times Post \times Ordonnance^{Post}$) and the interaction term of the base variables ($Post \times Ordonnance^{Post}$). The fixed effects capture the remaining base variables. The coefficient γ captures the general effect of the Ordonnance on firms' long-term debt ratios in the post-pledge period. The two coefficients of interest are δ and δ'. They capture the baseline effect of the use of IP collateral on the long-term debt ratio of IP-pledging firms (δ) and the additional effect of these IP pledges after the adoption of the Ordonnance in 2006 (δ'). Consistent with our empirical approach, a positive estimate on δ' would imply that IP collateral

is a less relevant feature of the IP-backed loan. We estimate this specification for the full sample and separately for firms with high and low shares of tangible assets, i.e., the treated and control group firms as defined above. Estimates in Column I of Table 5 show that the baseline effect applies when using the 2001-2009 subsample. The DID coefficient (0.038) is significant, positive, and comparable in magnitude to our baseline estimation (0.033, see Column II in Table 3).

More importantly, Table 5 also presents the results from estimating Equation (2). Column II presents the main specification. The coefficient associated with the triple interaction, δ', is not statistically significant. The insignificant coefficient indicates that the effect of IP pledges on debt ratios is not different before and after the Ordonnance, and mitigating concerns that unobserved use of tangible assets as collateral biases our findings on IP-backed loans. Columns III to VI present the results on the differential effects of the Ordonnance in more detail. The regressions presented in Columns III and IV use the subsample of "control" group firms as defined in (Aretz *et al.*, 2020), i.e., all low-tangible firms or trademark pledging firms outside the top quartile of the tangible asset distribution and their matching partners. The results confirm that the Ordonnance does not impact the effect of IP pledges on the debt ratios of relatively intangible-rich firms.

- Insert Table 5 here -

To further test the validity of the results, the regression displayed in Column V repeats the specification defined in Equation (2), using the subsample of high-tangible firms (i.e., firms "treated" by the Ordonnance as defined by Aretz *et al.*, 2020). The coefficient for the interaction term $Post_{it} \times Ordonnance_i^{post}$ is positive and significant at the ten percent level. This result shows that the Ordonnance is associated with an increase in post-pledge, long-term debt ratios both for tangible-rich IP-pledging and non-pledging firms. It is consistent with findings in Aretz *et al.* (2020), showing that the Ordonnance affected firms with a large stock of fixed assets. Importantly, however, the insignificant coefficient of the triple interaction term indicates no differential effect of IP pledges after the Ordonnance for these firms, which further undermines potential concerns of alternative unobserved collateral. For robustness, the regression presented in Column VI follows the same logic as the previous specification, but it uses the full sample and interacts the previously used regressors with an indicator for high-tangible firms (Tan^{high}).

Overall, the estimates provide consistent results and emphasize that alternative collateral is unlikely to drive our main results. As such, consistent with Hypothesis 1, these results can also be interpreted as follows: Changes in tangible assets' collateral value do not affect the cash flow attribution or the redeployability of IP assets. Consistently, facilitating the use of tangible

collateral does not affect the impact of IP-backed loans on firms' debt financing. These findings corroborate the view that IP assets are relevant components in respective loan agreements.

4.4 On the real economic implications of IP-backed loans

This section shows that the increased use of debt associated with IP collateralization has real economic implications. To this end, we first assess firms' year-to-year asset growth rates and distinguish between IP-pledging firms that raise their debt ratios after the pledge and those that do not.[13] Figure 6 plots the average asset growth rates for these two categories of firms and for the matched group of firms that do not pledge IP assets, using a symmetrical time window around the initial IP pledge. The subgroup of firms that pledge IP and raise their debt financing have significantly higher growth rates in the year of their use of IP collateral. This pattern is not observable for the subgroup of firms that pledge IP and renew loans and for non-pledging firms. It suggests that IP collateral for raising new loans supports firm-level growth.

- Insert Figure 6 here -

To assess this relationship in more detail, we reestimate similar regression as the baseline specification but use different firm-level growth measures as alternative dependent variables. As in Figure 6, we divide firms that pledge IP into those raising additional debt and those renewing loans. Panel A of Table 6 displays the DID coefficients for the respective subsamples where the dependent variable is either the log of total assets (Columns I and II), of total sales (Columns III and IV) or the number of employees (Columns V and VI). The results show large positive and statistically significant growth effects from using IP collateral on all growth indicators for the firms that pledge IP. The effects are particularly strong and significant for firms raising debt and smaller for firms renewing loans. These effects are also economically meaningful; the growth rate of firms that pledge IP and raise new loans ranges between 23 and 44% higher relative to the matched group that does not pledge IP. Overall, firms that raise debt financing via IP-backed loans are associated with significantly higher growth rates concerning total assets, size, and employment in the year of the pledge.

- Insert Table 6 here -

Furthermore, Panel B of Table demonstrates that these patterns are not exclusive to the specific subsamples chosen. The specifications are equivalent to before, only here we use the

[13] Specifically, we flag firms that either increase long-term debt holdings from zero to a positive amount of debt exceeding 2% of assets (corresponding to the mean increase in debt, see Section 4.1), or from any positive pre-pledge amount by at least a factor of 0.2. We check several combinations of these thresholds for robustness, which does not qualitatively affect the main conclusions. Firms that pledge IP but do not increase their debt ratios are considered to roll over or renew existing loans.

full sample of IP pledging firms (Columns I, III, and V) and a subsample of firms with below-median asset tangibility as defined before (Columns II, IV, and VI). For consistency, we only use pledges after the implementation of the Ordonnance. Across specifications, the coefficients are positive and significant. In addition to showing the robustness of the previous results, this finding also emphasizes that IP pledges positively affect the trajectories of intangible-rich firms.

5 IP characteristics as determinants of collateralization

5.1 Defining relevant characteristics for IP collateralization

This section examines distinct trademark and patent characteristics that affect the degree of pledgeability, testing Hypotheses 2 – 4. The analyses do not consider design rights as they are only pledged together with other rights. To assess the roles of identifiability, redeployability, and cash flow attribution, we estimate the following equation using (conditional) logistic regressions:

$$I(Collateral)_{pl} = \alpha_l + \delta\ Determinants_p + \theta X_p + u_{pl} \quad , \tag{3}$$

where $I(Collateral)$ is a dummy equal to one if the IP asset p is collateralized to secure loan l, and zero otherwise. *Determinants* is a vector of IP-level characteristics that relate to their identifiability, redeployability, and cash flow attribution. X is a vector of additional control variables, including filing year and technology class fixed effects. A vector of firm-event (i.e., loan) fixed effects, α_l, controls for further unobserved factors related to the parties involved in the loan agreement and their interaction. This comprises, for example, firms' innovative capabilities at the time of the loan grant or the banks' prior experience with IP-backed loans. Robust standard errors are clustered at the firm level.

Although determinants of identifiability, redeployability, and cash flow attribution should apply across asset types, legal specificities require us to use different measurement approaches for different IP types. Despite conceptual differences between trademarks and patents, however, the intuition behind the pledgeability determinants is mostly comparable. Table 7 provides an overview of the key definitions, relates the measures to the main hypotheses, and lists corresponding approaches to quantify the respective characteristics. Table IA5 (Appendix A) provides descriptive statistics on these measures.

- Insert Table 7 here -

5.2 IP identifiability and the timing of IP pledges:

Ultimately, the registration of a trademark or the grant of a patent validates their status as an identifiable asset. Figure IA7 in Appendix A illustrates the trademark registration and patent grant processes in France. To test Hypothesis 2, we distinguish between registered and not-yet-registered trademarks ($TM\_Registered$) as well as granted and pending patent applications ($Granted$), using binary indicators.

Descriptive statistics on the frequency of collateral events around the initial trademark registration and patent grant dates underline the importance of identifiability as the basic determinant for asset pledgeability. This test exploits that not-yet-registered and not-yet-granted IP assets can be used as collateral (Kieninger, 2020) and that we can observe the precise timing of application, registration, grant, and pledge dates. Panel A of Figure 7 displays the distribution of the pledge rate of trademarks in the months around the registration date. It shows a significant shift in the rate following the registration of the trademarks. Panel B shows a comparable pattern for patent grants, while the publication of the application appears to have an even stronger effect than the grant.[14] These observations directly illustrate the role of identifiability as a central feature of IP collateral, confirming Hypothesis 2. They corroborate the view that pre-grant uncertainty harms the ability to redeploy and evaluate IP, eventually lowering banks' willingness to accept pending IP applications compared to a formally granted right.

- Insert Figure 7 here -

5.2.1 Measuring redeployability:

In the following, we outline the specific measurement approaches of redeployability and cash flow attribution for trademarks and patents. We acknowledge that these two concepts are not mutually exclusive to the full extent. For example, a previous trademark transfer indicates the availability of a secondary market for that specific asset (i.e., its redeployability), such that previously transferred trademarks may have a higher pledgeability than those without prior transfers. At the same time, transfers provide actual market prices, facilitating the process of trademark valuation.

Trademarks: Complying with prior literature (e.g., Hochberg *et al.*, 2018), we consider prior transfers as a measure of redeployability. Specifically, we operationalize this feature using a dummy variable equal to one for trademarks already transferred before the first IP pledge

[14] Intuitively, the publication of the application gives a good indication of the legal boundaries of the right. We confirm this intuition by plotting hazard rates on the conditional probability of a patent pledged in a symmetrical time window around the respective events (see Figure IA8 Appendix A).

($Transferred$) and zero otherwise. In addition, we analyze the number of categories in which a trademark is protected, the so-called NICE classes. Counting the number of different NICE classes ($\#NiceClasses$) provides a measure of trademarks' breadth (e.g., Sandner and Block, 2011). This measure captures their legal boundaries and reflects the limits of exploitation of the exclusive right (Cabral, 2000; Graham *et al.*, 2018). Broader trademarks should be transacted on secondary markets more easily, i.e., have a higher redeployability.

Patents: As important patent-level measures for redeployability, we consider the number of distinct patent co-applicants ($\#Applicants$). A higher number of applicants significantly raises the complexity of legal ownership (Kuhn *et al.*, 2020). Hence, it is unlikely that a bank would accept a jointly owned patent as it significantly reduces the ability to re-sell the patent on the secondary market. Indeed, for this reason, French law does not allow pledges of co-owned trademarks, whereas no such law exists for patents. The number of patent applicants should thus negatively relate to its pledgeability. As an alternative patent-related redeployability measure, we follow the same intuition as with trademarks and quantify patents' technological breadth. Analog to trademarks, we calculate their number of distinct technology classes ($\#IPC4Classes$). Moreover, we also consider the number of backward citations in the patent literature as an indicator of technological breadth ($BwdCits\_pat$). Consistent with the above reasoning on trademarks, broader patents should have a higher redeployability.

5.2.2 Measuring cash flow attribution:

Trademarks: Prior research shows that product trademarks can be directly linked to sales while linking service trademarks to revenues is difficult (Block *et al.*, 2015). We thus distinguish service trademarks from product trademarks as they likely indicate lower cash flow relevance. To do so, we use the NICE classes, which explicitly differentiate service and product trademark classes. Specifically, we create a dummy ($ServiceMark$) equal to one if a trademark is listed in any service mark category and zero otherwise.

In addition, we exploit the fact that the cash flow attribution of trademarks should also vary within trademark classes. First, corporate trademarks represent the firms that stand behind the products or services provided to consumers and are highly value-relevant (Sandner and Block, 2011; Agostini *et al.*, 2015). As such, their pledgeability should be particularly high compared to other types of trademarks. Second, figurative trademarks informally convey the meaning of brands to the customers and rather have a supportive character (Krasnikov *et al.*, 2009). Hence, they should be less likely to be used as loan collateral.[15] We operationalize these two

[15]To illustrate, "NIKE" is a corporate trademark of the American sportswear designer and retailer Nike Inc.,

trademark types using dummy variables that mark corporate ($CorporateMark$) and figurative ($FigurativeMark$) trademarks, respectively.

As another dimension of cash flow attribution, we consider trademarks' use in commerce. In general, trademark renewals are due every ten years, and they indicate that the trademark is likely to be used in commerce. To operationalize trademarks' use in commerce, we thus count the number of previous renewals for each trademark until the pledge date ($Renewal$). We expect renewals to be particularly important since renewed trademarks most likely have some value to their owner and have an existing track record that facilitates evaluating revenue streams arising from the underlying product or service (Krasnikov *et al.*, 2009; Nasirov, 2020). Trademark renewals should thus be positively associated with collateralization. As an alternative measure to measure trademarks' use in commerce, we use information from the INPI registry on adjustments to its legal status. Specifically, we count the number of changes in the owner's addresses, legal oppositions, and licensing agreements ($IndicationUse$). These entries provide a good indication of whether the trademark is used in commerce (Sandner and Block, 2011). However, we acknowledge that this information may be subject to selection issues because registration of such adjustments is not mandatory in France.

Patents: To measure the cash flow attribution of patents, we again follow a similar logic as with trademarks. As such, we consider the number of patent renewals to be an important measure. In Europe, patents have to be renewed each year after filing. Like with trademarks, patent renewals should reflect the ability to link a patent to cash flows and the value to its owners (Trajtenberg, 1990; Hall *et al.*, 2005). In general, uncertainty about the associated revenues decreases with patent age as older patents have a longer track record by definition. Moreover, patents are filed at the early stages of the inventive process Hsu *et al.* (2022). Hence, especially younger patents are less likely to be relevant for cash flows. We quantify this dimension by calculating the age of a patent ($PatentAge$) as the number of years between the patent application and the pledge.

As another important value-relevant patenting dimension, we consider the number of active jurisdictions, i.e., the family size. Patent protection is a jurisdiction-based right; thus, patents seeking protection in several legal jurisdictions are likely to be of higher value (Harhoff *et al.*, 2003; Gill and Heller, 2024). More specifically, a larger family size indicates the relevance of the underlying technology for many markets and larger associated revenues. We compute the patent family size ($FamilySize$) as the number of jurisdictions in which a patent is active at

while the company's logo (the Swoosh) is a figurative trademark and subject to modifications over time. We follow previous studies (e.g., Agostini *et al.*, 2015; Nasirov, 2020) and flag corporate trademarks by string matching the legal name of a firm with the trademark text. Figurative trademarks only consist of figurative elements.

the time of the pledge. Alternatively, we also use the number of inventors ($\#Inventors$) as a value indicator.

Since lenders' ability to evaluate patent-related cash flows is vital for pledgeability, we regard the patents' technological complexity in this context. Indeed, complexity can harm patents' usefulness in market transactions (Colombo *et al.*, 2023). To quantify this dimension, we consider the reliance on scientific literature as measured by the number of backward citations of a patent to non-patent literature ($\#BwdCits\_nopat$). Patents with a higher reliance on scientific literature should be more complex than those with most reference to prior patents (Roach and Cohen, 2013).

5.3 IP characteristics as determinants for pledgeability

Trademark characteristics: We analyze IP characteristics as collateral determinants in a multivariate setting as presented in Equation (3). Table 8 presents the results of logistic regressions at the trademark level. All regressions contain registration-year fixed effects to account for general time trends. Column I presents the results for the full sample of trademarks that were valid in France at any point from 1995 to 2018. The estimates show that pledged trademarks are more often renewed, are more likely to be used in commerce, are more often transferred, have a greater breadth, and are less likely to be service trademarks. In Column II, we account for the highly skewed value distributions typically observed for IP and screen out low-quality trademarks by excluding those that were never renewed (e.g., Harhoff *et al.*, 1999; Arora and Gambardella, 2010). In Column III, we add industry fixed effects to account for heterogeneous patterns across sectors. In both cases, the previous results hold.

- Insert Table 8 here -

The regressions in Columns IV and V focus on the trademarks owned by pledging firms at the time of the collateral event. These regressions include firm-event fixed effects that control for the unobserved characteristics of the pledging firm, the bank, and the loan transaction. These fixed effects absorb a large share of spurious correlations but do not qualitatively affect the results. They show that these value indicators are significant determinants of pledgeability even within pledging firms. The coefficients associated with the indication of use, transfers, and service trademarks turn insignificant, suggesting that the effect was firm-year driven. Hence, it indicates that firms that actively use their trademark or own product trademarks are generally more likely to use (any of their) trademarks as collateral. Furthermore, we confirm that specific trademark types are more likely to be pledged than others: corporate (figurative) trademarks

have a higher (lower) probability of being used as collateral. Overall, the results show that redeployability and the ability to estimate expected returns via cash flows significantly raise the likelihood of a trademark being pledged.[16] The link to cash flows is crucial for determining pledgeability, particularly when considering variation within pledging firms.

Patent characteristics: Next, we examine the different patent characteristics as determinants for their use as loan collateral. Table 9 presents the results of estimating Equation (3) at the patent-level. Regressions presented in Columns I and II consider the universe of French patents regardless of their owner.

To allow a comparison with prior research on patent pledges in the US (e.g., Mann, 2018; Farre-Mensa *et al.*, 2020), the regression reported in Column I only comprises the number of forward citations and the filing-year and technology sector fixed effects. Our results for French patents are similar to those for US patents. They confirm that patents receiving more citations are more likely to be used in financial transactions. Column II comprises the full set of quality indicators as explanatory variables. Patents with more citations are still significantly more likely to be pledged, but the coefficient is more than halved compared to Column I. Patents with a larger family size, more inventors, and more patent references are more likely to be pledged. In contrast, patents with more non-patent references, IPC classes, and co-inventors are less likely to be collateralized. The latter findings on the patent-level controls are consistent with prior literature. For example, Zhang *et al.* (2021) show that patents linked to verified external inventions and those with a higher technological specification are pledged more often, i.e., reflected in more backward citations and fewer IPC classes, respectively.

- Insert Table 9 here -

Columns III to VI present the results of conditional logistic regressions that focus on the subsample of patents owned by pledging firms at the time of the loan event. The regressions reported in Columns III and IV mimic the ones in Columns I and II and add firm-event fixed effects. Including the patent family size as a regressor causes the coefficient associated with forward citations to turn insignificant. This insignificance may be because patent family proxies for the economic value of a patent, while forward citations measure its technological value (see Hall *et al.*, 2005). Hence, the results indicate that rather than its technological value, a patent's economic value (i.e., future expected cash flows) determines its pledgeability, which corroborates with Hypothesis 4. Patents with several applicants are less likely to be pledged, reflecting the

[16] Since trademarks are usually registered relatively soon after application and the time gap between publication and registration is naturally even shorter, we do not test for the registration effect in the regression framework.

increased administrative complexity of transactions with multiple stakeholders. Column V shows the relationship between age, grant, and the likelihood of being pledged. 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, significantly raising the identifiability of IP assets. Holding the grant information constant, older patents are more likely to be pledged than younger ones. These findings remain unchanged when adding all the quality indicators as regressors (Column VI). Overall, the results confirm our main Hypotheses 3 and 4, showing that pledged patents are more redeployable and their link to cash flows is higher than for the average (non-pledged) patent. In particular, the findings suggest that redeployability is especially relevant for the pledgeability of patents.

6 Conclusion and discussion

The surge in intangible capital that unfolded in the second half of the 20$^{\text{th}}$ century has caused a secular decline in commercial bank lending (Dell'Ariccia *et al.*, 2021; Falato *et al.*, 2022). It pushes bank-dependent borrowers to build up cash buffers and leads to financing gaps, especially for SMEs. While the transition towards an increasingly intangible-rich economy is a root cause of these issues, evidence suggests that intangible capital may indeed help firms satisfy their financing needs once it is protected by property rights. It is widely established that firms include IP rights as collateral in loan agreements, but little is known about the actual importance of IP assets in respective contracts and the underlying mechanisms. This paper deepens the understanding of IP collateralization by presenting new evidence along several key angles.

As a key feature, our analyses comprise *all* main industrial IP rights, trademarks, patents, and design rights. We find positive effects of IP pledges on firms' debt ratios and real economic activities. More importantly, we provide novel insights into the actual relevance of IP assets in loan contracts. Specifically, we test whether IP serves merely as an add-on collateral, amongst others, by exploiting a major change in credit law as a quasi-natural experiment. Summarized, our findings highlight the relevance of IP collateral and show that IP pledges raise the use of debt and stimulate growth irrespective of the underlying IP types and across a wide range of industries, with SMEs disproportionally benefitting from IP pledges. Moreover, we find that most IP-backed loans use trademarks, an asset that has been mostly overlooked by prior research on IP collateral. Consistent with the literature on tangible collateral, our estimations show that IP pledgeability requires asset identifiability. In addition to this, our analyses show that asset redeployability and cash flow attribution are key determining factors for IP pledgeability.

Overall, this paper sheds light on several previously undisclosed dimensions of IP collater-

alization and emphasizes its economic potential, especially for small, financially constrained, intangible-rich firms. From a policy perspective, the results suggest that fostering IP collateralization helps precisely those firms that have suffered from deteriorating borrowing conditions (i.e., small private firms) to leverage their IP assets. To enhance the use of IP collateral, it would be beneficial to facilitate IP redeployability and allow standardized valuation methods to estimate expected cash flows and IP value more reliably. From a managerial perspective, our results provide guidance for managers to consider their intangible capital as a means to secure external financing. This aspect is essential in the light of recent economic developments. Hence, firms should consider IP collateralization of different IP types and pay due attention to IP maintenance. Appropriating the strategic potential of IP should thus be of the highest concern to stimulate firms' access to external financing and, thus, growth.

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Tables from the main part

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

	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	4,186	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 and events by legal entities that use IP collateral 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 rights and loan events, distinguishing among trademarks, patents, and designs. The bottom displays the observations of the IP- and firm-level samples used in our analyses. Note that the corresponding firms (and observations) do not add up to the total, since firms may pledge any combination of trademarks, patents, or designs.

Table 2: Descriptive statistics on the firm types that use IP as collateral

Panel A: Firm types by IP collateral types

	IP-pledging firms by type				
	All	Trademarks	Patents	Combined	Non-pledgees
SMEs	78.5%	80.2%	85%	61.6%	96.5%
Private limited liability (LLC)	57.8%	58.9%	53.4%	55.0%	79.2%
Listed firms	4.8%	3.8%	10.2%	6.1%	0.5%
Median age	15	15	11	18	12
Median size (nbr. employees)	68	58	45	170	8

Panel B: Firms' trademark and patent portfolios

	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
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

Panel C: Summary statistics, main firm-level variables

	Obs.	Mean	SD	p10	p25	p50	p75	p90	min.	max.
FirmSize	17,269	16.743	2.146	13.971	15.417	16.902	18.175	19.350	0	24.496
FirmAge	17,259	24.654	16.157	5	11	21	38	51	0	53
TotalDebt	17,194	0.644	0.260	0.303	0.481	0.647	0.806	0.964	0.012	1.197
ShortTermDebt	17,159	0.263	0.181	0.043	0.119	0.232	0.383	0.542	0	0.655
LongTermDebt	17,183	0.087	0.170	0	0	0.001	0.103	0.279	0	1.133
Tangibility	17,192	0.125	0.159	0.001	0.015	0.064	0.178	0.331	0	0.939
Profitability	17,096	0.066	0.186	–0.058	0.012	0.071	0.142	0.233	–1.283	0.750
CashFlow	16,526	0.049	0.179	–0.082	0.016	0.061	0.118	0.193	–0.094	0.654
CurrentRatio	17,163	1.582	1.115	0.549	0.912	1.285	1.851	3.025	0.184	4.961
#Empl	11,843	387.9	1076.9	9	30	105	352	867	1	45,072

Table 3: High dimensional fixed effect regressions explaining firms' debt ratios

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
Timing 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 the estimates from fixed effect regressions that are similar to those 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 the comparison group. Column I shows the estimates of 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 comprise multi-leveled fixed effects in accordance with 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 collateralization; Column IV excludes the 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 between the collateralization of trademarks (Column V) or patents (Column VI), respectively. Note that these two categories are not mutually exclusive. Column VII is similar to Column II but adds an interaction term $IP^{pat.} \times Post$ that captures any additional effects of patent pledge ($IP^{pat.}$) on *LongTermDebt*. Standard errors (in parentheses below coefficients) are clustered at the firm level. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

Table 4: The role of alternative collateral available at the time of IP collateralization

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
Timing 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). 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 use of collateral. 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. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

Table 5: Quasi-experimental setting: the *Ordonnance 2006-346* and IP collateralization

Dep. variable	$LongTermDebt$					
	I	II	III	IV	V	VI
IP × Post	0.038***	0.030***	0.035***	0.033**	0.029*	0.031***
	(0.008)	(0.010)	(0.011)	(0.013)	(0.016)	(0.012)
IP × Post × $\text{Ordonnance}^{\text{Post}}$		0.023	0.026	0.019	-0.003	0.029
		(0.018)	(0.021)	(0.020)	(0.032)	(0.021)
Post × $\text{Ordonnance}^{\text{Post}}$		0.012	0.010	0.004	0.040*	0.002
		(0.015)	(0.018)	(0.021)	(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	-0.099	-0.043	-0.093
	(0.081)	(0.081)	(0.085)	(0.087)	(0.179)	(0.081)
Sample: Tangibility	Full	Full	<P75	<P75	>P75	Full
Additional controls:						
Firm-level	yes	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes	yes
Timing FE	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes
R^2	0.431	0.432	0.444	0.467	0.483	0.433
N	5,288	5,288	3,766	2,901	1,512	5,288

Notes: The table displays estimates from fixed effect-regressions explaining firms' use of debt. The sample is all matched firms from the main part during the years from 2001 to 2009. Column I repeats the baseline specification Equation (1) and Column II in Table 3) 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 is equivalent to the previous specification but includes firms that only pledge trademarks. Column V uses firms that with a fixed assets-to-total assets ratio in the top quartile in respective years. Column VI repeats Column II but adds interactions with Tan^{high} that is 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. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

Table 6: DID estimates relating IP pledges to firm growth

Panel A: Loan renewals, new debt issues, and growth

Dep. variable	Log (assets)		Log (sales)		Log (employees)	
	I	II	III	IV	V	VI
IP × Post	0.231**	0.085*	0.435**	0.136	0.245**	0.030
	(0.084)	(0.051)	(0.204)	(0.145)	(0.100)	(0.058)
Raising/renewing debt:	Raising	Renewing	Raising	Renewing	Raising	Renewing
Additional controls:						
Firm-level	yes	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes	yes
Timing 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	0.900	0.924
N	3,096	7,728	3,096	7,728	2,088	5,631

Panel B: Post-Ordonnance pledges, asset tangibility, and growth

Dep. variable	Log (assets)		Log (sales)		Log (employees)	
	I	II	III	IV	V	VI
IP × Post	0.261***	0.256**	0.273**	0.313**	0.170**	0.193**
	(0.059)	(0.082)	(0.126)	(0.142)	(0.070)	(0.096)
Sample: Tangibility	Full	<P50	Full	<P50	Full	<P50
Additional controls:						
Firm-level	yes	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes	yes
Timing FE	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes
R^2	0.952	0.952	0.777	0.793	0.922	0.925
N	4,763	2,747	4,763	2,747	3,158	1,769

Notes: The table displays the estimates of Equation (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 firms that pledge IP and significantly raise their debt financing after the initial use of IP collateral (Columns I, III, and V) and those that do not extend their debt financing (Columns II, IV, and VI). Panel B is similar to Panel A, only here the sample is all pledges in the post-Ordonnance era (i.e., since 2006). Columns I, III, and V display estimates for the full sample and Columns II, IV, and VI display regressions using the sample of firms with low asset tangibility. Here, the threshold is the median pre-pledge level of firms' tangible assets-to-total assets ratio. Standard errors (in parentheses below coefficients) are clustered at the firm level. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

Table 7: Overview on the key IP characteristics and pledgeability determinants

Determinant	Approximation concept	Variable name (hyp. relationship)
Trademarks:		
H2: Identifiability	Formal establishment via registration	$TM\_Registered$ (+)
H3: Redeployability	The breadth of the legal right and and availability of market values	$\#NiceClasses$ (+), $Transferred$ (+)
H4: Cash flow	Trademark types determining cash flow link and indication of use in commerce	$CorporateMark$ (+), $ServiceMark$ (–), $FigurativeMark$ (–), $Renewal$ (+), $IndicationUse$ (+)
Patents:		
H2: Identifiability	Formal establishment upon grant	$Granted$ (+)
H3: Redeployability	Breadth of the legal right and ease of reassigning ownership rights,	$IPC4Classes$ (+), $BwdCits\_pat$ (+), $\#Applicants$ (–)
H4: Cash flow	Ability to assign cash flows, value relevance, and technological complexity	$PatentAge$ (+), $FamilySize$ (+), $\#Inventors$ (–), $BwdCits\_nopat$ (–)

Notes: The table summarizes the different determinants of pledgeability, using the IP-level characteristics that are described in Section 5.1. All variables are listed also in the variable list in Table IA3 (Appendix A). The signs in the parentheses behind the variable names display the assumed relationship, corroborating the set of Hypothesis as outlined in Section 2.

Table 8: 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)
Transferred	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)
FigurativeMark				-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 the estimates of a logit regression 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 as outlined in Section 5.3. 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 were never renewed. That sample includes trademarks registered after 2010. Conditional logistic regressions in Columns IV and V contain only those trademarks that are owned by a trademark-pledging firm at the time of the initial collateralization. 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 clustered at the firm-level and displayed in parentheses below coefficients. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

Table 9: Logit estimations on the determinants of patent collateral

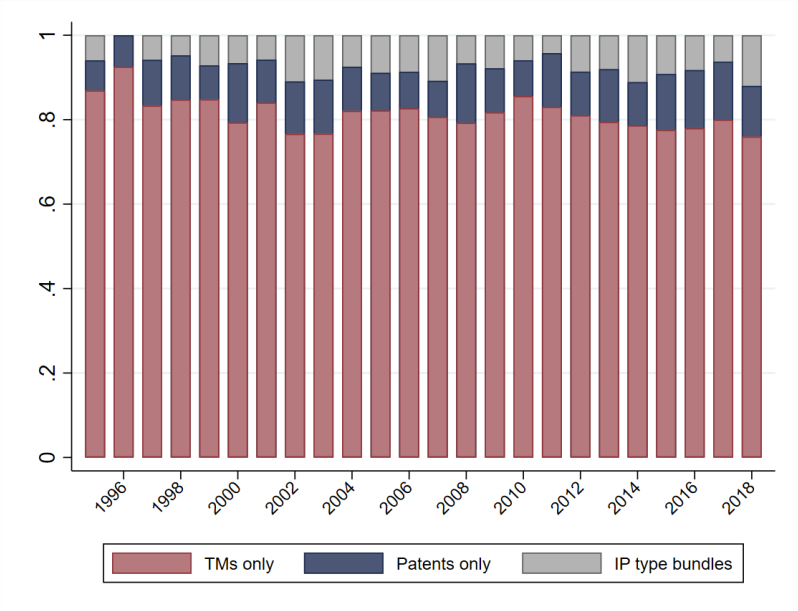
Dependent variable	I(Collateral)					
	I	II	III	IV	V	VI
#FwdCits, log	0.382***	0.182***	0.188***	0.071		0.047
	(0.018)	(0.024)	(0.051)	(0.054)		(0.051)
FamilySize, log		0.397***		0.302***		0.304***
		(0.024)		(0.089)		(0.091)
#Applicants, log		-1.608***		-2.367***		-2.362**
		(0.227)		(0.693)		(0.768)
#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 IA3 (Appendix A). Robust standard errors are clustered at the firm level. If not indicated otherwise, all regressions contain firm-event and filing-year fixed effects. The constant is included but not reported. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

Figures from the main part

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

Panel A: Share of IP types in events



Panel B: IP collateral and event counts

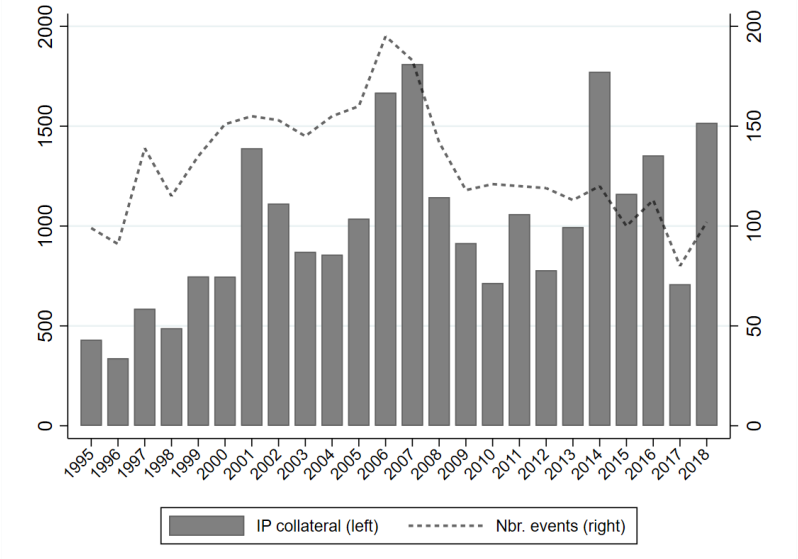
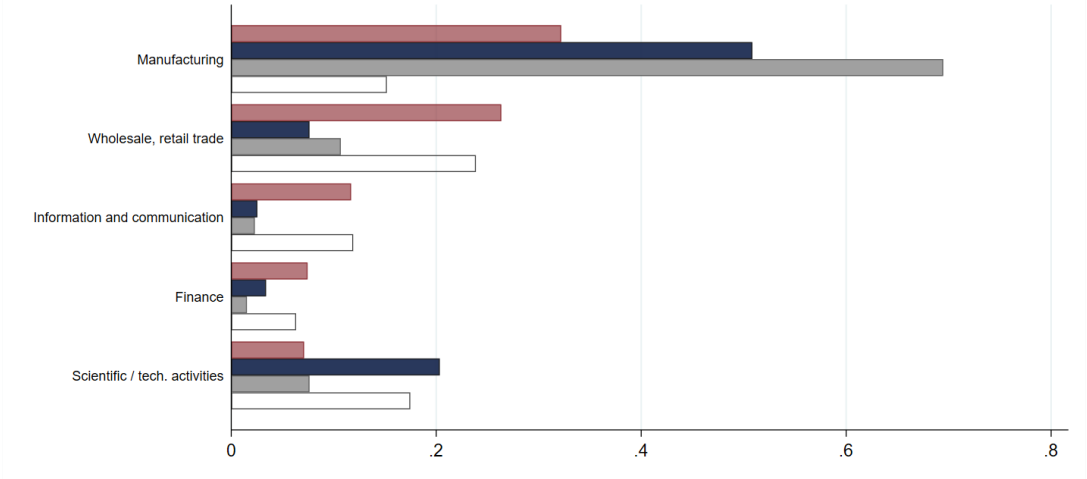


Figure 2: Sectoral affiliations across firm types

Panel A: Five sectors with the highest share of IP-pledging firms, by main NACE class



Panel B: Intra-sectoral distribution of borrowers in the manufacturing sector

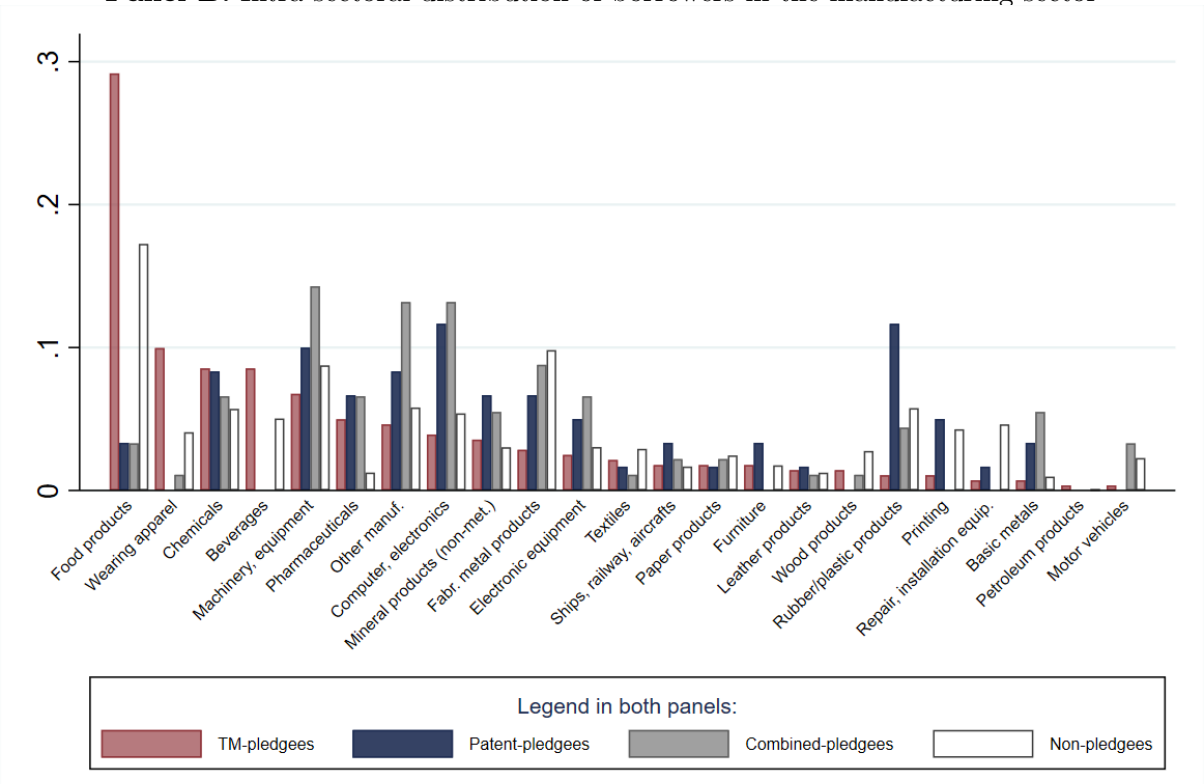
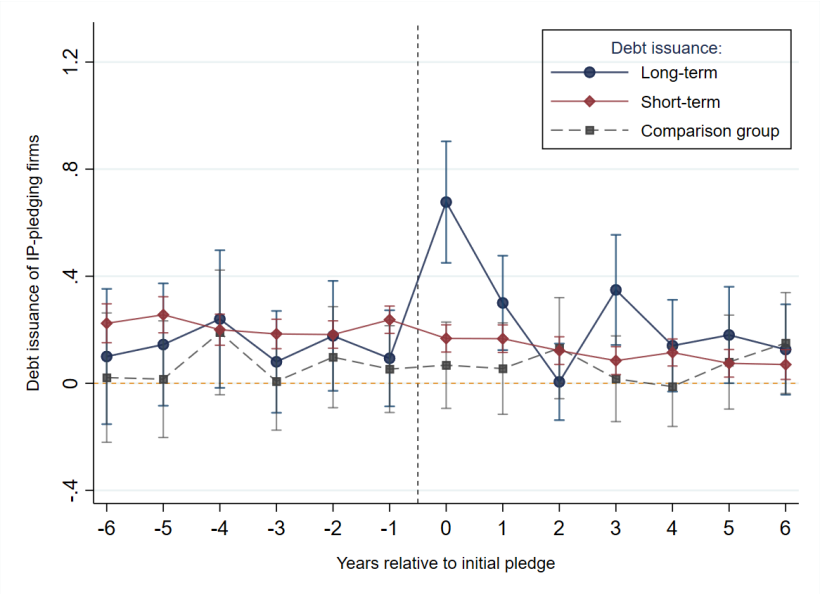


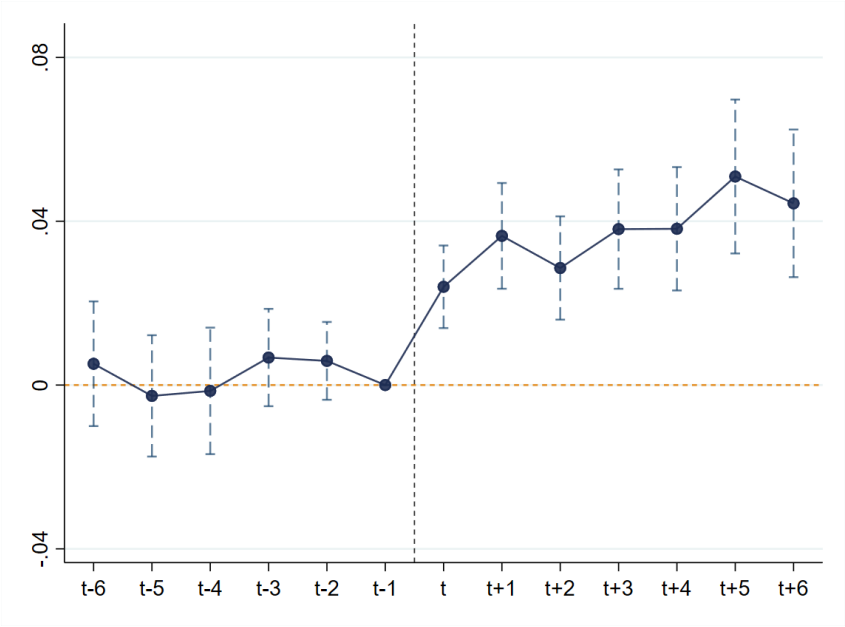
Figure 3: Debt financing activities around the IP loan event year



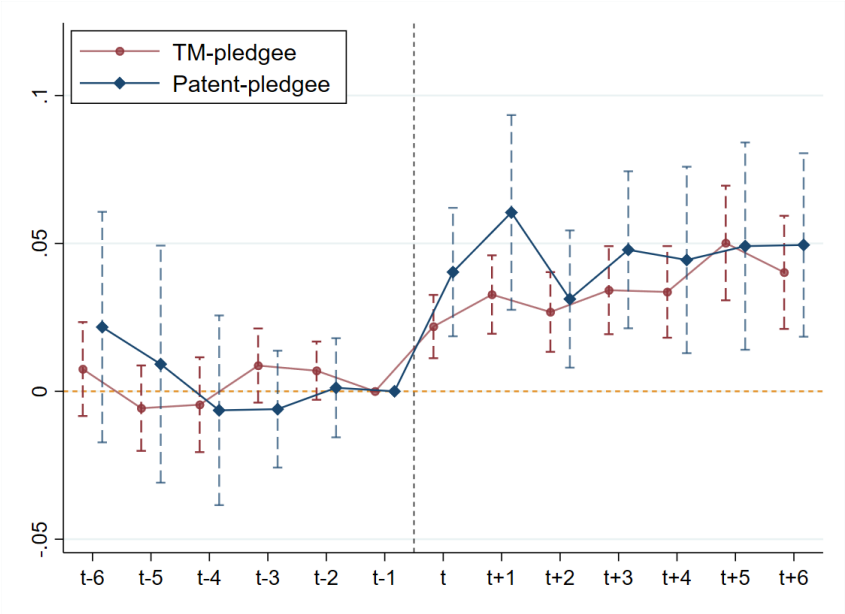
Notes: The figure plots mean values of the annual year-to-year growth rate, or debt issuance, in a symmetrical time window around the initial use of IP as collateral (t=0). Long-term and short-term refer to the year-to-year growth rate in long-term debt ($DebtIssuance$) and in short-term debt ($ShortDebtIssuance$) of firms that pledge IP. *Comparison group* refers to the year-to-year growth rate in long-term debt of matched firms that do not pledge IP. All variables are defined in Table IA3 (Appendix A). The whiskers span the 95 percent confidence intervals.

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

Panel A: Full sample



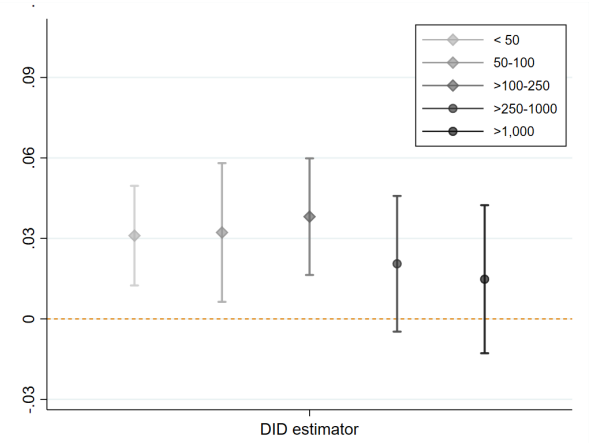
Panel B: Separating TM and patent pledges



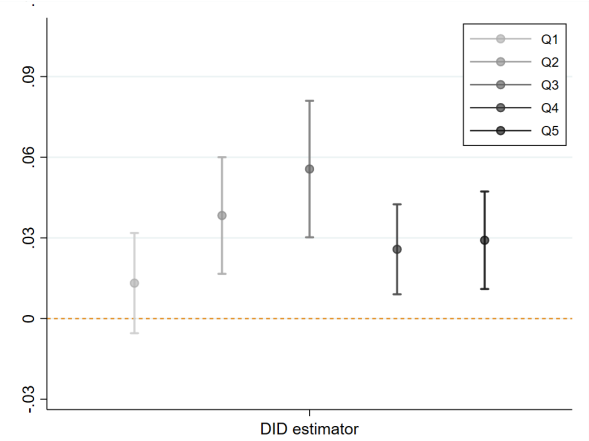
Notes: The graph plots the dynamic treatment effects using event-study regressions that explain the effect of the use of IP collateral on debt financing by firms relative to a matched group that does not pledge IP and over time. The graph shows β-coefficients from the following estimation equation: $LongTermDebt_{ijst} = \varphi X_{it} + \sum_{S=-6}^{-2} \beta_1^S (IP_i \times Pre_{it}^S) + \sum_{S=0}^{6} \beta_2^S (IP_i \times Post_{it}^S) + \gamma_{js} + \gamma_i + \gamma_t + \varepsilon_{ijst}$, where all variables are defined as in the baseline regression from Equation (1). The year before the initial pledge ($t = -1$) serves as the reference year. Standard errors are clustered at the firm level. Panel A displays estimates using the full sample. In Panel B, coefficients are estimated separately for IP pledges that include trademarks and patents, respectively. In both panels, whiskers span the 90 percent confidence intervals.

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

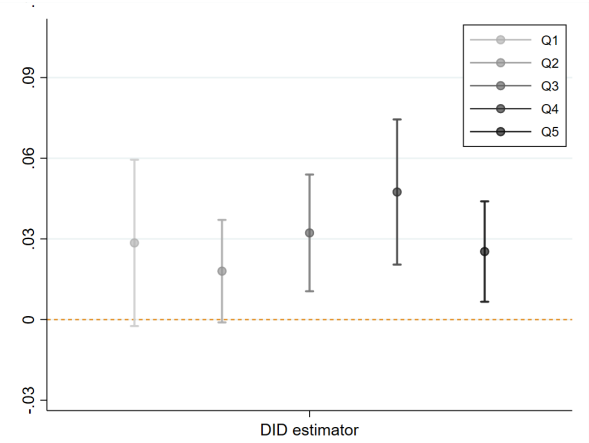
Panel A: Firm size (# Empl)



Panel B: Firm age (Quintiles)

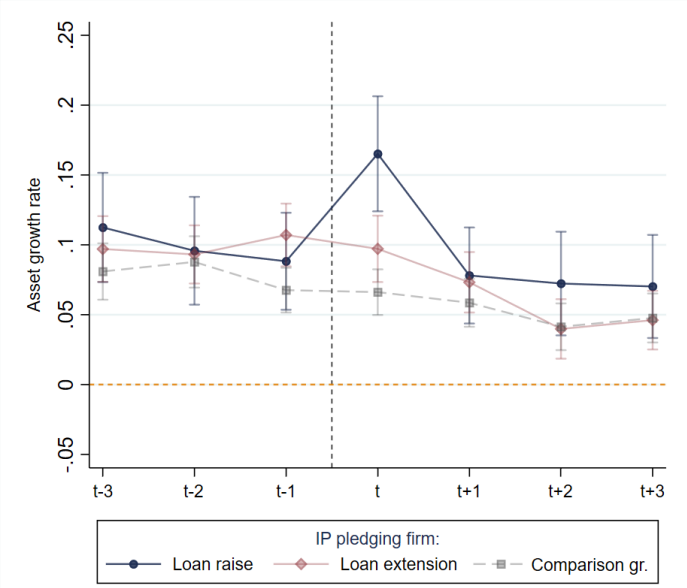


Panel C: RZ index (Quintiles)



Notes: The figures plot the coefficients of the DID estimators of the baseline regressions estimated for different subsamples that are based on three firm-level categories: size (measured as the number of employees), age (splitting the age distribution into quintiles), and dependence on external financing (splitting the RZ index distribution into quintiles); all of which are measured in the year prior to the initial IP collateralization. The RZ index is defined in Rajan and Zingales (1998) and measures the wedge between total capital expenditures and total net cash flow in the year before its first use of IP collateral (or of its matched firm). All variables are defined in Table IA3. In all panels, the whiskers span the 90 percent confidence intervals.

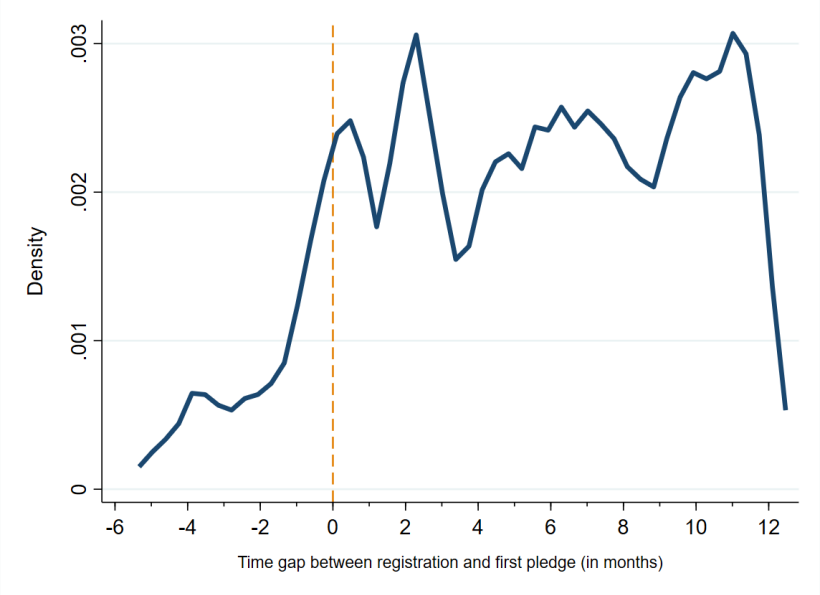
Figure 6: Asset growth rates relative to the pledge



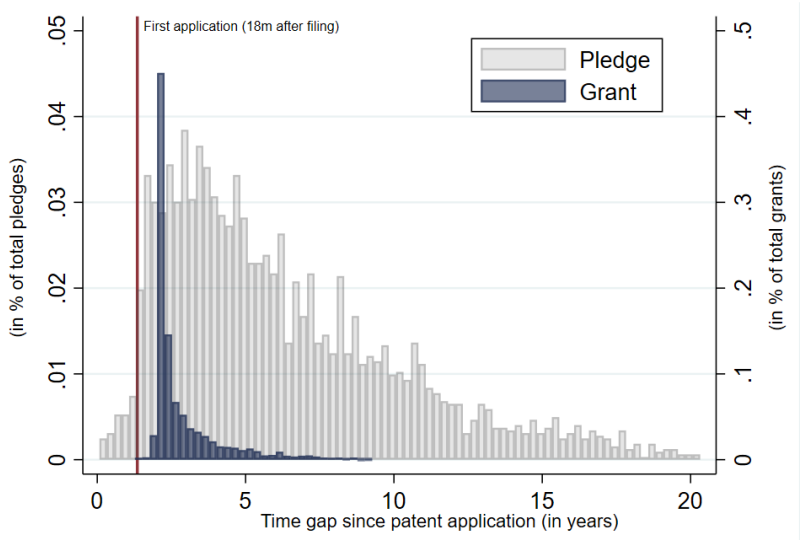
Notes: This figure plots average values of firm-level year-to-year asset growth rates, *AssetGrowth* as defined in Table IA3 (Appendix A). It distinguishes firms that pledged IP collateral and increased their debt ratios ("loan raise") as well as those that do not increase their debt ratios ("loan renewal") and the matched control group of non-IP pledging firms ("comparison group"). Whiskers span the 95 percent confidence intervals.

Figure 7: Identifiability of IP assets and pledgeability: the timing of IP pledges

Panel A: Pledge rates of trademarks relative to their registration date



Panel B: Pledge rates of patents across patent life



Notes: The figure display the timing of IP pledges in France between 1995 and 2018 relative to key legal events in respective IP lives. Panel A The figure plots the kernel density estimates for all trademark pledges that occurred within the six months before until one year after the registration date. The bandwidth is set to 10.0 (resembling the equivalent number of days) and the dashed orange line indicates the registration date. Panel B plots the distribution of patent pledges (gray boxes, indexed on the left y-axis) across their entire lifespan of 20 years. The red line indicates the mandatory disclosure date of the patent application, as stipulated by law 18 months after initial filing. The blue boxes reflect the grant dates of respective patents.

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 firms (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: 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: Comparison of sample means for pledging and comparison group firms

	Mean			
	IP pledging firm	Matched counterparty	Differences in means	*t-values*
Firm size (log. assets)	16.476	16.359	0.118	(0.816)
Age	20.913	21.800	-0.887	(-0.784)
Debt-ratio	0.656	0.645	0.011	(0.449)
Tangibility	0.103	0.117	-0.014	(-1.386)
Profitability (RoA)	0.031	0.029	0.002	(0.151)
Current-ratio	1.938	2.061	-0.201	(-0.667)
Cash flow-ratio	0.050	0.057	-0.007	(-0.606)

Notes: This table displays statistics on observable key financial variables using the matched sample described in Section 4.1. It compares mean values, distinguishing IP-pledging firms with the firms from the matched 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 IA3: List of variables

IP-level variables:	
*I(Collateral)**	Dummy = 1, if IP is pledged as loan collateral
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 citations made to patent literature
#BwdCits_nopat	Number of backward citations 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
Trademark-specific variables:	
Renewal	Count of trademark renewals (due every 10 years)
# NiceClasses	Trademark-breadth; Count of different registered trademark classes
Transferred	Dummy = 1, if trademark is transferred 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)
FigurativeMark	Dummy = 1, if trademark includes a figurative element
CorporateMark	Dummy = 1, if trademark represents the company name
Firm-level 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 first use of IP collateral (within matched strata) and zero otherwise
$Post^S$	Dummy = 1 for any firm-specific year S ($\in$ [1,6]) after the first use of IP collateral (within matched strata) and zero otherwise
Pre^S	Dummy = 1 for any firm-specific year S ($\in$ [-6,-1]) before the first use of IP collateral (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 pledge is in 2006 or later and zero otherwise

(*Continued on next page*)

Table IA3: List of variables (*continued*)

Other firm-level variables (Orbis `code`):	
SME	Dummy = 1 for firms with less than 250 employees (`empl`), and a maximum 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`)
RZindex	The wedge between capital expenditures (`exp_mat`) and firms' cash flows (`cf`) measured as `exp_mat-cf`)/`cf`.
# 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`)

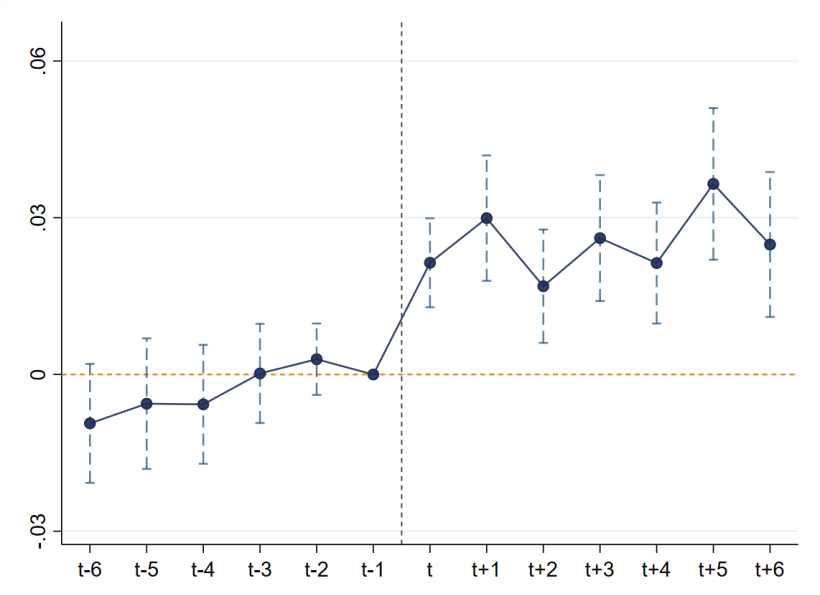
Notes: The table lists and defines all variables used in this paper. * indicate firm-level controls that are included in all regressions (unless explicitly stated otherwise). Firm-level variables are obtained from ORBIS; IP-level data is obtained from INPI and PATSTAT. For firm-level variables, corresponding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

Table IA4: Robustness tests using alternative specification of the comparison group

Panel A: DID regression estimates

Dep. variable	*LongTermDebt*					
	I	II	III	IV	V	VI
IP × Post	0.029***	0.027***	0.017**	0.028***	0.027***	0.038***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.011)
Post	-0.002***					
	(0.001)					
IP	0.007*					
	(0.004)					
Constant	0.032***	-0.083***	-0.055***	-0.071***	-0.086***	0.055
	(0.004)	(0.014)	(0.015)	(0.015)	(0.014)	(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
Timing 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

Panel B: Event-study regression design



Notes: The table provides results from complementary analyses on the baseline estimations in Section 4.2. Panel A displays high dimensional fixed effect regressions equivalent to Table 3, only here the matched 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 4.1. Standard errors (in parentheses below coefficients) are clustered at the firm level. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$. Panel B plots the coefficients for the baseline specification that are similar to Figure 4, only here the matched group of non-pledging firms is specified again without selecting the closest neighbors of the IP- pledging firms. The whiskers span the 90 percent confidence intervals.

Table IA5: Descriptive statistics on the characteristics of IP rights

Panel A: Trademark characteristics

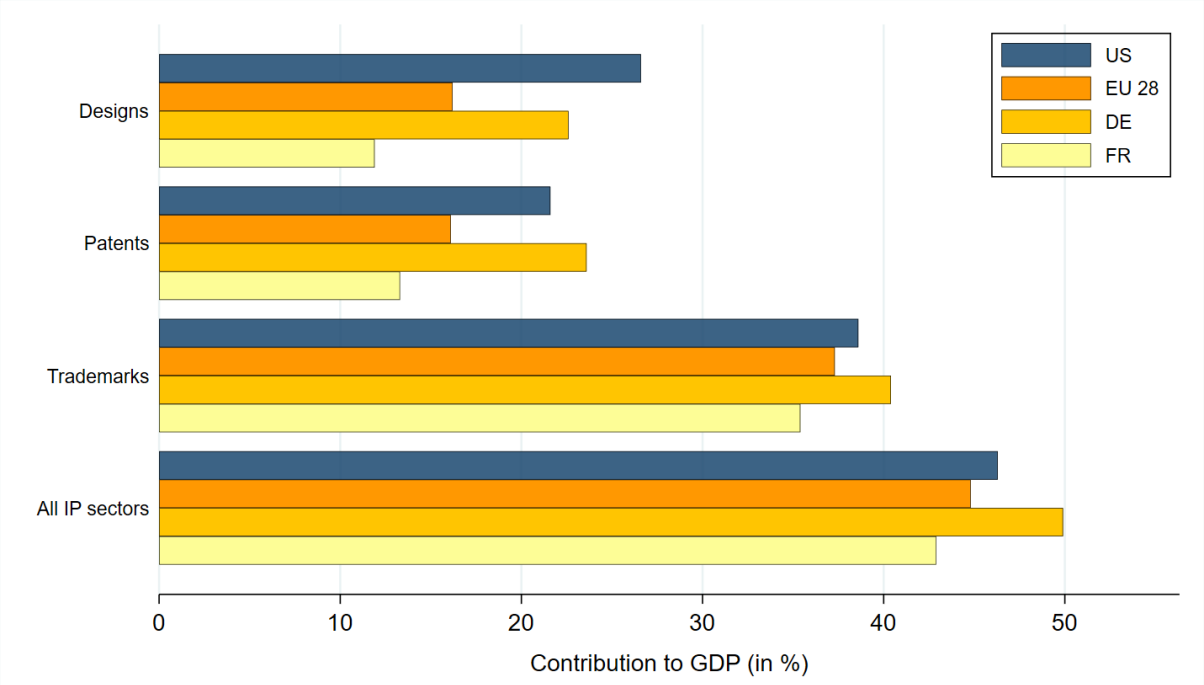
Variable	min.	max.	Mean		Difference
			Pledged	Not-pledged	
Renewal	0	3	1.268	0.802	0.466***
#NiceClasses	1	45	3.022	2.866	0.156***
Transferred	0	1	0.111	0.062	0.068***
IndicationUse	0	1	0.413	0.257	0.156***
ServiceMark	0	1	0.066	0.081	-0.015***
FigurativeMark	0	1	0.032	0.042	-0.010***
CorporateMark	0	1	0.013	0.003	0.010***

Panel B: Patent characteristics

Variable	min.	max.	Mean		Difference
			Pledged	Not-pledged	
PatentAge	0	20	6.491	5.168	1.323***
Granted	0	1	0.792	0.645	0.147***
FamilySize	1	59	5.687	5.004	0.683***
#FwdCits	0	237	8.809	9.938	-1.129***
#Inventors	0	10	1.999	2.535	-0.536***
#Applicants	1	5	1.021	1.067	-0.046***
#BwdCits_pat	0	18	4.217	3.852	0.365***
#BwdCits_nopat	0	30	0.375	0.808	-0.433***
#IPC4Classes	1	11	1.646	1.861	-0.215***

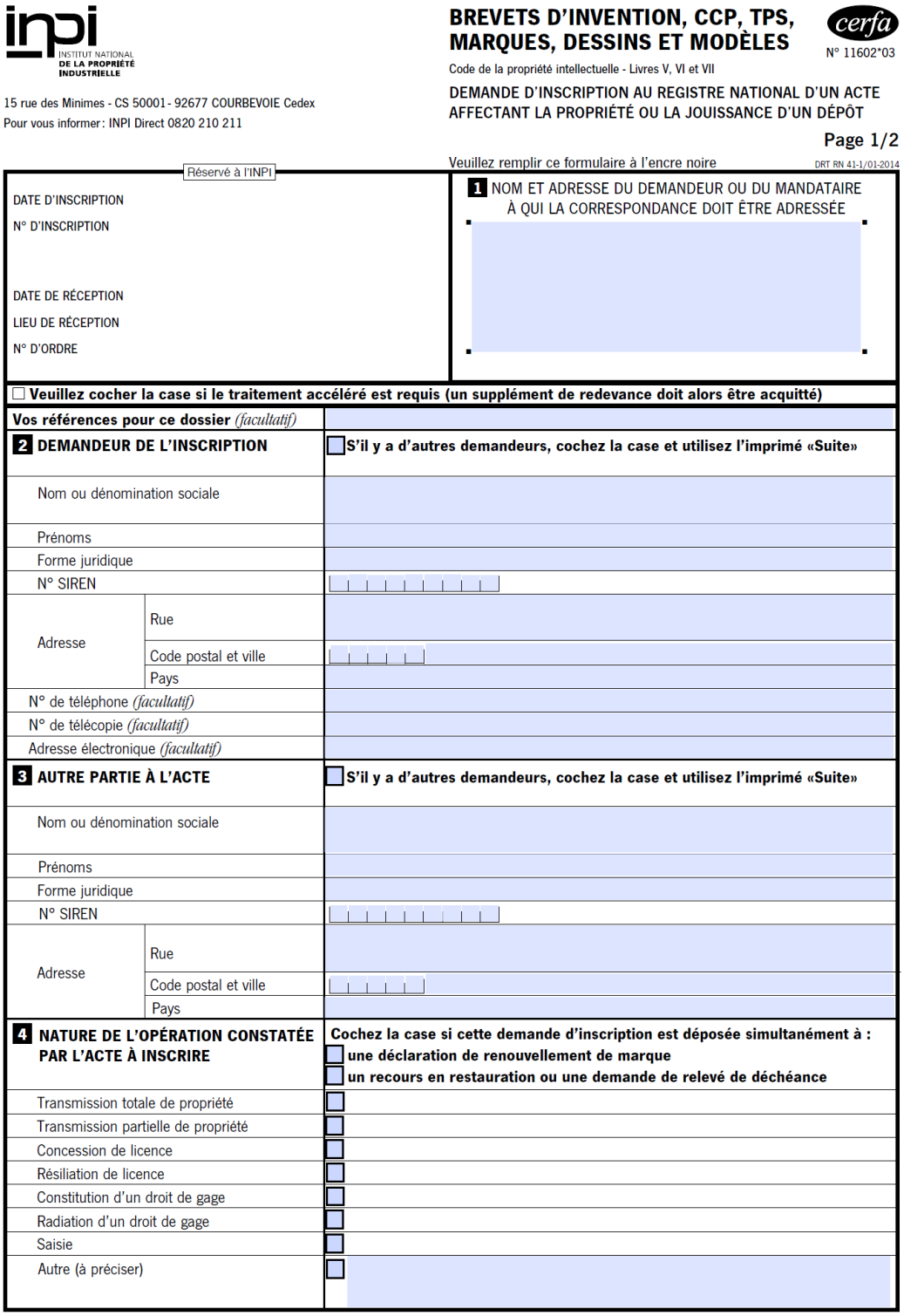
Internet Appendix B : Figures

Figure IA1 : Contribution of IP-intensive sectors 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. Industries are classified as IP-intensive, if the industry average of IP types 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



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)**

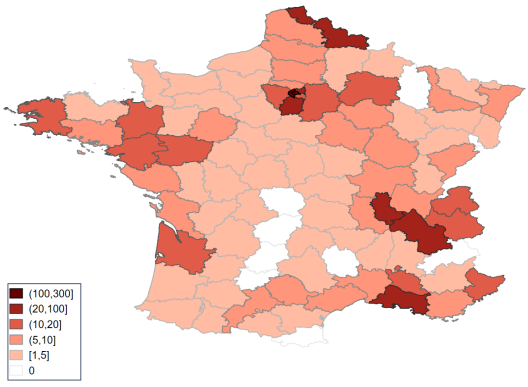
Vos références pour ce dossier *(facultatif)*		
2 DEMANDEUR DE L'INSCRIPTION		☐ **S'il y a d'autres demandeurs, cochez la case et utilisez l'imprimé «Suite»**
Nom ou dénomination sociale		
Prénoms		
Forme juridique		
N° SIREN		
Adresse	Rue	
	Code postal et ville	
	Pays	
N° de téléphone *(facultatif)*		
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*.

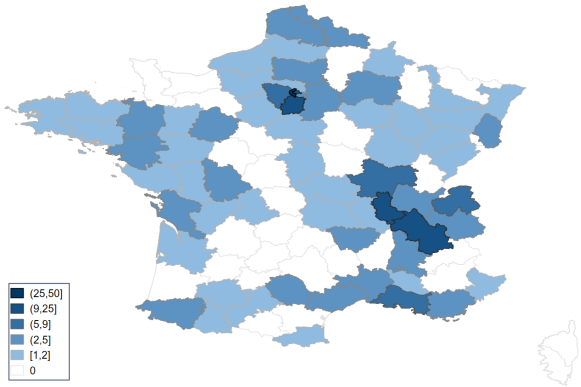
Figure IA3: Firm locations and lending institutions

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

Trademarks:



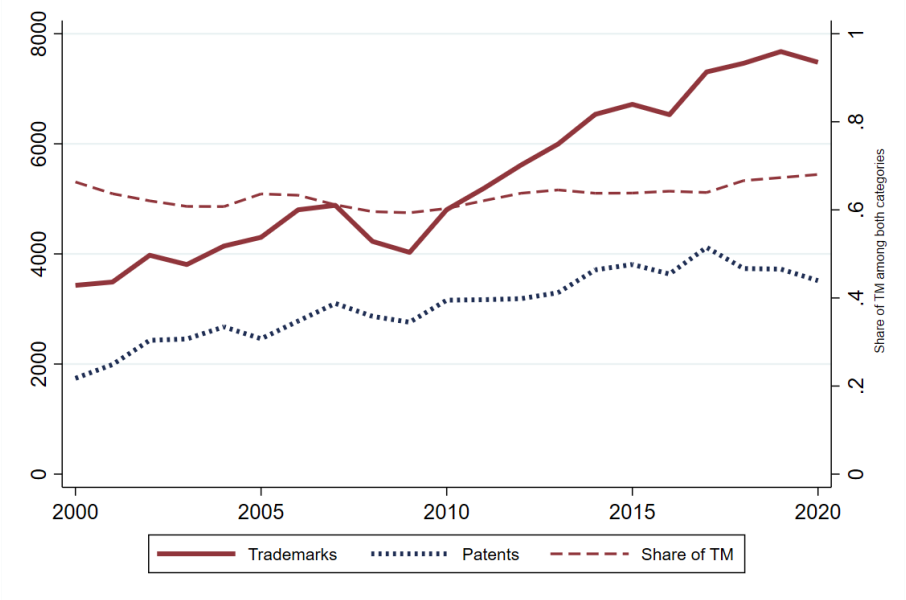
Patents:



Panel B: Most frequently involved credit institutions (2015-2018)

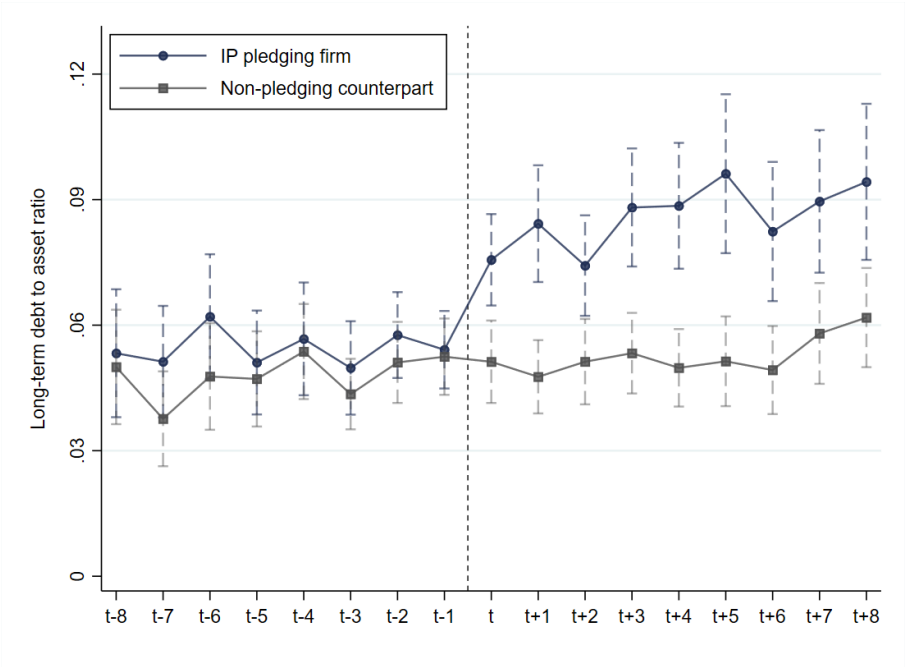
Credit institutions	Share	Cumulative
Crédit Agricole	16.7%	16.7%
Groupe BPCE	14.9%	31.6%
Crédit Mutuel	8.5%	40.1%
BNP Paribas	6.7%	46.8%
Société Générale	4.7%	51.5%

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



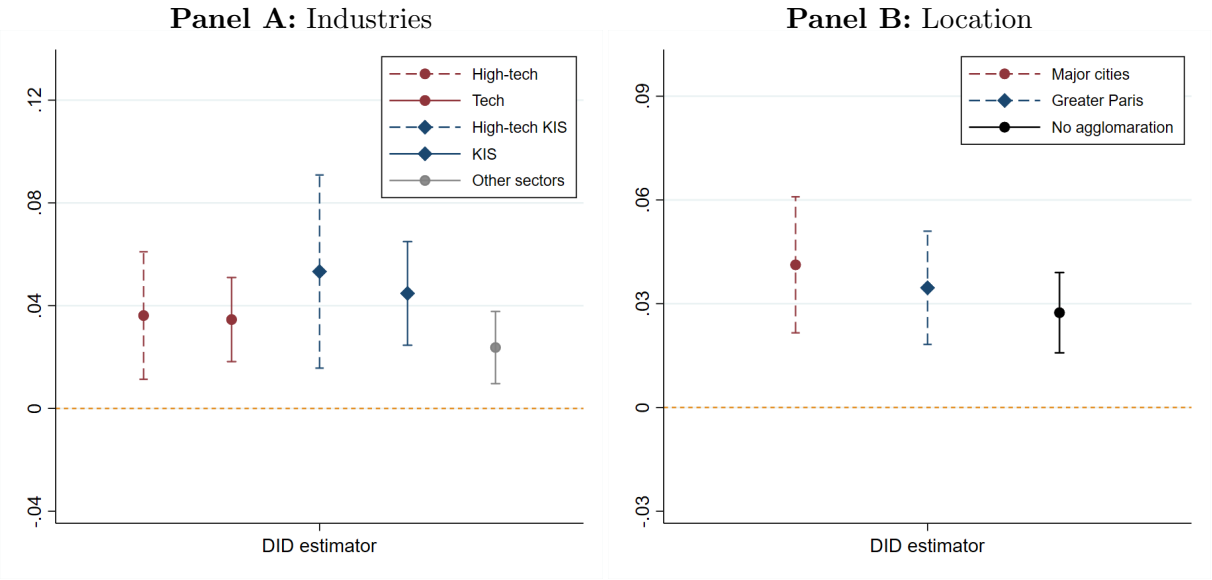
Notes: The graph displays the use of IP rights as loan collateral in the US for the years from 2000 to 2020, distinguishing between trademarks and patents. Data are obtained from the USPTO trademark and patent assignment datasets. Observations are marked as IP pledges whenever the convey text indicates the establishment of either a "security agreement" or a "security interest". The numbers of patent and trademark loan events are represented on the left-axis. 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 of long-term debt-to-asset ratios relative to pledge year



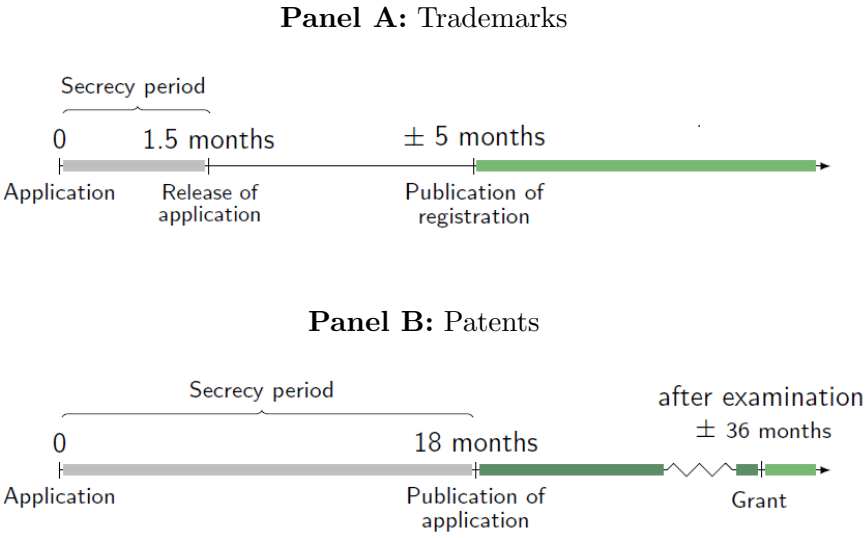
Notes: The figure plots mean values of firms' total debt-to-asset ratios in a symmetric time window of eight years around the initial pledge. The graphs differentiate between IP-pledging firms and matched non-pledging firms from the comparison group. The whiskers span the 95 percent confidence intervals.

Figure IA6: Sectoral and geographical differences in the baseline results



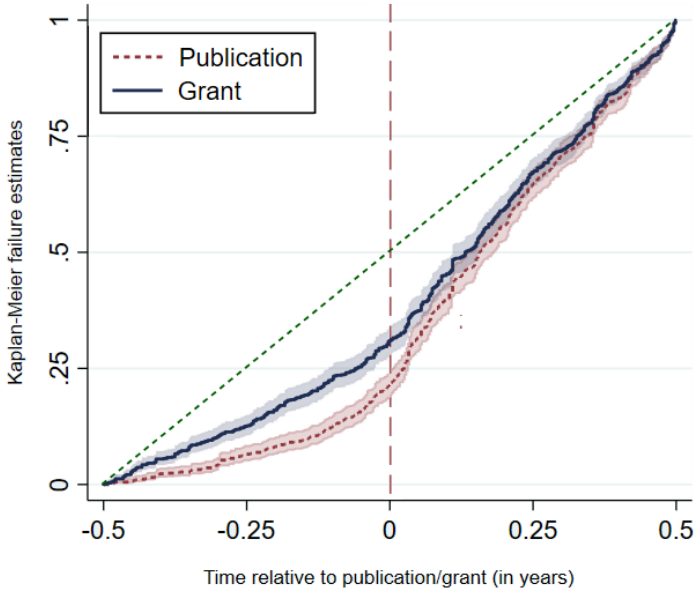
Notes: The figures plot the coefficients of the DID estimators of variants of the baseline regressions. Here, regressions are run on subsamples according to the sectoral affiliation of firms and the location of their headquarters. In Panel A, we use five different groups of sectors, by following the 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 separate firms according to the location of their headquarters intro 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, the whiskers span the 90 percent confidence intervals.

Figure IA7: Timelines of the main application steps for trademarks and patents in France



Notes: The figures presents a stylized timeline of the trademark (Panel A) and patent (Panel B) application process in France. Legal entities or individuals can apply for a trademark or patent at the French IP office (INPI) or the corresponding European authorities. During the secrecy periods public cannot view IP applications but only respective IP authorities. Law then stipulates at what point in time the applications are published, i.e., released to the public. Published applications give the IP a certain degree of identifiability. Still, they do not give rights to the creators of works, but simply inform the public that works might be protected in the future. In contrast, the registration and the grant are key dates as they provide the IP holder with the formally established right. The dates of the publication of the trademark registration and the patent grant are not legally defined. The indicated timeline refers to averages in our sample data.

Figure IA8: Hazard rates: Patent pledges relative to first publication and grants



Notes: The figure presents the Kaplan-Meier failure estimates (hazard rates) illustrating the probability of patent pledges over time, conditional on respective patents being pledged within these periods. Specifically, the graph displays the hazard rates for patent pledges in a one-year symmetrical time window around the publication of application and the patent grant. The publication of the application is fixed at 18 months after the initial filing, whereas patent grants are patent-specific (see Figure). For comparison, we use the relative timing of pledges to these events such that they can be stacked on top of each other. The green dashed lines illustrate the timing of IP pledges if they were evenly distributed across time. The shaded areas around the hazard rates reflect the 95 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 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 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 and that indicate they belong to the respective associations, such as alliances in the airline industries.

For all loan agreements, the contract must contain a 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. Maintenance entails, for example, 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 has to defend its ownership right in court.

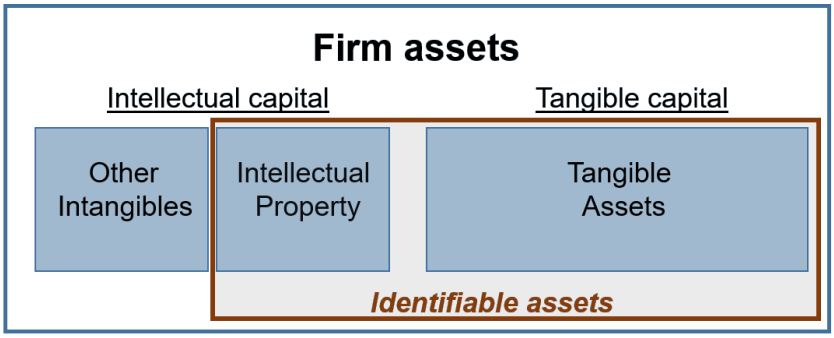
Resolving the contract: There are generally three possible scenarios for ending a loan agreement that each have different implications in the case of IP-backed loan contracts. First, the loan is repaid in full resulting in a release of any obligations attached to the IP collateral back to the original owner. Second, default of a loan without insolvency. In this case, the lender has the right to obtain a court order allowing the sale at auction (CC 2346) or to keep the respective IP 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, after 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-backed loan. 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

As outlined in the main part, identifiability of assets is the fundamental criteria (*conditio sine qua non*), determining whether an asset can be potentially used in contractual agreements. However, identifiability does not directly imply pledgeability, or, more generally, usability of IP for monitization strategies. Instead, inherent characteristics of IP assets determine the degree of usability. Overall, there are three main strategies how firms can monetize their IP, summarized in Table ID1.

Table ID1: Monetizing IP: the strategic options to exploit IP for financing purposes

Panel A: Terminology of identifiable (i.e., bankable) assets



Panel B: Summary of the three main monetization strategies

	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

First, selling IP has the benefit of obtaining a lump sum fee that may help firms to cover financing demands on the spot. Selling is a rationale option if the transfer price exceeds the expected private return to its owner, Moreover, selling comes at particular costs, all of which are based on the irreversible loss of ownership of the IP: owners forgo the option to use the subject matter protected by the respective IP right.[17] If the selling firm operates on the downstream market, buyers are likely to be competitors. They can also be non-practicing entities (NPEs)

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

that generate revenues from monetizing IP to practicing firms (see, Cohen *et al.*, 2019). A strategy to maintain the opportunity to use the IP even after transfer would be a sale-and-license back clause. Yet, like in a sale transaction, tacit knowledge would have to be displayed and control rights are lost.

Second, IP owners (i.e., licensors) can grant a licensee to use the IP in exchange for payment. Licensing of IP is well-documented in the economic literature, in particular patent licensing (e.g., Arora *et al.*, 2004). The obvious benefit for the licensor is to maintain the monopoly right of exploiting the IP while satisfying financial needs. 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 remains one key disadvantage of licensing. As such, licensing is explicitly not limited to granting the use of an IP, but on top of this tacit knowledge that is required for proper use of the right is transferred as well (Arora *et al.*, 2001). Hence, similar to IP right transfers, in licensing contracts the original IP owner obtains financing at the cost of displaying tacit knowledge, potentially of strategic importance. This is crucial, once licensees and licensors are competitors.[18]

Third, an IP owner can use the respective rights as collateral to obtain payment in the 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 at maturity. Unlike IP transfers and licensing, however, using IP 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. Specifically, IP collateral does not require the borrower to display any tacit knowledge to other market participants, nor does it mean losing control and ownership. From this perspective, collateralization appears as a promising strategy to monetize IP rights.[19]

[18] 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" to competitors. However, we acknowledge that licensing to competitors may even be beneficial for generating knowledge spillovers, as shown in the case of pharmaceutical patents (Kelchtermans *et al.*, 2022).

[19] 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.