Securing Debt in the Knowledge Economy: Evidence from Intellectual Property Registers*

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Abstract

This study examines the role of intellectual property (IP) rights as loan collateral in debt financing. We use novel data from French IP registers combined with firm-level financial information to systematically document the characteristics of IP-backed loans and IP-pledging firms. Exploiting a major reform of French security law as a quasi-natural experiment, our analysis shows that IP collateral facilitates access to debt financing in knowledge-based economies, particularly for small, intangible-intensive private firms. We further provide evidence that trademarks and patents can be meaningful components of collateral packages and that the legal framework plays a central role in shaping their use.

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I. Introduction

External debt financing is essential for funding investment and growth, especially among small and private firms (Carbo-Valverde, Rodriguez-Fernandez and Udell, 2009; Robb and Robinson, 2014; Kerr and Nanda, 2015). Over the past decades, the growing importance of intangible capital as a component of firm value has increasingly affected firms' financing activities (Falato, Kadyrzhanova, Sim and Steri, 2022; Crouzet, Eberly, Eisfeldt and Papanikolaou, 2022). Small and private firms tend to hold fewer pledgeable tangible assets, limiting their access to secured debt financing via traditional channels (Dell'Ariccia, Kadyrzhanova, Minoiu and Ratnovski, 2021). In this context, protecting intangible assets with intellectual property (IP) rights may help alleviate these financing frictions because it enables their use as loan collateral (e.g., Mann, 2018; Graham, Marco and Myers, 2018).

Despite the growing attention to IP-backed financing in knowledge-based economies, the absence of systematic and standardized loan registrations restricts the empirical analysis of firms' IP collateralization patterns and associated loan characteristics (see Jacobs, 2011; Graham *et al.*, 2018; Heller, Leitzinger and Walz, 2024). As a result, central questions regarding the potential of IP rights to enhance access to debt financing remain open. In particular, it is unclear whether IP rights constitute a meaningful element of the collateral package in loan agreements and whether policy initiatives can effectively influence their use.

In this paper, we leverage novel IP register data from France for the years 1995-2018 to take an initial step to explore these aspects. The French legal framework allows us to provide a comprehensive picture of firms' IP collateralization in a large, knowledge-based economy. France has strict registration rules for loan collateral, which require that collateralized assets are

individually listed in loan agreements and incentivize timely registrations at the national IP office. In addition, the register data contain the French national firm identifier (SIREN) and unambiguous identifiers for IP rights, which allow us to combine the IP collateral information with firm-level financial data from Bureau van Dijk and granular IP-level data on trademarks, patents, and design rights. To study the causal impact of IP collateral and the influence of the legal framework on its use, we examine a major reform in the French security law, the Ordonnance *2006-346*. The reform exogenously facilitated secured lending in France, with differential effects across firms and asset types.

This setting enables us to examine IP collateralization across multiple dimensions from two complementary empirical angles. First, we systematically characterize the main properties of IP collateral, IP-pledging firms, and IP-backed loans in France. We find that intellectual property collateral typically consists of rights with high redeployability and clear cash-flow attribution. Trademarks are by far the most frequently pledged type, accounting for 81% of cases. The majority of IP-pledging firms are well-established private small and medium-sized enterprises (SMEs) and have low asset tangibility. To examine specific loan-level characteristics, we analyze changes in the debt structures of firms in a matched sample of IP-owning firms. Our results show that IP collateral is primarily used to secure long-term rather than short-term debt and is associated with increases in firms' debt capacity along both the intensive (debt ratios) and extensive margins (the likelihood of raising debt). IP-backed loans are linked to moderately higher borrowing costs, which is consistent with lenders classifying them as relatively risky. These findings are similar across IP types and irrespective of firms' availability of tangible assets, that is, traditional forms of loan collateral. We also show that raising debt through IP-backed loans is associated with higher asset and employment growth, suggesting that IP-pledging firms are not

limited to marginal borrowers. Overall, these patterns emphasize the considerable potential of IP collateralization to secure financing, especially for small, private, and intangible-rich firms.

In the second part of the analysis, we examine a major policy reform in France, the Ordonnance *2006-346*, as a quasi-natural experiment to address two key questions: Are IP rights an meaningful component of loan contracts, and can policymakers guide the use of IP collateral through legal reforms? The Ordonnance liberalized secured transactions by expanding the set of eligible collateral and simplifying the collateralization process, with a disproportionate effect on *tangible* assets (see Aretz, Campello and Marchica, 2020). We therefore exploit cross-sectional variation in firms' pre-reform asset structure to identify differences in the propensity to respond to the policy change, reasoning that firms with a higher share of tangible assets before the reform experience a disproportionate increase in the set of pledgeable assets. Accordingly, we can compare firms with high and low ex-ante asset tangibility before and after 2006 using a difference-in-differences (DID) design.

To assess the importance of IP rights in loan contracts, we exploit the differential implications of the French security law reform for firms with varying availability of tangible collateral. If IP assets were not a meaningful component of the collateral package, the reform should differentially affect the size and cost of IP-backed loans for firms with high versus low shares of tangible assets. Conversely, if IP rights themselves serve as important collateral, these patterns should remain unaffected by the reform. Consistent with the latter view, we find that the Ordonnance did not significantly affect the size or cost of IP-backed loans, suggesting that IP assets constitute a meaningful component of the collateral package.

To study whether the legal framework can effectively shape IP collateralization, we take advantage of the differential effects of the Ordonnance on the pledgability of specific IP types,

depending on their complementarity with hard movable assets. As we show, the legal reforms enhance the pledgability not only of hard movable assets, such as machinery and equipment, but also of complementary assets. Indeed, we find a significant increase in patent pledges after the Ordonnance for tangible-rich firms, especially in patent technology classes related to machinery and equipment. This shift is not limited to volumes, but firms also pledge patents with more favorable properties for external financing, such as higher value, redeployability, and clearer cash flow attribution. In line with our reasoning, the use of trademarks as collateral remained largely unchanged. These results indicate that lenders adjusted their assessment of IP quality following the Ordonnance, highlighting the responsiveness of lending practices to legal change.

These findings advance our understanding of IP collateralization and its role in supporting external debt financing in knowledge-based economies. We construct a comprehensive dataset from administrative sources covering all IP collateral events in France since the 1990s and link these records to detailed IP- and firm-level characteristics. The data allows us to observe which IP assets are pledged, by which firms, and how these pledges shape loan terms and financing patterns. Our analysis thereby provides new perspectives on IP collateralization for a wide range of firms and IP assets. This broad scope is crucial for understanding of IP-backed financing, both because collateralization is not confined to large corporations but particularly relevant for SMEs (e.g., Mann, 2018; Luck and Santos, 2023), and because extending the analysis beyond patents to trademarks and design rights is essential given their economic relevance, frequent use, and suitability for financial transactions (Graham *et al.*, 2018; Chan, Mihm and Sosa, 2018; Hsu, Li, Li, Teoh and Tseng, 2022; Desai, Gavrilova, Silva and Soares, 2022).[1]

[1]Some financial analysts suggest that non-patent IP may be preferred as collateral, arguing that trademarks can be accepted more quickly as collateral since their cash flows "*can be proven easily*" (Financial Times, 2020).

As another key contribution, we explore our data using a quasi-experimental setting based on a major reform of French security law. First, we present novel evidence on the role of IP rights in the collateral package. This aspect is crucial given that loan agreements typically bundle different assets as collateral, such that assessing the contribution of individual asset types is challenging. Second, our results underscore the ability of legislators to support IP collateralization. This finding is particularly relevant because lending practices and firms' IP strategies often adjust only gradually over time (e.g., Haselmann, Pistor and Vig, 2010; Bhaskarabhatla and Hegde, 2014), despite the growing need for reforms to promote IP-backed financing and unlock the full financial potential of intangible assets (see Heller *et al.*, 2024). Specifically, we find that firms pledge higher-quality IP rights following the reform, highlighting the strategic nature of collateralization decisions and the responsiveness of market participants in adjusting lending practices to changes in the law. More broadly, it demonstrates how IP characteristics, beyond mere ownership, can support more effective access to credit. Our analysis therefore reinforces the idea that the pledgeability of IP rights is determined by the economic features of the underlying asset rather than its specific type, which is a pattern previously only observed in the context of tangible assets (e.g., Campello and Giambona, 2013).

Our study integrates three main strands of the literature. First, we relate to studies on the use and implications of collateral in external financing. Prior research highlights the importance of collateral in reducing financing costs, improving access to debt, and its implications for investment decisions, especially of financially constrained firms such as small or innovative companies (Stiglitz and Weiss, 1981; Benmelech and Bergman, 2009; Hall and Lerner, 2010; Norden and van Kampen, 2013; Kim and Kung, 2017). Second, we speak to the literature on how firms can monetize their IP assets to satisfy financing needs. In this context, prior work examines

the sale, licensing, and collateralization of IP rights (Arora, Fosfuri and Gambardella, 2001; Arora and Gambardella, 2010; Serrano, 2010; Mann, 2018). Third, we contribute to studies that investigate the role of IP rights in attracting financing (e.g., Hsu and Ziedonis, 2008; Block, De Vries, Schumann and Sandner, 2014; Farre-Mensa, Hegde and Ljungqvist, 2020) and, in particular, external debt financing (Saidi and Žaldokas, 2021; Horsch, Longoni and Oesch, 2021; Mauer, Villatoro and Zhang, 2022; Suh, 2023).

A small but growing number of studies, including ours, lie at the intersection of these three strands and examine IP rights as collateral in loan agreements.[2] Our work contributes to this literature by assessing the role of pledged IP rights in the overall collateral package of loan agreements. In our setting, French law prohibits the collective pledge of all business assets, requiring IP assets to be explicitly listed in loan agreements and allowing IP rights to be collateralized individually (see French IP Code Article L. 714-1). This feature is important because most existing studies examine settings in which blanket liens are common and IP pledges are tied to business goodwill. In addition, we provide new insights into the role of legal change in shaping IP collateralization. While prior research has examined how broad shifts in creditor rights or changes in IP law affect access to financing (e.g., Mann, 2018; Hegde and Luo, 2018; Chiu *et al.*, 2022; Gill and Heller, 2024), we analyze a reform that modernized the collateral law without strengthening creditor rights or IP protection. This distinction allows us to isolate how direct policy interventions, rather than indirect shifts in creditors' or debtors' enforcement power, influence the use of IP in loan agreements and their implications for corporate financing. Thus,

[2]While most existing work focuses on patents to study the effect of IP-backed financing on R&D investment, innovative activity, and performance (e.g., Amable, Kirsten and Chatelain, 2010; de Rassenfosse and Fischer, 2016; Mann, 2018; Hochberg, Serrano and Ziedonis, 2018), a more recent strand of the finance literature also considers trademarks as loan collateral (Chiu, Hsu and Wang, 2022; Du, 2023). In legal literature, the use of non-patent IP as collateral is widely discussed (Kieninger, 2020), but quantitative evidence remains scarce and limited to stylized facts (e.g., Nguyen and Hille, 2018).

our study provides new insights into the potential of IP collateral to promote access to financing in knowledge-based economies.

The remainder of the paper is organized as follows. Section II presents the institutional background, the data, and details on IP collateral, IP-pledging firms, and IP-backed loans. Section III introduces the quasi-natural experimental setting and provides causal evidence on the relevance of IP collateral and the role of law in shaping IP collateralization. Section IV concludes.

II. IP collateral in France: Background and loan patterns

A. Institutional background

IP rights and pledgeability: Our empirical analysis covers the three most common types of industrial property rights: trademarks, patents, and designs. Each of these IP types requires a standardized and centralized application process via public authorities. Once approved, IP rights grant their owners a temporary monopoly over the protected subject matter. However, the value of IP rights extends beyond exclusive ownership. The establishment of a formal legal right turns intellectual property into uniquely *identifiable* assets and, thus, makes them fungible for market transactions: Firms can use IP rights to obtain financing through sales, licensing, or collateralization.[3]

In principle, IP assets are therefore bankable, similar to more traditional forms of tangible collateral. However, in addition to the identifiability of an asset, the *redeployability*, *value*, and *cash flow attribution* are essential to ensure pledgeability. These properties relate to key

[3]Table IA1 (Appendix A) summarizes the key characteristics of trademarks, patents, and design rights. Our analysis does not cover personal rights, such as copyrights, as they exist without formal registration but *qua existence*. Appendix B details the different IP monetization methods.

determinants of banks' lending decisions, namely the ability and commitment of borrowers to make interest payments and repay the principal. Redeployability reflects the liquidation value of assets on the secondary market, i.e., the compensation value for the lender in case of loan default (Benmelech and Bergman, 2009; Kim and Kung, 2017). The cash flows associated with collateral provide a strong signal about its value to the debtor, i.e., the willingness to serve the debt (Holmstrom and Tirole, 1997; Jimenez, Salas and Saurina, 2006), and they allow lenders to better monitor the collateral value during the loan period (Shleifer and Vishny, 2010).

Empirical evidence shows that IP rights can generally fulfill these criteria. Redeployability is supported through (secondary) markets, since lenders are generally quick to resell seized IP rights in case of loan default (Ma, Tong and Wang, 2022). IP rights can have substantial value (Kogan, Papanikolaou, Seru and Stoffman, 2017; Chan, Hsu and Tseng, 2022; Hsu *et al.*, 2022) and they are highly cash flow relevant as they can be directly linked to revenues generated from sales (Heath and Mace, 2020; Hsu *et al.*, 2022). Their standardized granting process can further signal expected revenues (Saidi and Žaldokas, 2021). Nevertheless, other inherent characteristics of IP rights can also have adverse effects on their pledgeability. For example, ambiguities in the legal boundaries of IP rights persist even after the formal grant, creating agency issues due to imperfect contracting (Gans, Hsu and Stern, 2008; Hegde and Luo, 2018). Similarly, asymmetric information and uncertainty related to IP rights complicate precise IP valuation (see Hall and Lerner, 2010). In line with these concerns, secondary markets for IP rights remain relatively thin and fragmented compared to those for more traditional assets (e.g., De Marco, Scellato, Ughetto and Caviggioli, 2017; Serrano and Ziedonis, 2019).

Legal framework: In most jurisdictions, lenders possess the right to seize non-possessory interests in their debtors' property. This is a prerequisite for the use of IP rights as loan collateral. However, differences in administrative requirements lead to significant variation in the documentation of IP pledges, which poses a major obstacle to the systematic analysis of IP-backed loans. For example, many European countries do not have centralized registries (Heller *et al.*, 2024). In other jurisdictions, such as the United States, blanket liens are very common in loans to non-financial firms (Luck and Santos, 2023), and pledges of certain IP rights, such as trademarks, must cover the goodwill or other assets of the business in which the IP right is used (see Section 10 of the Lanham Act; 15 U.S.C. §§1051–1141n), which makes it difficult to assess the secured IP assets individually.

Importantly, the French legislative system mitigates several common, jurisdiction-specific obstacles to examining IP pledges. First, French law has a long-standing tradition of strict registration requirements for loan collateral (Attal, 2004; Aretz *et al.*, 2020). In particular, it provides strong incentives for registering IP events at the national IP office, the Institut National de la Propriété Industrielle (INPI), shortly after the effective date. Registration is required for lenders to enforce their priority claims and for borrowers to oppose infringements by third parties. Further, it entails only low administrative and monetary costs, consisting primarily of a simple form sheet (see Figure A2, Appendix) at a maximum cost of 270 Euros per loan. There are also strong incentives for a *timely* registration, since it is the order of the register entry and not the event date that determines the seniority of the claims (Riffard, 2016). Second, French law does not recognize general charges over all corporate assets in security agreements, meaning that assets are not added as collateral by default. The *general principle of specialty of security interests* and Art. 2325 and 2333 of the French Civil Code stipulate that security interests must be created for

each type of asset individually. Third, the law facilitates the standalone assessment of IP collateral. The French IP Code (Art. L.714-1) states that IP assets are freely transferable property that can be pledged independently of the underlying business. Accordingly, collateralized IP assets must be specified separately and independently from related tangible assets in loan agreements (see Séjean and Binctin, 2020).[4] While these properties are not exclusive to France, they rarely exist in combination in other jurisdictions. Overall, the French legal framework thereby is particularly well suited to analyze IP collateralization as it ensures a consistent, complete, and timely registration of IP pledges.

B. Construction of the dataset

We construct a novel dataset that combines information on IP collateral events, IP-level characteristics, and firm-level financial data. Our primary source is the INPI registers, from which we collect data on i) the effective dates of any loan agreement that uses trademarks, patents, or designs as collateral, ii) IP-level identification numbers, and iii) the unique national identifier of the pledging firm, the so-called SIREN number.[5] These three elements allows us to systematically link data on firms, IP rights, and loan events. The SIREN number is essential to connect the collateral data with firm-level financial data from Bureau van Dijk (BvD), which covers annual balance sheets and profit and loss statements. BvD uses the combination of "FR" and the SIREN as its internal firm identifier (the `bvdid`). Therefore, the SIREN enables a straightforward, 1:1 link between the register and the financial data. Further, the IP identifier allows us to connect the register data with information on all IP rights, which we retrieve from INPI's FTP server and the

[4] Appendix C provides further details on the legal issues of IP loan contracts in France.

[5] French authorities assign this unambiguous number to each firm upon creation. It uniquely identifies any firm located in France over time.

worldwide patent database PATSTAT Spring 2021 edition. This data comprises bibliographic information about the pledged and non-pledged patents and trademarks of IP-pledging firms.

The initial dataset contains 29,193 IP-event combinations, spanning the years 1995 to 2018. Removing foreign firms, individual entrepreneurs, and observations with missing SIREN results in 24,216 IP-event combinations that involve trademarks (18,058), patents (5,419), and design rights (449).[6] IP rights can appear in more than one event when they are repeatedly used as collateral. 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%).[7] We aggregate the data into an unbalanced firm-year panel comprising 1,816 unique French firms. We then exclude firms without financial data and observations with zero, negative, or missing total assets. To reduce the influence of outliers, we winsorize all continuous variables at the one-percent level. The final firm-level dataset covers 1,122 firms, corresponding to 17,269 firm-year observations. Table 1 summarizes the sample generation process. Table IA2 (Appendix) contains all variable definitions, including the corresponding Orbis codes.

- Insert Table 1 here -

C. The properties of IP collateral and IP-pledging firms

IP collateral characteristics: This section presents several stylized facts about IP collateralization. We start by examining the composition of loans by IP types, using the French

[6]To avoid biases from singular events, we exclude data related to the exceptional case of Alcatel Lucent in 2013, in which several thousand patents and hundreds of trademarks were pledged at once (see Reuters, 2012). Similarly, we focus on patents filed via the national route and by French firms to mitigate selection concerns.

[7]This distribution is consistent with the high use of trademarks relative to other IP types. In the EU, 53% of firms with at least 250 employees owned trademarks, while 18% owned patents between 2017 and 2019 (EPO-EUIPO, 2021). Among IP-intensive industries, trademark sectors contributed 82% to GDP, while patent sectors contributed only 37% (EPO-EUIPO, 2022). Similar patterns apply in the U.S., see Figure IA1 (Appendix).

register data from 1995 to 2018. Panel A of Figure 1 shows that the vast majority (81%) of IP-backed loans are secured by trademarks only, without patents or design rights. About 11% of loans exclusively contain patents, while 8% of IP-backed loans use at least two out of the three types of IP rights. Design rights are exclusively pledged in bundles with other IP types. These patterns remain broadly stable over time, although the share of patent-backed loans increases moderately during the second half of the sample period. 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 fluctuates between 800 and 1,800 throughout the sample period with no clear trend. Overall, the presence of trademarks, patents, and design rights confirms that all three IP types are, in principle, bankable assets that satisfy the identifiability criteria discussed above.[8] The observed patterns also align with statistics from other jurisdictions documenting the widespread use of patents and, especially, trademarks in secured loan agreements (e.g., Graham *et al.*, 2018).

- Insert Figure 1 here -

Furthermore, the data corroborate the idea that certain characteristics of IP assets are favorable for collateralization. For example, we find that many firms pledge specific rights rather than using their entire IP portfolio. The average trademark-pledging firm owns 36.7 trademarks, of which 47% are used as collateral. Patent-pledging firms own, on average, 27.3 patents and use 65% of their portfolios as loan collateral. Overall, merely 24% and 36% of firms that pledge

[8]Notably, design rights appear to have a relatively limited pledgeability, potentially reflecting that they are rather used as complements for technical and identity aspects of other assets (see Andersson, Ekman, Huila and Tell, 2023), making them difficult to transfer without complementary assets. As outlined in Section A, such separation is easier for patents and trademarks under European and French law: unlike in the U.S., trademarks do not have to be pledged alongside the goodwill or other tangible assets of the business connected with their use.

trademarks and patents, respectively, use their full IP portfolios. Appendix B details the specific IP-level characteristics associated with IP pledgeability.

Borrower characteristics: Next, we assess the basic characteristics of IP-pledging firms.[9] Table 2 shows that most of IP-pledging entities are SMEs (78%), privately-owned limited liability firms (55%), and not listed (94%). They are fairly mature but small and intangible-rich, with an average age of 25 years, 388 employees, and tangible assets accounting for only 12.5% of total assets. The median values are much smaller, implying right-skewed distributions; see Table IA3 (Appendix) for more details. IP-pledging firms are also moderately leveraged with an average total-debt-to-asset ratio of 64%. Their average interest payment for external debt is 2.6%. About half of the IP-pledging firms did not hold long-term debt prior to issuing their first IP-backed loan, whereas the other half of IP pledge events are loan renewals, i.e., extensions of existing long-term debt.

- Insert Table 2 here -

Table 2 also highlights important similarities and differences between trademark- and patent-pledging firms. On the one hand, their financing patterns are broadly similar in terms of the capital structure, debt usage, and financing costs. On the other hand, patent-pledging firms tend to be younger, smaller, and exhibit higher tangibility ratios than trademark-pledging firms. These differences likely reflect differences in business orientation. Consistent with this interpretation, we observe substantial heterogeneity in sector affiliation across firms depending on the type of pledged IP: The majority of IP-pledging firms are from the manufacturing sector, i.e., 32%, 51%,

[9]Our data comprises unconsolidated balance sheet information, reflected in the share of entities with a major external shareholder of 44%. We gather this information from the Orbis Ownership Database, which is available to us from 2007 until 2018. This way, we can retrieve ownership information on 944 firms, out of which 417 were majority-owned at one point in time, i.e., they had at least one shareholder with at least 50% ownership share.

and 69% of firms that pledge trademarks, patents, or a mix of IP rights, respectively (see Panels A and B of Figure IA3 in the Appendix). However, there is considerable variation across the manufacturing subsectors. Trademark-pledging firms are concentrated in the food, wearing apparel, and beverages industries (48%), whereas patent-pledging manufacturers operate in the production of machinery, equipment, and computer electronics (22%). Finally, also the geographic distribution of IP-pledging firms broadly mirrors the distribution of economic activity across France.[10]

D. IP loan attributes and debt structures

Estimation approach: We proceed by studying specific characteristics of IP-backed loans.[11] Since our data do not contain loan-level information, we rely on matched-sample regressions. Specifically, we compare pairs of firms with very similar observable characteristics over time until one firm pledges an IP asset as loan collateral. We expect firms to adjust their borrowing activities following their initial IP pledge, such that relative changes in balance sheet characteristics between IP-pledging firms and their matched counterparts are informative about the properties of IP-backed loans.[12]

Following the related literature, we combine exact matching and Coarsened Exact Matching (CEM) to identify the closest matching firms from the universe of French firms

[10]Economic activity in France is centralized around Greater Paris, where 31% of total GDP and 40% of R&D expenditures were accrued in 2019 (L'Institute Paris Region, 2022). Consistently, 44% of IP-pledging firms in our sample are located in this region. Still, overall, IP-pledging firms are spread across the entire country with similar distributions for trademark and patent pledges (see Panel D of Figure IA3).

[11]For a subset of loans, issued between 2015 and 2018, we observe the corresponding lending institutions. The credit institutions that are most frequently listed in IP-backed loans during this period are the Crédit Agricole (16.7%), Banque Populaire BPCE (14.9%), and Crédit Mutuel-Banque CIC (8.5%), Société Générale (4.7%). Because this information is not consistently available, we chose not to analyze this dimension.

[12]Assuming that respective changes can be attributed to IP loans seems reasonable because the firms in our sample (i.e., mainly SMEs) are unlikely to systematically obtain multiple loans within the same calendar year.

available in Orbis for the IP-pledging firms in the French register data (for similar applications, see, e.g., Azoulay, Graff Zivin and Wang, 2010; Balsmeier, Fleming and Manso, 2017; Campello, Kankanhalli and Muthukrishnan, 2024). Our approach requires potential matching partners to share the same industry affiliation, legal form (private versus public corporation), age, IP ownership (trademarks, patents, or both), and ex-ante loan demand (zero loans or non-zero loans before the initial pledge). As continuous CEM parameters, we consider different measures of firms' financing behavior before their first IP pledge, such as firm size, capital structure, and asset tangibility (see Frank and Goyal, 2003). The year before the IP-pledging firms' first IP collateral event serves as the reference period, delineating the pre- and post-pledge periods. CEM assigns firms with similar characteristics to distinct strata, from which we keep the closest matching partner. This approach ensures that firms are comparable during the pre-pledge period and we avoid issues associated with using largely imbalanced numbers of comparison units (Baker, Larcker and Wang, 2022). Table IA4 (Appendix) confirms that the matched firms are comparable along basic characteristics, both in terms of pairwise and joint significance. The final matched sample consists of 19,971 firm-year observations from 1995 to 2018 and 1,028 firms.

Figure 2 illustrates the debt financing dynamics in the matched sample around firms' initial use of IP as collateral, providing support for our empirical approach. The year-to-year long-term debt growth rate for pledging firms spikes sharply in the pledge year and is significantly higher than in any other year of the observed time frame. By contrast, the long-term debt growth rate of the matched firms and the issuance of short-term debt remain stable over time. We obtain similar results when considering the long-term debt-to-asset ratios instead of the growth rates (see Figure IA4, Appendix).

- Insert Figure 2 here -

To systematically examine IP loan characteristics, we estimate the following fixed effect regression, which captures how IP-pledging firms' financing patterns change after the IP pledge:

$$Y_{ijst} = \beta(\text{IP}_i \times \text{PLEDGE}_{it}) + \alpha_i + \alpha_{js} + \alpha_t + \phi X_{it} + \epsilon_{ijst} \quad , \tag{1}$$

where Y_{ijst} denotes different outcome variables related to the debt-financing activities of firm i, which operates in industry j, in calendar year s, relative to the initial IP collateralization (in $t = 0$). IP_i is a dummy equal to one for IP-pledging firms and zero for firms in the matched control group. PLEDGE_{it} is a dummy equal to one for both IP-pledging firms and their matched counterparts in all years after the first use of IP collateral. Hence, β is the parameter of interest and captures changes in IP-pledging firms' balance sheet characteristics after their first IP pledge, relative to the comparison group. Vector X_{it} contains firm-level controls, including size, profitability, tangibility, liquidity, cash flow, and the current ratio. Industry-calendar year fixed effects (α_{js}), firm fixed effects (α_i), and (stacked) panel-year fixed effects (α_t) account for industry-level macroeconomic fluctuations, time-invariant firm characteristics, and other unobserved factors associated with the timing of the initial pledge event, respectively. ϵ_{ijst} is the idiosyncratic error term. Standard errors are clustered at the firm level.

Loan characteristics: We estimate Equation (1) using different debt financing measures as dependent variables to assess the properties of IP-backed loans. Column I of Table 3 uses the long-term debt-to-asset ratios as outcome variable. The coefficient of IP $\times$ PLEDGE is positive and statistically significant at the one-percent level (0.033), indicating that the long-term debt-to-asset ratios of IP-pledging firms increase after the initial pledge by 3.3 percentage points

relative to non-pledging firms. With an average pre-pledge long-term debt ratio of 0.054, the estimated effect is economically meaningful and corresponds to an increase of approximately 61%.[13] Using the logarithm of long-term debt as the dependent variable yields qualitatively similar results (see Column II). This finding is important because it shows that firms raise long-term debt rather than merely changing their composition of debt and assets.

Furthermore, we assess changes along the extensive margin of long-term debt usage by employing an indicator as the dependent variable that equals one for firms with zero long-term debt outstanding (see Column III). The estimated coefficient (-0.082) implies a significant decrease in the share of firms without long-term debt by 8.2%. Together with the previous findings, this result suggests that IP loans promote long-term debt financing both on the intensive and extensive margin. Notably, when we construct the dependent variables using debt with a maturity of one year or less, the estimated coefficients become statistically insignificant and substantially smaller in magnitude (Columns IV–VI). This pattern suggests that IP collateral is primarily used to secure long-term rather than short-term loans, which is consistent with previous findings on the maturity structure of IP-backed loans (e.g., Mann, 2018; Gill and Heller, 2024).

Next, we estimate changes in interest burden associated with IP pledges. We measure interest rates as interest expenses reported in the income statement divided by average debt outstanding during the previous period. The coefficient on the interaction term is positive and weakly statistically significant (see Column VII), suggesting that the interest burden of IP-backed loans is moderately higher than for other loans. The effect is economically small, corresponding

[13]Note that the interaction term components are not estimated due to perfect multicollinearity caused by including firm and time fixed effects. Estimates in Table IA5 (Appendix) show that the time-varying firm-level controls have the expected signs (Panel A), e.g., compared with Frank and Goyal (2003). As a robustness test, Panel B shows that these results are not sensitive to considering different ownership structures.

to an increase in interest burden of 0.2 percentage points.[14] The result is robust to using the natural logarithm of total interest expenses as the dependent variable (Column VIII). These findings may reflect a relatively higher risk associated with IP assets and the preferential treatment of traditional tangible-asset-based collateral practices in Europe (see Heller *et al.*, 2024).

- Insert Table 3 here -

We confirm the results from Table 3 using an event-study specification, in which we replace the post-pledge indicator with a set of dummy variables, PLEDGE^{post_s} and PLEDGE^{pre_s}, 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. The results reported in Figure 3 confirm the positive effect of IP pledges on long-term debt, the moderate increase in the interest burden, and the absence of an effect on short-term debt. Notably, the estimates for the pre-pledge period demonstrate that IP-pledging firms and matched firms follow parallel trends prior to the initial pledge event. Figure IA5 (Appendix) shows that the results do not hinge on the specific measurement approach or distinct IP assets (i.e., trademarks vs. patents).

- Insert Figure 3 here -

Moreover, we uncover several additional patterns in the debt-financing results. First, the effects are more pronounced for small and financially constrained firms (see Figure IA6, Appendix). This finding aligns with the notion that asset-backed debt financing is particularly relevant for these firms (de Rassenfosse, 2012; Luck and Santos, 2023).[15] Second, we show that

[14] With an average interest burden of 2.6 percent (see Table 2), this effect implies a cost increase of 2,000 Euros for a bank loan of one million Euros, i.e., raising the interest burden from 26,000 to 28,000 Euros.

[15] The effects are strongest for SMEs and firms between ages 12 and 28. The former results confirm anecdotal

the overall effect of IP collateralization on debt financing does not depend on the availability of tangible collateral (see Table IA6). Since higher asset tangibility reflects greater availability of alternative collateral, one might expect the main effects to be driven by firms with more tangible assets. However, this is not the case in our setting, as the effects remain present even among firms with (close to) zero tangible assets. Third, we show that raising new loans is associated with significantly higher growth rates for IP-pledging firms (see Table IA7). This is important, given that related studies have raised concerns that extending collateral menus mainly benefits weak borrowers (e.g., Assunção, Benmelech and Silva, 2014). Our findings instead suggest that IP-backed loans do *not* merely benefit marginal borrowers.

III. Evidence from a quasi-natural experiment

A. The Ordonnance *2006-346* and IP-backed loans

This section sheds light on two central questions in the context of IP collateralization. First, are IP rights an integral component in loan contracts? Second, can legal reforms effectively guide the use of IP as collateral? To answer these questions, we exploit exogenous variation in the ability to pledge collateral in loan agreements arising from the implementation of a major amendment in the French security law in March 2006, the Ordonnance *2006-346* (hereafter the Ordonnance). The reform introduced several changes that are relevant to our analysis.

Most generally, the Ordonnance harmonized and simplified the overall regime for secured lending in France, mirroring U.S.-American practices at the time. Prior to 2006, French security

evidence suggesting that large established corporations rather pledge IP when facing economic hardship, as illustrated by the case of Alcatel-Lucent (see, e.g., Reuters, 2012). The latter results may reflect that for very young firms it is more difficult to obtain IP-backed financing, e.g., as they face problems to demonstrate the returns associated with their IP, despite potentially high demands.

law was highly formalistic and often ill-suited to modern intangible assets (Renaudin, 2013). Inspired by Article 9 of the Uniform Commercial Code (UCC) in the United States, the Ordonnance created a unified and flexible framework for pledges (Renaudin, 2013; Riffard, 2016). In particular, it specified that a security interest could be created over any present or future, tangible or intangible, or group of movable assets (*Code Civil (CC) 2333 and 2355*), provided the asset could be identified through a written description (*CC 2336*). These amendments placed effectively pledges of intangible movable property (so-called $nantissement$) on equal legal footing as pledges of tangible assets. Further, the Ordonnance modernized enforcement remedies for secured transactions, for example by allowing multiple creditors to simultaneously hold security rights over the same asset or asset pool.

As a specific element, the Ordonnance notably enlarged the number of assets firms could include in loan agreements. It stipulated that a contractual security interest no longer required dispossession of the debtor. Instead, a security interest could be created solely through a written agreement published in the national registers. This change significantly eased the use of tangible assets as collateral because borrowers no longer had to physically transfer pledged assets to creditors in order to establish a valid security interest. Firms could therefore continue using pledged assets, such as machinery and equipment, in production while simultaneously employing them as collateral (Renaudin, 2013; Castellano, 2015). These aspects had only a limited impact on the pledgeability of IP rights.[16] Instead, the reform primarily affected firms that had previously faced constrained in using movable fixed assets, such as machinery and equipment, by creating new opportunities to secure debt using these assets as collateral (Aretz *et al.*, 2020).

[16]Indeed, non-possessory charges to IP rights had been established already before 2006 under the French IP Code, which separately governs IP law in France (e.g., L.613-8 and L.714-7), as documented by the use of IP collateral before the adoption of the Ordonnance in our data (e.g., see Figure 1).

Taken together, the Ordonnance substantially enhanced the pledgeability of assets in France. While several provisions explicitly concerned tangible assets, others also apply to intangibles. This reinforces the idea that the reform was, overall, conducive to secured lending. Consistently, both academic and anecdotal evidence emphasize the importance of the Ordonnance for secured credit markets in France. For example, Aretz *et al.* (2020) highlight the importance of the amendments by ascribing to them a democratizing effect on debt financing. Similarly, practitioners such as Jean-Paul Decorps, Honorary President of the French Notarial Council, described the Ordonnance as a "*wide-ranging reform, which has led to the reorganisation of a significant part of our Civil Code, [...] to simplify the creation of securities*" (Decorps, 2014).

Crucially for our empirical analysis, the effects of the Ordonnance should vary with firms' availability of specific asset types. In particular, firms with larger shares of fixed tangible movable assets benefited more from the reform because it expanded the range of assets that could be used as collateral. We explore this feature to test both the relevance of IP collateral in loan agreements and the impact of changes in secured lending law on IP-pledging behavior. In both analyses, we use our sample of IP-pledging firms and rely on cross-sectional variation in firms' pre-2006 tangibility ratios to identify the corresponding effects. We distinguish between firms with a high and low tangible fixed assets-to-total assets ratio in the years prior to the implementation of the Ordonnance. This approach is consistent with other studies the firm-level implications of the Ordonnance (e.g., Aretz *et al.*, 2020).

To ensure that our approach of comparing firms with high and low shares of tangible assets is suitable to capture differences in financing activities attributable to the Ordonnance rather than pre-existing balance sheet or investment characteristics, we test for parallel pre-treatment trends. Figure IA7 (Appendix) confirms that firms in the comparison groups exhibit

parallel trends during the years before the implementation of the Ordonnance with respect to debt financing and IP-pledging activities, and key balance sheet characteristics, including profitability, financing needs, or cash flows.

B. The role of IP assets as collateral in loan contracts

We first turn to the question of whether IP collateral is a relevant component of the overall collateral package used to secure debt financing. To do so, we exploit the fact that the Ordonnance expanded the collateral menu to fixed tangible assets, thereby increasing the pledgeability of tangible relative to intangible assets such as IP rights. The underlying rationale is that changes in the effects of IP pledges following the Ordonnance, as documented in Section D, are informative about the importance of IP assets in IP-backed loans. If loan agreements involving IP collateral primarily rely on tangible assets pledged alongside IP rights, then the reform should affect both the volume and cost of borrowing. Conversely, the Ordonnance should *not* alter borrowing patterns if, and only if, IP assets themselves constitute a meaningful component of the collateral package for the IP-pledging firms in our sample.

We formally test this idea by estimating the following fixed effect regression specification:

$$Y_{ijst} = \gamma(\text{TAN}_i^{high} \times \text{POST}_t^{Ord.} \times \text{PLEDGE}_{it}) + \alpha_{js} + \alpha_t + \varphi X_{it} + \varepsilon_{ijst} \quad , \tag{2}$$

where the indicator TAN^{high} equals one for all firms with an above-median share of tangible assets to total assets before 2006. $\text{POST}^{Ord.}$ is a binary variable equal to one for firms that pledged IP collateral after the Ordonnance, and zero otherwise. The term PLEDGE equals one for all firm-year observations t following an IP pledge by firm i, and zero otherwise. The dependent variables (Y_{ijst}) correspond to the three measures of long-term debt and interest burden used in

Table 3. We include industry-year fixed effects (α_{js}) and time-to-pledge-year fixed effects (α_t). The vector X_{it} contains the same time-varying firm-level controls as in Equation (1), and the lower-order terms of the triple interaction that are not absorbed by the fixed effects. The coefficient γ captures the effect of the Ordonnance on the volume and cost of IP-backed loans for high-tangibility firms relative to firms with lower tangibility.

The estimation sample is a firm-year panel covering the period from 2000 to 2012, and we observe firms during the four years before and after their initial IP pledge. This way, we avoid selection biases on the dependent variable while maintaining a sufficiently narrow window around the implementation of the Ordonnance. Our variable definitions and estimation time frame closely follow Aretz *et al.* (2020), who use the same financial data source (Orbis) and similarly exploit the Ordonnance as an identifying event.

Table 4 reports the results from estimating Equation (2) and reveals several notable patterns. Most importantly, we find that the adoption of the Ordonnance did not alter the effects of IP pledges on firms' debt structures or borrowing costs. The coefficient on the triple interaction term is statistically insignificant across all specifications (Columns I-V), suggesting no differential effect of IP pledges between high- and low-tangible firms after 2006. Thus, variation in the availability of tangible collateral does not significantly affect debt financing or the costs of debt in our setting, highlighting the central role of IP rights for these loan agreements. Robustness tests in Table IA8 (Appendix) confirm that the results are not sensitive to using alternative estimation windows (Panel A) and do not extend to short-term debt financing (Panel B).

- Insert Table 4 here -

The estimates on the lower-order components of the triple interaction term are also

informative about the broader effects of modernizing French security law on debt financing. First, the coefficients on $\text{POST}^{Ord.} \times$ PLEDGE capture the effect of pledging activity on the variables of interest after the implementation of the Ordonnance. The corresponding estimates in Table 4 are statistically significant for all three measure of long-term debt, but not for borrowing costs. These results indicate an increase in debt financing on the intensive and extensive margins and therefore point to a generally positive effect of the Ordonnance on the IP-backed financing activities of firms in our sample. At the same time, the increased use of IP assets does not affect firms' borrowing costs.

Second, the coefficient on $\text{TAN}^{high} \times \text{POST}^{Ord.}$ captures the average effect of the Ordonnance on the financing patterns and characteristics of IP-backed loans for IP-pledging firms with high asset tangibility. The corresponding estimates are statistically significant for all three measures of long-term debt, showing that high-tangible firms increase their debt financing in response to the Ordonnance in general—a finding consistent with prior studies of the reform (i.e., Aretz *et al.*, 2020). Likewise, the coefficients on $\text{TAN}^{\text{high}} \times$ PLEDGE and TAN^{high} are statistically indistinguishable from zero, suggesting that high- and low-tangible firms exhibit similar debt-financing patterns after controlling for observable characteristics. Together, these findings further support the validity of our empirical approach.

Overall, the results consistently show that IP assets constitute meaningful components of loan agreements. Moreover, our analysis confirms the positive effects of the Ordonnance described in previous literature and extends these findings to research-oriented IP-pledging firms, which benefit from the modernization of the French security law.

C. The responsiveness of IP collateralization to legal change

Next, we address the central question of whether changes in the legal framework can effectively shape IP collateralization patterns. To do so, we test whether the Ordonnance led to differential changes in the use of specific types of IP assets as collateral. The underlying idea is that expanding the set of pledgeable assets encourages the use of collateral in asset classes that become newly available for secured lending, such as hard movable assets in our setting (e.g., Bolton, Freixas, Gambacorta and Mistrulli, 2016; Aretz *et al.*, 2020). Importantly, such a stimulating effect likely extends to complementary assets. Complementarity among collateral assets can be beneficial, for example, when bundled assets retain greater liquidation value than individual components (Shleifer and Vishny, 1992). Consistent with this view, empirical evidence shows that certain types of collateral co-occur in loan contracts more frequently than would be expected by chance (Degryse, De Jonghe, Laeven and Zhao, 2025).

We conjecture that patents exhibit stronger complementarity with hard movable assets, such as machinery and equipment, than trademarks because of differences in their functional relationship to these assets. Patents protect technological inventions embodied in industrial assets and, thus, complement machinery and other assets susceptible to industrial application. This link is substantially weaker for trademarks, which primarily protect the names and logos of final products or services and are therefore less directly connected to production assets.[17]

Against this background, we posit that the Ordonnance enhances the pledgeability of patents rather than trademarks. Accordingly, if market participants are responsive to the

[17]For example, the value of a machine used for industrial production depends on its physical components and technological properties. Patents can enhance the value of these technological properties by granting firms a temporary monopoly on novel features. By contrast, trademarks on assets used in the production process do not enhance the value of technological properties. Instead, trademarks usually protect the identifiers of goods or services in consumer markets to help customers distinguish them in the marketplace.

modernization of the security law in France, we expect the use of patents—but not trademarks—as collateral to increase after the implementation of the Ordonnance among firms with high tangibility ratios relative to firms with low tangibility ratios.[18] Descriptive statistics support this prediction: The share of IP pledges involving patents increased significantly among firms with high tangibility ratios after the adoption of the Ordonnance (35.2%) relative to before (23.0%). This pattern does not hold for trademark pledges or for firms with relatively low asset tangibility (see Table IA9, Appendix). Notably, we also observe a compositional shift within patent collateral. To assess this, we use the CPC technology classes of patents to identify patents related to technological inventions on machinery and other technical equipment. Figure IA8 (Appendix) shows that the share of pledged patents associated with respective CPC classes was close to zero in the five years preceding the Ordonnance and surged to about 18% thereafter.

We investigate these patterns more systematically by estimating the effects of the Ordonnance on the properties of IP pledges. Given that this analysis focuses on the effects of the Ordonnance on IP collateral characteristics, the triple-DID model from Equation (2) simplifies to the following DID model: $\Upsilon_{ijst} = \delta(\text{TAN}_i^{high} \times \text{POST}_t^{Ord.}) + a_{js} + a_t + \psi X_{it} + u_{ijst}$, where Υ denotes a vector of IP collateral characteristics. All remaining variables are defined as before.

We start by assessing changes in the extent to which different IP rights are used as collateral following the Ordonnance. Panel A of Table 5 reports DID estimates using several quantitative measures of patent and trademark collateral as dependent variables. In this setting, the interaction term $\text{TAN}^{high} \times \text{POST}^{Ord.}$ captures the effect of the Ordonnance on IP pledging

[18] We acknowledge that our empirical setting does not allow us to separately identify demand- and supply-side mechanisms, i.e., whether the observed effects are driven by debtors choosing to pledge more patents or by creditors demanding additional collateral. Instead, we capture the overall impact of the legal reform on collateralization patterns and leave the distinction between these channels to future research.

patterns. Column I shows that the likelihood of a patent pledge increases significantly after the adoption of the Ordonnance for firms with high asset tangibility relative to the control group. The coefficient of the interaction term (0.031) corresponds to an increase of about 74% relative to the sample mean (0.042). We obtain similar results when using the (log+1) number of pledged patents (Column II) and the share of patents that are pledged out of the overall patent portfolio (Column III), suggesting that patent collateralization increases along both the extensive and intensive margins. By contrast, we do not observe comparable effects when using analogous measures for trademark collateral as dependent variables (Columns IV-VI). These results are robust to adjusting the estimation time window and estimating logistic regressions for the binary outcome variables (see Table IA10, Appendix). Overall, the findings are consistent with the view that the Ordonnance affected the pledgeability of patents, but not trademarks.

- Insert Table 5 here -

Moreover, we show that the Ordonnance differentially affected the types of pledged IP rights used as collateral, as reflected in their qualitative characteristics. In our analysis, these characteristics correspond to patent-level measures of asset value, redeployability, and cash-flow attribution, as defined in Appendix B. We use these three dimensions as dependent variables and repeat the previous estimations. The coefficients of the interaction term $\text{TAN}^{\text{high}} \times \text{POST}^{\text{Ord.}}$ are positive across all specifications and statistically significant at moderate levels (see Panel B of Table 5). Hence, firms are not only more likely to pledge patents as collateral after the Ordonnance, but the pledged patents also exhibit characteristics that are more conducive to collateralization.[19] In line with the previous results, the estimated effects of the Ordonnance on

[19]To address concerns about using forward citations as a value indicator of patents (e.g., Alcácer, Gittelman and Sampat, 2009), Table IA11 (Appendix) displays robustness tests using alternative measures of patent value.

the qualitative dimensions of trademarks pledged after 2006 are statistically insignificant (see Panel C of Table 5).

In sum, these findings suggest that the modernization of the French security law in 2006 induced a shift in the composition of IP-backed loans. Consistent with the view that patents are functional complements to hard movable assets, the possibility of pledging such assets also stimulated the use of patents as collateral. We interpret these results as evidence that the equilibrium composition of collateral bundles adjusts in response to legal reforms and reflects market participants' ability to incorporate such changes into lending practices. Notably, firms not only pledged more patents, but also patents with characteristics that are particularly favorable for secured lending. This finding is consistent with a more active (or better-informed) screening and selection of IP collateral in the lending process. Taken together, these results highlight the important role of modernizing security laws in promoting IP-backed financing.

IV. Summary and discussion

The surge in intangible capital during the second half of the 20th century has contributed to a secular decline in commercial bank lending (Dell'Ariccia *et al.*, 2021; Falato *et al.*, 2022). While the growing importance of intangible assets is a key driver of these financing frictions, it also represents opportunities to alleviate them. In particular, the use of IP rights as collateral in loan agreements may provide firms with an additional channel to stimulate their financing needs. Although IP-backed financing has attracted increasing attention from practitioners, researchers, and policymakers, data limitations have so far prevented a comprehensive assessment of IP collateralization activities, the actual role of IP assets in respective contracts, and the extent to

which legal reforms can shape IP-backed financing. This paper introduces a novel dataset that combines French IP register data with financial information on a comprehensive set of firms, allowing us to take an initial step in shedding light on these aspects.

We analyze this data in two separate steps. First, we systematically document the IP-, firm-, and loan-level characteristics of IP-backed borrowing activities. Second, we answer two central questions in the context of IP collateralization: How relevant is IP as loan collateral, and can legal reforms effectively shape its use? To answer these questions, we exploit a major policy effort in France to modernize the security law, the Ordonnance *2006-346*, as an identifying event. The reform exogenously facilitated the use of collateral in loan agreements, with differential effects both across and within asset types. Consistent with the idea that IP assets are meaningful components of the collateral package, we find robust evidence that the reform did not translate into differences in financing patterns. At the same time, we find a compositional shift in IP pledges towards valuable IP rights with stronger complementarity to hard movable assets following the Ordonnance, suggesting that financial markets can effectively adapt to legal changes.

These results provide guidance for managers to consider their intangible capital as a potential source to secure external financing. As our analysis shows, the collateralization of different IP types can entail meaningful financial benefits for firms. At the same time, firms must carefully address issues related to IP collateralization, such as IP maintenance and selection of the appropriate IP from the portfolio of available assets. Effectively leveraging the strategic value of IP should therefore be an important consideration for firms seeking to improve access to external financing, particularly for small, financially constrained, and intangible-intensive firms. This issue

is especially relevant in light of the ongoing transition toward increasingly knowledge-based economies.

Our analysis also contributes to the broader discussion on the enforceability of using IP as collateral, which have potentially far-reaching implications for firms. These debates increasingly spark attention whenever prominent borrowers engage in IP loan agreements, such as the U.S.-based apparel retailer, J. Crew Group, Inc., in 2018 (Reuters, 2018), or the French telecommunication giant, Alcatel Lucent, in 2012 (Reuters, 2012). Our analysis emphasizes the generalizability of such anecdotal insights and shows that it is rather small firms that can substantially benefit from pledging their IP rights.

Finally, this paper highlights the responsiveness of the financial sector to changes in legal and institutional frameworks, suggesting that both creditors and debtors adapt to the modernization of the security law. This insight is crucial given the ability of IP collateral to improve access to financing in knowledge-based economies. From a policy perspective, our findings advocate for facilitating IP redeployability and for allowing standardized valuation methods to estimate expected cash flows and IP value more reliably. Such reforms could further enhance the use of IP collateral—and ultimately spur growth.

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Tables from the main part

TABLE 1

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

	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
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 IP-pledging firms

IP-pledging firm type	Any pledge			Trademarks only			Patents only		
	Obs.	Mean	SD	Obs.	Mean	SD	Obs.	Mean	SD
$TotalDebt^{ratio}$	17,194	0.644	0.260	13,259	0.649	0.260	1,625	0.640	0.279
$LongTermDebt^{ratio}$	17,183	0.087	0.170	13,248	0.086	0.167	1,625	0.087	0.178
log($LongTermDebt$)	17,185	7.242	7.483	13,250	7.248	7.484	1,625	6.625	6.898
$LongTermDebt^{NoLoan}$	17,185	0.499	0.500	13,250	0.500	0.500	1,625	0.503	0.500
$LongTermDebt^{growth}$	7,900	0.228	1.492	6,074	0.223	1.488	733	0.245	1.542
log($ShortTermDebt$)	17,153	10.209	6.003	13,227	10.346	5.977	1,625	9.414	5.785
$ShortTermDebt^{NoLoan}$	17,159	0.224	0.417	13,224	0.217	0.412	1,624	0.241	0.428
$InterestBurden^{ratio}$	11,449	0.026	0.021	8,797	0.026	0.022	1,104	0.023	0.020
log($ttlAssets$)	17,269	16.743	2.146	13,319	16.747	2.107	1,632	15.841	2.229
$Tangibility$	17,192	0.125	0.159	13,257	0.120	0.160	1,625	0.143	0.148
$Profitability$	17,096	0.066	0.186	13,181	0.070	0.170	1,607	0.024	0.261
$CashFlow$	16,526	0.049	0.179	12,687	0.051	0.167	1,581	0.027	0.230
$CurrentRatio$	17,163	1.582	1.115	13,235	1.533	1.102	1,623	1.693	1.153
$FirmAge$	17,259	24.654	16.157	13,309	25.022	16.230	1,632	19.385	14.123
$Employees$	11,843	387.9	1076.9	9,080	375.1	1059.8	1,080	247.4	443.5
SME	14,570	0.776	0.417	11,187	0.795	0.404	1,494	0.834	0.372
$LimitedLiabilityFirm$	17,269	0.552	0.497	13,319	0.551	0.497	1,632	0.561	0.496
$ListedFirms$	17,269	0.058	0.234	13,319	0.052	0.222	1,632	0.110	0.313

Notes: This table present descriptive statistics on French firms that pledge IP between 1995 and 2018. IP data is obtained from INPI and PATSTAT. Balance sheet variables are obtained from Orbis and scaled by total assets, if not explicitly stated otherwise; Here, the $NoLoan$ variables measure whether a firm has no outstanding long or short term debt at the end of the year prior to the initial IP pledge. The first three columns display statistics for the full sample, whereas the other columns display statistics for firms that only pledge trademarks or patents, respectively. Table IA3 (Appendix) provides further details on the displayed variables and subsamples.

TABLE 3

Fixed effect regressions explaining characteristics of IP-backed loans

Dep. variable	LONG_TERM_DEBT			SHORT_TERM_DEBT			INTEREST_BURDEN	
	ratio	log.	$NoLoans$	ratio	log.	$NoLoans$	ratio	log.
	I	II	III	IV	V	VI	VII	VIII
IP × PLEDGE	0.033***	1.388***	-0.082**	-0.007	-0.156	-0.038	0.002*	0.283**
	(0.006)	(0.306)	(0.028)	(0.004)	(0.240)	(0.040)	(0.001)	(0.111)
Additional controls:								
Firm-level	yes	yes	yes	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Timing FE	yes	yes	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.407	0.558	0.405	0.449	0.452	0.422	0.604	0.785
N	10,856	10,855	6,317	10,838	10,838	3,115	8,440	8,424

Notes: The table displays fixed effects regression estimates explaining the change in debt characteristics of IP-pledging firms (IP) after their initial IP collateral event (PLEDGE) as defined in Equation (1); all variables are specified accordingly. The estimations use the matched sample of IP-pledging firms and their non-pledging counterparts for the years 1995-2018. 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. Columns I-III use three different measures of firms' long-term debt use: (i) the long-term debt-to-asset ratio, (ii) the natural logarithm of total long-term debt, and (iii) an indicator equal to one for all firm-year observations in which the long-term debt use is zero, capturing the extensive margin of debt financing. Columns IV-VI use the corresponding specifications but refer to short-term debt use, i.e., loans with a maturity of one year or less. The last two columns use the interest burden of firms as dependent variable, calculated as the interest expenses divided by the annual average debt holdings for a firm (Column VII) and as the natural logarithm of total interest expenses (Column VIII). Control variables are omitted in the output. All variables are defined in Table IA2 (Appendix). Standard errors (in parentheses below coefficients) are clustered at the firm level. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

TABLE 4

The *Ordonnance 2006-346* and the relevance of IP collateral

Dep. variable	LONG_TERM_DEBT			INTEREST_BURDEN	
	ratio	log.	$NoLoans$	ratio	log.
	I	II	III	IV	V
$TAN^{high} \times POST^{Ord.} \times PLEDGE$	-0.037	-0.129	0.010	-0.014	-0.011
	(0.024)	(0.961)	(0.064)	(0.012)	(0.301)
$POST^{Ord.} \times PLEDGE$	0.036**	1.594**	-0.115**	0.002	-0.202
	(0.017)	(0.674)	(0.046)	(0.008)	(0.232)
$TAN^{high} \times POST^{Ord.}$	0.047**	1.752**	-0.101*	0.001	0.058
	(0.022)	(0.871)	(0.059)	(0.006)	(0.260)
$TAN^{high} \times PLEDGE$	-0.001	-0.413	0.034	-0.001	-0.286
	(0.013)	(0.592)	(0.039)	(0.010)	(0.197)
TAN^{high}	-0.004	0.262	-0.027	-0.002	0.224
	(0.012)	(0.573)	(0.038)	(0.004)	(0.174)
Additional controls:					
Firm-level	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes
Timing FE	yes	yes	yes	yes	yes
R^2	0.172	0.355	0.350	0.049	0.659
N	4,712	4,710	4,710	3,629	3,622

Notes: The table provides estimates from fixed effect regressions explaining firms' use and costs of long term debt before and after their IP pledge (PLEDGE). It distinguishes these effects for firms before and after the implementation of the Ordonnance in 2006 ($POST^{Ord.}$) and with different levels of asset tangibility (TAN^{high}), indicating their propensity to respond to the Ordonnance. To capture these differential effects, the model fully interacts these indicators. Otherwise, the regression follows the specification as defined in Equation (2) and the unit of observation is a firm-year panel for the time window of 2000–2012. Columns I-III report results for the three alternative measures of long-term debt, as in Table 3: (i) the long-term debt-to-assets ratio, (ii) the natural logarithm of long-term debt, and (iii) an indicator equal to one for all firm-year observations in which the long-term debt use is zero. Columns IV and V report results for the interest burden measured as ratio of total liabilities and in logs. All regressions include industry-year fixed effects, timing fixed effects, and control for time-varying IP and balance-sheet characteristics. Standard errors, clustered at the firm level, are reported in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

TABLE 5

The *Ordonnance 2006-346* shaping IP collateralization patterns

Panel A: The use of patent and trademarks as collateral

Dep. variable	PATENT_PLEDGE			TM_PLEDGE		
	Binary	log(Pats.)	Share of portfolio	Binary	log(TMs)	Share of portfolio
	I	II	III	IV	V	VI
$TAN^{high} \times POST^{Ord.}$	0.031**	0.061**	0.010*	0.000	-0.012	-0.010
	(0.012)	(0.028)	(0.006)	(0.017)	(0.037)	(0.008)
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
Mean DV	0.042	0.073	0.014	0.167	0.253	0.045
R^2	0.191	0.123	0.127	0.628	0.447	0.417
N	4,713	4,713	4,713	4,713	4,713	4,713

Panel B: Patent collateral value, redeployability, and cash flow characteristics

	VALUE		REDEPLOYABILITY		CASH_FLOW_ATTRIBUTION	
Dep. variable	$FwdCits$	$FamilySize$	$IPC4Classes$	$BwdCits\_pat$	$PatentAge$	$Applicants$
	I	II	III	IV	V	VI
$TAN^{high} \times POST^{Ord.}$	1.779**	0.418*	0.094**	0.286**	0.289**	0.007
	(0.691)	(0.224)	(0.046)	(0.132)	(0.141)	(0.008)
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
R^2	0.285	0.405	0.529	0.551	0.485	0.035
N	1,119	1,119	1,119	1,119	1,119	1,119

(*Continued on next page*)

Table 5: (*continued*)

Panel C: Trademark collateral value, redeployability, and cash flow characteristics

	VALUE		REDEPLOYABILITY		CASH_FLOW_ATTRIBUTION	
Dep. variable	$Corporate$	$Renewal$	$NiceClasses$	$Transferred$	$ConsGoods$	$IndicationUse$
	I	II	III	IV	V	VI
$\text{TAN}^{\text{high}} \times \text{POST}^{\text{Ord.}}$	0.007	0.038	0.106	0.011	0.014	0.005
	(0.008)	(0.023)	(0.085)	(0.011)	(0.010)	(0.005)
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
R^2	0.095	0.566	0.427	0.422	0.131	0.094
N	4,420	4,420	4,420	4,420	4,420	4,420

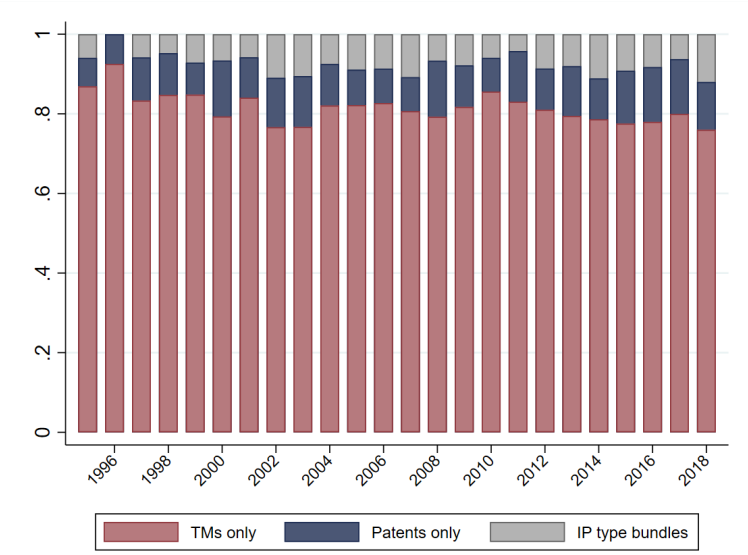
Notes: The table displays estimates from fixed effect regressions explaining the differential effects of the Ordonnance on IP loan characteristics, captured using the interaction of $\text{TAN}^{high} \times \text{POST}^{Ord.}$. The regression specification is defined in Equation (2) and the unit of observation is a firm-year panel for the time window of 2000–2012. Panel A reports results on the use of patents and trademarks as collateral, with dependent variables being pledge indicators (Columns I and IV), the log number of pledged IP rights (Columns II and V), and the number of pledged IP rights as a fraction of all IP rights owned by the borrower (Columns III and VI). In Panel B, uses the characteristics of the pledged patents as dependent variables, using proxies for IP value (Columns I and II) measured by forward citations and patent family size, redeployability (Columns III and IV) measured by IPC classes, patent backward citations, and clearer cash flow attribution (Columns V and VI) measured by patent age, and the number of applicants. Panel C is similar to before but uses the characteristics of pledged trademarks as dependent variable, with value (Columns I and II) measuered by indicators of corporate marks and trademark renewals; redeployability (Columns III and IV) measured by the number of NICE classes and the number of prior transfers; and cash flow attribution (Columns V and VI) measured by a indicators for specific trademark types (i.e., consumer goods trademark) and a general indication of use. Appendix B contains the specific variable definitions. All regressions include firm-level controls, industry-year and timing fixed effects. Standard errors (in parentheses) are clustered at the firm level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Figures from the main part

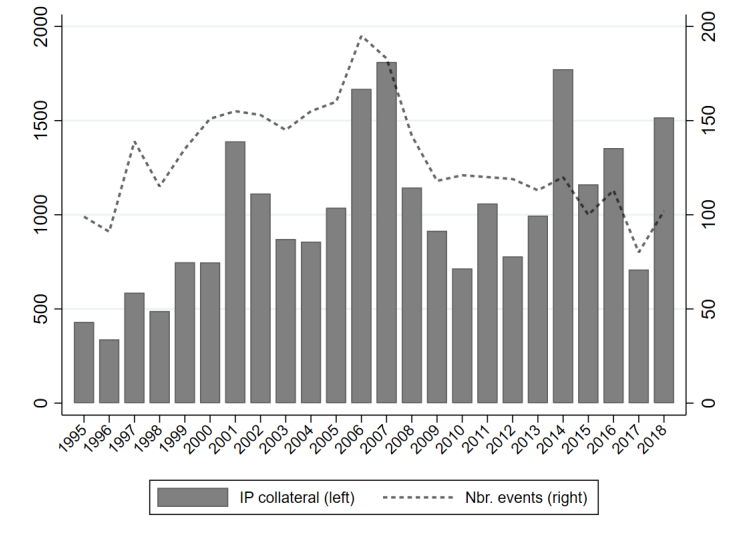
FIGURE 1

IP collateral: composition and frequency of events, by year

Panel A: Share of IP types in events



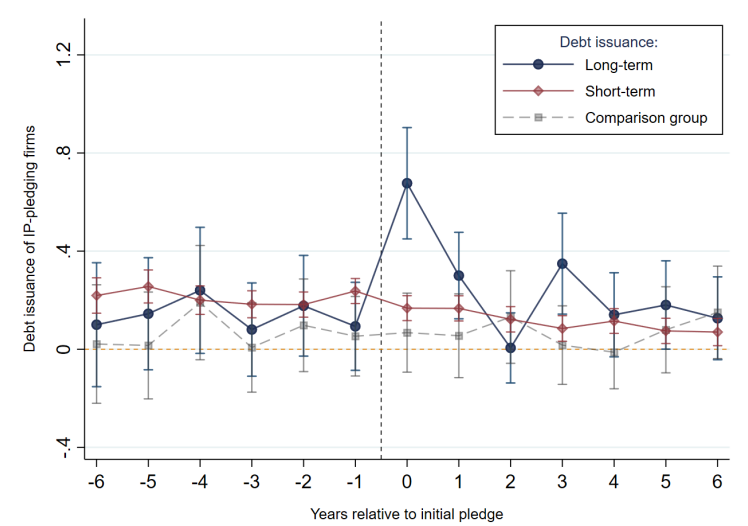
Panel B: IP collateral and event counts



Notes: The figure shows the composition and frequency of IP collateral events over time. Sample period is 1995–2018. Panel A plots the share of collateral events by IP type (trademarks only, patents only, or bundles of trademarks and patents). Panel B displays the annual count of individual IP rights used as loan collateral (bars, left axis) together with the annual number of collateral events (dashed line, right axis).

FIGURE 2

Debt financing activities around the IP loan event year

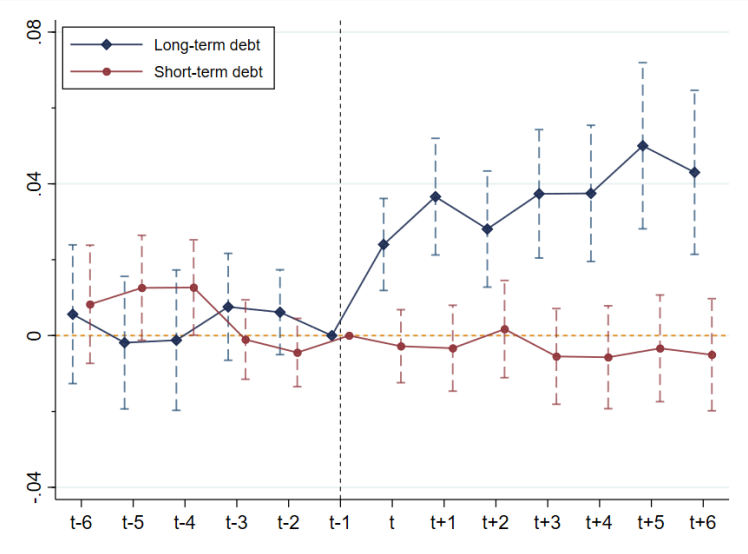


Notes: The figure plots mean values of the year-to-year growth rate, or debt issuance, using the matched sample of IP-pledging firms and their non-pledging counterparts for the years 1995-2018. Means are displayed for each year in a symmetrical time window around the initial use of IP as collateral (t=0). Long-term and short-term refer to the year-to-year growth rate in long-term debt ("Long-term") and in short-term debt ("Shoft-term") of firms that pledge IP, as defined in Table IA2 (Appendix). *Comparison group* refers to the year-to-year growth rate in long-term debt of matched firms that do not pledge IP. The whiskers span the 95 percent confidence intervals.

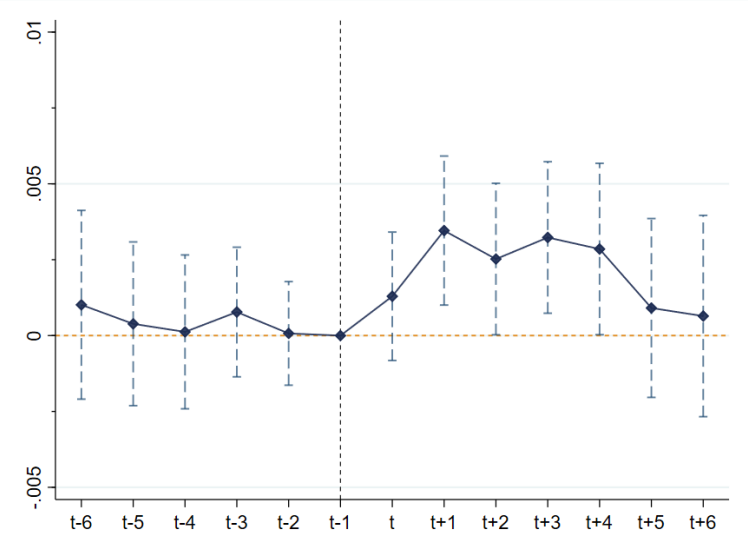
FIGURE 3

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

Panel A: Loans by debt maturity



Panel B: Interest burden



Notes: The graph plots the coefficients of event-study regressions that explain the effect of the use of IP collateral on debt financing and interest burden, comparing IP-pledging firms with a matched group that does not pledge IP and over time for the years 1995-2018. The specifications are similar to those specified in Equation (1), but decompose the PLEDGE-indicator into PLEDGE^{pre_s} and PLEDGE^{post_s}. The graph shows the β-coefficients from the following estimation equation: $Y_{ijst} = \varphi X_{it} + \sum_{s=-6}^{-2} \beta_1^s (IP_i \times PLEDGE_{it}^{pre_s}) + \sum_{s=0}^{6} \beta_2^s (IP_i \times PLEDGE_{it}^{post_s}) + \gamma_{js} + \gamma_i + \gamma_t + \varepsilon_{ijst}$, where all variables are defined as before. The year before the initial pledge ($t = -1$) is the reference year. Standard errors are clustered at the firm level. Panel A displays estimates from two separate estimations that use long-term and short-term debt-to-asset ratios as dependent variable (as in Columns I and IV of Table 3), respectively. In Panel B, the dependent variable is the interest burden of firms (as in Column VII of Table 3), calculated as the interest expenses divided by the annual average debt holdings for a firm. In both panels, whiskers span the 95 percent confidence intervals.

ONLINE APPENDIX

Securing Debt in the Knowledge Economy:

Evidence from Intellectual Property Registers

Laurie Ciaramella David Heller Leo Leitzinger

Appendix A : Additional Tables and Figures

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 its 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 United States, Japan, or Korea. Notably, unlike in the United States, design rights are not patented in Europe but are they registered IP rights that protect the whole or part of a product and may arise from aesthetic forms and non-functional product features.

Table IA2: List of variables

Firm-level variables:	
Main regressors:	
IP	Dummy = 1 for any firm that pledges an IP right at any point in time and zero for matched comparison group firms.
Pledge	Dummy = 1 for any firm-year observation after the first IP collateral event (within matched strata), and zero otherwise.
$Post^{Ord.}$	Dummy = 1 for firms (and their matched partner) with a first IP pledge after the implemention of the Ordonnance *2006-346* into French law, i.e., in 2006 or later, and zero otherwise.
Tan^{high}	Dummy = 1 for firms with above-median levels of $Tangibility$, as defined below, and zero otherwise. Following (Aretz *et al.*, 2020), firms with levels of tangible assets are disproportionally responsive to the legal changes of the Ordonnance and, thus, this variable indicates firms in the treated group.
$Pledge^{post_S}$	Dummy = 1 for any firm-year observation s ($\in$ [1,6]) *after* the first use of IP collateral (within matched strata), and zero otherwise.
$Pledge^{pre_S}$	Dummy = 1 for any firm-year observation s ($\in$ [-6,-1]) *before* the first use of IP collateral (within matched strata), and zero otherwise.
Independence	Dummy=1 if firms that did not have at least one shareholder with >50% ownership share at some point in time between 2007-2018 and zero otherwise.
Main financial outcome variables (Orbis `code`):	
$LongTermDebt$	Long-term debt (`ltdb`) referring to loans outstanding with a maturity of at least one year
$LongTermDebt^{ratio}$	Long-term debt (`ltdb`) divided by total assets (`toas`)
$LongTermDebt^{NoLoans}$	Dummy = 1 for any firm-year observation in which a firm does not have any long-term debt (`ltdb`) outstanding at the end of the period, and zero otherwise.
$LongTermDebt$	Short-term debt (`loan`) referring to loans outstanding with a maturity of one year or less.
$ShortTermDebt^{ratio}$	Short-term debt (`loan`) divided by total assets (`toas`).
$ShortTermDebt^{NoLoans}$	Dummy = 1 for any firm-year observation in which a firm does not have any short-term debt (`loan`) outstanding at the end of the period, and zero otherwise.
$InterestBurden$	Total interest expenses throughout the period t (`interest`)
$InterestBurden^{ratio}$	Interest expenses (`interest`) divided by the average total debt holdings during t, defined as the average of current (`culi`) and non-current liabilities (`ncli`) held in t and t-1 or ((`culi`$_t$+`culi`$_{t-1}$+`ncli`$_t$+`ncli`$_{t-1}$)/2).
Main IP-level outcome variables:	
I($PatentPledge$)	Dummy = 1 for each IP pledge with at least one patent used as collateral; denoted as "Binary" in the regression output tables
log($PatentPledge$)	Logarithm of the number of patents pledged as collateral in the focal IP loan
I($TMpledge$)	Dummy = 1 for each IP pledge with at least one trademark used as collateral; denoted as "Binary" in the regression output tables
log($TMpledge$)	Logarithm of the number of trademarks pledged as collateral in the IP loan
Share of portfolio	The share of patents or trademarks pledged as loan collateral among total patents or trademarks, respectively
FwdCits	Average number of total forward citations received by pledged patents.
FamilySize	Average number of jurisdictions patents are active in at the time of their pledge
IPC4Classes	Average count of different main patent IPC technology classes (4-digit level) of pledged patents
BwdCits_pat	Average number of backward citations to patent literature of pledged patents

(*Continued on next page*)

Table IA2: List of variables (*continued*)

PatentAge	Average number of years patents have been active at the time of their pledge
Applicants	Average number of applicants in the patent filing of pledged patents
I(*AnyCit*)	Dummy equals one if pledged patents received at least one forward citation.
Originality	Citation-based index that captures how broadly a patent draws on prior technological fields by measuring the dispersion of the technological classes of the patents it cites.
Generality	Citation-based index that captures how broadly a patent's impact spreads across technological fields by measuring the dispersion of the technological classes of the later patents that cite it.
Corporate	Dummy = 1, if the corporate trademark is among the pledged trademarks
Renewal	Average number of renewed trademarks among pledged trademarks
NiceClasses	Average count of different registered NICE classes of trademarks pledged
Transferred	Average number of trademarks that have been transferred before being pledged
ConsGoods	Dummy = 1, if at least one of the pledged trademarks protects a consumer good
IndicationUse	Average number of pledged trademarks with at least one notes of a legal change prior to the pledge

Firm-level control variables (Orbis `code`):

log(*ttlAssets*)	Logarithm of total assets (`toas`), as measure of firm size
Profitability	Return on assets (RoA) measured as total 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`)

Other firm-level financial 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.
LimitedLiabilityFirm	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`) 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`)
LongDebtIssuance	Year-to-year growth in long-term debt (`D.ltdb`/`L.ltdb`)
ShortDebtIssuance	Year-to-year short-term debt growth (`D.loan`/`L.loan`)
RZindex	Firms dependence on external financing, measured as the difference between capital expenditures (`exp_mat`) and cashflows (`cf`): (`exp_mat-cf`)/`cf`.
Employees	Number of employees at end of period (`empl`)
AssetGrowth	Year-to-year growth in total assets (`D.toas`/`L.toas`)
log(*sales*)	Logarithm of total sales (`sale`)

Notes: The table lists and defines all variables used in this paper. Throughout the analysis several variables are measured using the natural logarithm; these specifications are not explicitly listed. Firm-level variables are obtained from Orbis; IP-level data is obtained from INPI and PATSTAT. For firm-level variables, corresponding mnemonics provided by Bureau van Dijk are stated in parentheses, such as the code `toas` abbreviating total assets in the Orbis data.

Table IA3: Detailed descriptive statistics on IP-pledging firms

Panel A: Detailed variable distributions

	Obs.	Mean	SD	p10	p25	p50	p75	p90	min.	max.
$TotalDebt^{ratio}$	17,194	0.644	0.260	0.303	0.481	0.647	0.806	0.964	0.012	1.197
$LongTermDebt^{ratio}$	17,183	0.087	0.170	0	0	0.001	0.103	0.279	0	1.133
log($LongTermDebt$)	17,185	7.242	7.483	0	0	4.234	14.592	16.663	0	22.871
$LongTermDebt^{NoLoan}$	17,185	0.499	0.500	0	0	0	1	1	0	1
$LongTermDebt^{growth}$	7,900	0.228	1.492	-1	-0.631	-0.114	0.296	1.839	-1	5.314
log($ShortTermDebt$)	17,159	10.209	6.003	0	6.908	12.581	14.750	16.277	0	16.674
$ShortTermDebt^{NoLoan}$	17,153	0.224	0.417	0	0	0	0	1	0	1
$InterestBurden$	11,449	0.026	0.021	0.002	0.009	0.021	0.037	0.057	0	0.079
log($ttlAssets$)	17,269	16.743	2.146	13.971	15.417	16.902	18.175	19.350	0	24.496
$Tangibility$	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
$FirmAge$	17,259	24.654	16.157	5	11	21	38	51	0	53
$Employees$	11,843	387.9	1076.9	9	30	105	352	867	1	45,072
SME	14,570	0.776	0.417	0	1	1	1	1	0	1
$LimitedLiabilityFirm$	17,269	0.552	0.497	0	0	1	1	1	0	1
$ListedFirms$	17,269	0.058	0.234	0	0	0	0	0	0	1

Panel B: Differentiating IP-pledging firms by IP type

IP pledges	Any combination			Trademarks			Patents		
	Obs.	Mean	SD	Obs.	Mean	SD	Obs.	Mean	SD
$TotalDebt^{ratio}$	2,372	0.618	0.248	15,569	0.645	0.258	3,935	0.628	0.261
$LongTermDebt^{ratio}$	2,372	0.093	0.175	15,558	0.087	0.169	3,935	0.091	0.177
log($LongTermDebt$)	2,372	7.659	7.817	15,560	7.307	7.539	3,935	7.225	7.479
$LongTermDebt^{NoLoan}$	2,372	0.491	0.500	15,560	0.499	0.500	3,935	0.498	0.500
$LongTermDebt^{growth}$	1,126	0.250	1.493	7,167	0.226	1.487	1,826	0.245	1.507
log($ShortTermDebt$)	2,369	10.037	6.212	15,534	10.29217	6.019	3,932	9.748	6.067
$ShortTermDebt^{NoLoan}$	2,367	0.243	0.429	15,529	0.222	0.415	3,929	0.245	0.430
$InterestBurden$	1,572	0.025	0.019	10,345	2.587	2.128	2,652	2.415	1.995
log($ttlAssets$)	2,380	17.327	2.119	15,637	16.838	2.115	3,950	16.732	2.271
$Tangibility$	2,372	0.144	0.155	15,567	0.124	0.160	3,935	0.144	0.153
$Profitability$	2,370	0.075	0.205	15,489	0.071	0.176	3,915	0.054	0.232
$CashFlow$	2,308	0.054	0.197	14,945	0.052	0.172	3,839	0.043	0.212
$CurrentRatio$	2,367	1.785	1.147	15,540	1.571	1.111	3,928	1.748	1.145
$FirmAge$	2,380	26.203	16.4375	15,627	25.204	16.257	3,950	23.413	15.845
$Employees$	1,718	538.886	1379.518	10,763	402.054	1119.9	2,763	430.292	1130.668
SME	1,950	0.628	0.483	13,076	0.770	0.421	3,383	0.714	0.452
$LimitedLiabilityFirm$	2,380	0.567	0.496	15,637	0.551	0.497	3,950	0.558	0.497
$ListedFirms$	2,380	0.054	0.226	15,637	0.053	0.223	3,950	0.078	0.269

Notes: This table presents details on the descriptives from Table 2 by presenting the actual distributions of the variables more granularly. Panel A repeats the statistics presented before for the full sample and displays detailed statistics on the distributions of the variables. Panel B is similar to before but displays statistics for firms that pledge at least two different types of IP rights as collateral (*Any combination*), those that pledge trademarks (and potentially also other IP rights), and those that pledge patents (and potentially also other IP rights).

Table IA4: Comparing IP-pledging and comparison group firms' main characteristics

	Mean			
	IP-pledging firm	Matched counterparty	Differences in means	(*t-values*)
$LongTermDebt^{ratio}$	0.054	0.049	0.005	(1.206)
$\log(ttlAssets)$	16.584	16.473	0.111	(1.557)
Tangibility	0.118	0.119	-0.001	(-0.194)
Profitability	0.092	0.088	0.004	(0.845)
CurrentRatio	1.903	1.901	0.002	(0.023)
CashFlow	0.067	0.067	-0.000	(-0.050)
Manova test results:				
	Statistic	F(df1, df2)	F	Prob>F
Wilks' lambda	0.9979	6.0 2948.0	1.04	(0.398)
Lawley-Hotelling trace	0.0021	6.0 2948.0	1.04	(0.398)

Notes: This table displays statistics on main dependent variable and other financial characteristics used as control variables in all regressions for of the matched sample described in Section 2.4. The top part of the table displays the mean values of these characteristics for IP-pledging firms and firms from the matched group for the three years preceeding the initial IP pledge. The last two columns show the differences in means and the corresponding t-values in parentheses. The bottom of the table presents test results on the joint significance of these using the Wilks' lambda and the Lawley-Hotelling trace tests. The results suggest that the overall mean vector of the displayed variables does not differ between the two groups.

Table IA5: Robustness tests to Table 3

Panel A: Displaying all control variables

Dep. variable	*LongTermDebt*			*ShortTermDebt*			*InterestRate*	
	ratio	log.	*NoLoans*	ratio	log.	*NoLoans*	ratio	log.
	I	II	III	IV	V	VI	VII	VIII
IP × Pledge	0.033***	1.388***	-0.082**	-0.007	-0.156	-0.038	0.186*	0.283**
	(0.006)	(0.306)	(0.028)	(0.004)	(0.240)	(0.040)	(0.001)	(0.111)
FirmSize	0.005	1.056***	-0.021*	0.012***	1.504***	-0.086***	0.187***	1.314***
	(0.003)	(0.164)	(0.011)	(0.003)	(0.146)	(0.018)	(0.053)	(0.079)
Tangibility	0.110***	6.003***	-0.194*	0.027	0.778	-0.309*	1.295**	3.067***
	(0.029)	(1.324)	(0.112)	(0.019)	(1.061)	(0.176)	(0.415)	(0.598)
Profitability	-0.031	0.950	-0.135**	-0.032**	-1.436**	0.064	0.355	-0.220
	(0.021)	(0.703)	(0.058)	(0.014)	(0.648)	(0.090)	(0.274)	(0.384)
CashFlow	-0.041**	-0.777	0.026	-0.047***	-0.888	0.030	-0.788**	-0.910**
	(0.016)	(0.589)	(0.049)	(0.012)	(0.603)	(0.082)	(0.261)	(0.332)
CurrentRatio	0.003***	0.132***	-0.006*	-0.003***	-0.250***	0.013***	0.006	-0.038**
	(0.001)	(0.030)	(0.003)	(0.000)	(0.025)	(0.002)	(0.010)	(0.012)
Constant	-0.048	-12.667***	1.169***	-0.128**	-13.712**	1.734***	-1.084	-10.537***
	(0.057)	(2.745)	(0.186)	(0.043)	(2.429)	(0.294)	(0.009)	(1.322)
Additional controls:								
Industry-Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Timing FE	yes	yes	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.407	0.558	0.405	0.449	0.452	0.422	0.604	0.785
N	10,856	10,855	6,317	10,838	10,838	3,115	8,440	8,424

Panel B: Distinguishing firms with different ownership structures

Dep. variable	*LongTermDebt*			*ShortTermDebt*			*InterestRate*	
	ratio	log.	*NoLoans*	ratio	log.	*NoLoans*	ratio	log.
	I	II	III	IV	V	VI	VII	VIII
IP × Pledge	0.027**	1.582**	-0.098**	-0.009	-0.047	-0.045	0.002	0.213
	(0.009)	(0.498)	(0.041)	(0.007)	(0.362)	(0.057)	(0.001)	(0.144)
Pledge × Independence	0.004	0.457	-0.044	-0.004	-0.316	0.035	-0.000	0.027
	(0.007)	(0.457)	(0.042)	(0.006)	(0.339)	(0.062)	(0.001)	(0.163)
IP × Pledge × Independence	0.009	-0.279	0.029	0.007	0.071	0.010	-0.000	0.138
	(0.012)	(0.646)	(0.058)	(0.009)	(0.0487)	(0.080)	(0.002)	(0.222)
Additional controls:								
Industry-Year FE	yes	yes	yes	yes	yes	yes	yes	yes
Timing FE	yes	yes	yes	yes	yes	yes	yes	yes
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.419	0.562	0.411	0.444	0.449	0.418	0.602	0.776
N	10,213	10,212	5,813	10,198	10,198	2,968	7,908	7,893

Notes: Panel A displays the estimates equivalent to Table 3, only here the regression output displays also the estimates on the firm-level control variables. The interst burden ratio in Column VII is expressed in percentage points to better illustrate these effects. Panel B is similar to the estimation in Table 3, only here we deploy a triple interaction of the IP-Pledge interaction with a dummy, *Independence*, which is equal to one for all firms that did not have at least one shareholder with >50% ownership share at some point in time between 2007-2018, and zero otherwise. The regressions also control for the individual components of the interaction term. 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 IA6: Robustness test on the role of tangible assets as alternative collateral

Panel A: Alternative collateral and debt ratios

Dep. variable	$LongTermDebt^{ratio}$					
	I	II	III	IV	V	VI
IP × Pledge	0.033***	0.024**	0.036*	0.031***	0.034***	0.030***
	(0.008)	(0.010)	(0.020)	(0.008)	(0.008)	(0.008)
Pledge × Tan^{high}					0.003	0.029
					(0.007)	(0.029)
IP × Pledge × Tan^{high}					-0.002	0.021
					(0.011)	(0.047)
Sample: Tangibility	$< P50$	$< P33$	$< P10$	$> P50$	all	all
Tan^{high} definition:	-	-	-	-	binary	continuous
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

Panel B: Alternative collateral and interest burden

Dep. variable	$InterestBurden^{ratio}$					
	I	II	III	IV	V	VI
IP × Pledge	0.206	0.115	0.253	0.141	0.221	0.063
	(0.145)	(0.194)	(0.363)	(0.129)	(0.147)	(0.133)
Pledge × Tan^{high}					0.024	-0.579
					(0.131)	(0.508)
IP × Pledge × Tan^{high}					-0.065	1.009
					(0.196)	(0.702)
Sample: Tangibility	$< P50$	$< P33$	$< P10$	$> P50$	all	all
Tan^{high} definition:	-	-	-	-	binary	continuous
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	0.643	0.633	0.633	0.691	0.658	0.658
N	3,940	2,539	687	4,475	8,440	8,440

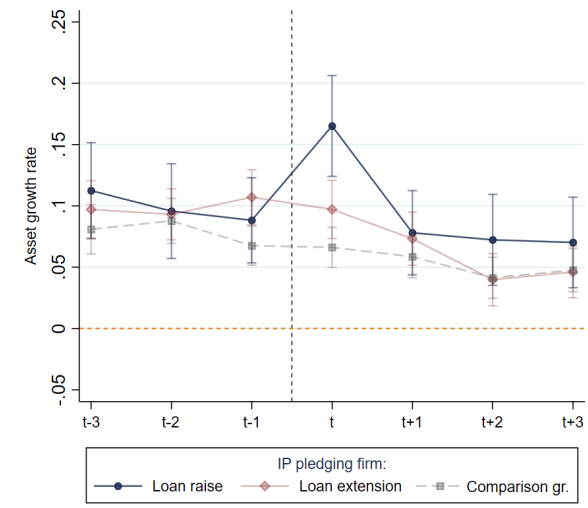
Notes: The table displays estimates explaining the effect of IP pledges on firms long-term debt-to-asset ratios and the complementary importance of alternative collateral, i.e., tangible assets. In Panel A, the first four columns estimate the same specification as defined in Equation (1), using different subsamples out of the matched sample of IP-pledging firms and their non-pledging counterparts for the years 1995-2018 depending on firms' tangible fixed-assets-to-total asset ratio: firms in the bottom half (Column I), bottom tercile (Column II), bottom decile (Column III), and top half (Column IV) of the asset tangibility distribution, respectively. Column V is run on the full sample but adds a triple interaction term $IP \times Pledge \times Tan^{\text{high}}$ and the base value of $Pledge \times Tan^{\text{high}}$. The level variables are dropped because of perfect multicollinearity due to the inclusion of the fixed effects. Tan^{high} is equal to one if a firm has above median levels of tangible assets, and zero otherwise. Column VI is similar to Column V but uses the continuous tangible asset ratio, $Tangibility$ instead of Tan^{high}. To avoid reverse causality issues, all tangibility ratios are measured in the year before the initial IP pledge. Columns I-IV include controls equivalent to those specified before. Columns V and VI do not additionally control for asset tangibility. Panel B is similar to the first panel, only here, the dependent variable is firm-level interst burden. 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 IA7: Assessing borrower quality

Panel A: Matched sample estimates on loan renewals, new debt issues, and growth

Dep. variable	log(*ttlAssets*)		log(*Sales*)		log(*Employees*)	
	I	II	III	IV	V	VI
IP × Pledge	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: Asset growth rates relative to the pledge



Notes: The table displays the effect of IP pledges on subsequent growth patterns of firms, by estimating of Equation (1). Specifically, it compares the average year-to-year asset growth rates of IP-pledging firms that raise more debt, IP-pledging firms that rollover debt, and non-IP-pledging firms. The specifications are equivalent to those in Table 3, using the matched sample of IP-pledging firms and their non-pledging counterparts for the years 1995-2018. The dependent variables relate to firm-level growth, namely the natural logarithms of total assets (Columns I and II), total sales (Columns III-IV), and the number of employees (Columns V-VI) as defined in Table IA2 (Appendix). Further, regressions are separately 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). Standard errors (in parentheses below coefficients) are clustered at the firm level. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$. In this context, obtaining new loans should mostly stimulate firm-level investment and growth if firms raise additional financing, instead of renewing loans, i.e., rolling over debt at constant levels. The graph in Panel B confirms this notion by showing that firms that pledge IP and raise their debt financing have significantly higher growth rates in the year of their use of IP collateral. Specifically, it plots mean values of the year-to-year growth rate in firms' total assets, using the matched sample of IP-pledging firms and their non-pledging counterparts for the years 1995-2018. Means are displayed for each year in a symmetrical time window around the initial use of IP as collateral. It distinguishes firms that pledged IP collateral and increased their debt ratios ("loan raise"), those that pledge IP but roll-over debt, i.e., 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.

Table IA8: Robustness tests: the *Ordonnance 2006-346* and the relevance of IP collateral

Panel A: Full sample, 1995-2018

Dep. variable	*LongTermDebt*			*InterestBurden*	
	ratio	log.	*NoLoans*	ratio	log.
	I	II	III	IV	V
$Tan^{high} \times Pledge \times Post^{Ord.}$	-0.021	0.048	0.006	0.040	-0.020
	(0.020)	(0.760)	(0.051)	(0.065)	(0.255)
$Pledge \times Post^{Ord.}$	0.025*	1.046**	-0.081**	-0.028	-0.201
	(0.015)	(0.561)	(0.038)	(0.032)	(0.201)
$Tan^{high} \times Post^{Ord.}$	0.035*	1.898**	-0.121**	-0.066	-0.163
	(0.018)	(0.749)	(0.050)	(0.063)	(0.239)
$Tan^{high} \times Pledge$	-0.014	-0.692	0.047	-0.003	-0.258*
	(0.011)	(0.476)	(0.032)	(0.008)	(0.153)
Tan^{high}	0.004	0.354	-0.027	0.004	0.302*
	(0.009)	(0.441)	(0.029)	(0.006)	(0.155)
Additional controls:					
Firm-level	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes
Timing FE	yes	yes	yes	yes	yes
R^2	0.128	0.310	0.303	0.100	0.658
N	6,995	6,993	6,993	5,010	5,003

Panel B: The Ordonnance and short-term debt patterns

Dep. variable	*ShortTermDebt*					
	ratio	log.	*NoLoans*	ratio	log.	*NoLoans*
	I	II	III	IV	V	VI
$Tan^{high} \times Pledge \times Post^{Ord.}$	0.069**	0.701	-0.005	0.066***	0.321	-0.000
	(0.032)	(0.791)	(0.057)	(0.025)	(0.634)	(0.046)
$Pledge \times Post^{Ord.}$	-0.050**	-0.962*	0.056	-0.053***	-0.852*	0.049
	(0.023)	(0.583)	(0.042)	(0.020)	(0.482)	(0.035)
$Tan^{high} \times Post^{Ord.}$	-0.039	-0.419	-0.022	-0.021	-0.240	-0.013
	(0.027)	(0.684)	(0.050)	(0.023)	(0.603)	(0.044)
$Tan^{high} \times Pledge$	-0.060***	-1.278***	0.060*	-0.049***	-0.727*	0.042
	(0.021)	(0.489)	(0.034)	(0.018)	(0.403)	(0.029)
Tan^{high}	0.051***	1.454***	-0.065**	0.033**	0.967***	-0.051**
	(0.020)	(0.466)	(0.032)	(0.016)	(0.366)	(0.025)
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
R^2	0.198	0.154	0.056	0.189	0.157	0.067
N	4,712	4,712	4,709	6,988	6,988	6,984

Notes: This table presents robustness tests for estimations displayed in Table 4. All specifications are equivalent to before. Only here, Panel A uses the full sample timeframe from 1995-2018. Panel B repeats the first three specifications of Table 4 but uses short-term instead of long-term debt as dependent variables (Columns I-III) and repeats these estimations using the full observation period of 1995-2018 (Column IV-VI). Standard errors (in parentheses below coefficients) are clustered at the firm level. $^{*}(p < 0.10)$, $^{**}(p < 0.05)$, $^{***}(p < 0.01)$.

Table IA9: The average shares of IP pledges containing patents and trademarks as collateral before and after the *Ordonnance 2006-346*

		Mean			
		Before	After	Differences in means	*t-values*
High tangible assets (Treated)	Patent pledge	0.230	0.352	0.121***	(2.686)
	TM pledge	0.877	0.846	-0.031	(0.887)
Low tangible assets (Control)	Patent pledge	0.180	0.131	-0.049	(1.644)
	TM pledge	0.899	0.909	0.010	(0.419)

Notes: The table reports the share of IP pledge events that contain at least one patent or one trademark, distinguishing between firms with high and low ex-ante asset tangibility, before and after the implementation of the 2006 collateral reform. The sample is all pledges between 2000 and 2012. Differences in means are reported with corresponding *t*-values in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table IA10: Robustness tests: the *Ordonnance 2006-346* and IP collateralization patterns

Panel A: Full sample, 1995-2018

Dep. variable	*PatentPledge*			*TMPledge*		
	Binary	log(Pats.)	Share of portfolio	Binary	log(TMs)	Share of portfolio
	I	II	III	IV	V	VI
$\text{Tan}^{\text{high}} \times \text{Post}^{\text{Ord.}}$	0.033***	0.079***	0.009*	-0.001	0.007	0.001
	(0.010)	(0.027)	(0.0005)	(0.014)	(0.035)	(0.007)
Firm-level controls	yes	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes	yes
Timing FE	yes	yes	yes	yes	yes	yes
R^2	0.187	0.125	0.1224	0.648	0.432	0.416
N	7,000	7,000	7,000	7,000	7,000	7,000

(*Continued on next page*)

Table IA10: Robustness tests (*continued*)

Panel B: Timeframe as in Aretz *et al.* (2020), 2002-2009

Dep. variable	*PatentPledge*			*TMPledge*		
	Binary	log(Pats.)	Share of portfolio	Binary	log(TMs)	Share of portfolio
	I	II	III	IV	V	VI
$\text{Tan}^{\text{high}} \times \text{Post}^{\text{Ord.}}$	0.036**	0.070**	0.014*	0.003	0.017	-0.007
	(0.015)	(0.031)	(0.007)	(0.020)	(0.047)	(0.011)
Firm-level controls	yes	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes	yes
Timing FE	yes	yes	yes	yes	yes	yes
R^2	0.200	0.138	0.128	0.645	0.452	0.424
N	3,080	3,080	3,080	3,080	3,080	3,080

Panel C: Logistic regressions

Dep. variable	*I(PatentPledge)*			*I(TMPledge)*		
	I	II	III	IV	V	VI
$\text{Tan}^{\text{high}} \times \text{Post}^{\text{Ord.}}$	1.409**	1.295*	1.385**	-0.134	-0.146	-0.234
	(0.634)	(0.724)	(0.592)	(0.407)	(0.482)	(0.381)
Timeframe	2000-2012	2002-2009	1995-2018	2000-2012	2002-2009	1995-2018
Firm-level controls	yes	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes	yes
Timing FE	yes	yes	yes	yes	yes	yes
N	2,236	1,578	2,984	2,799	1,845	3969

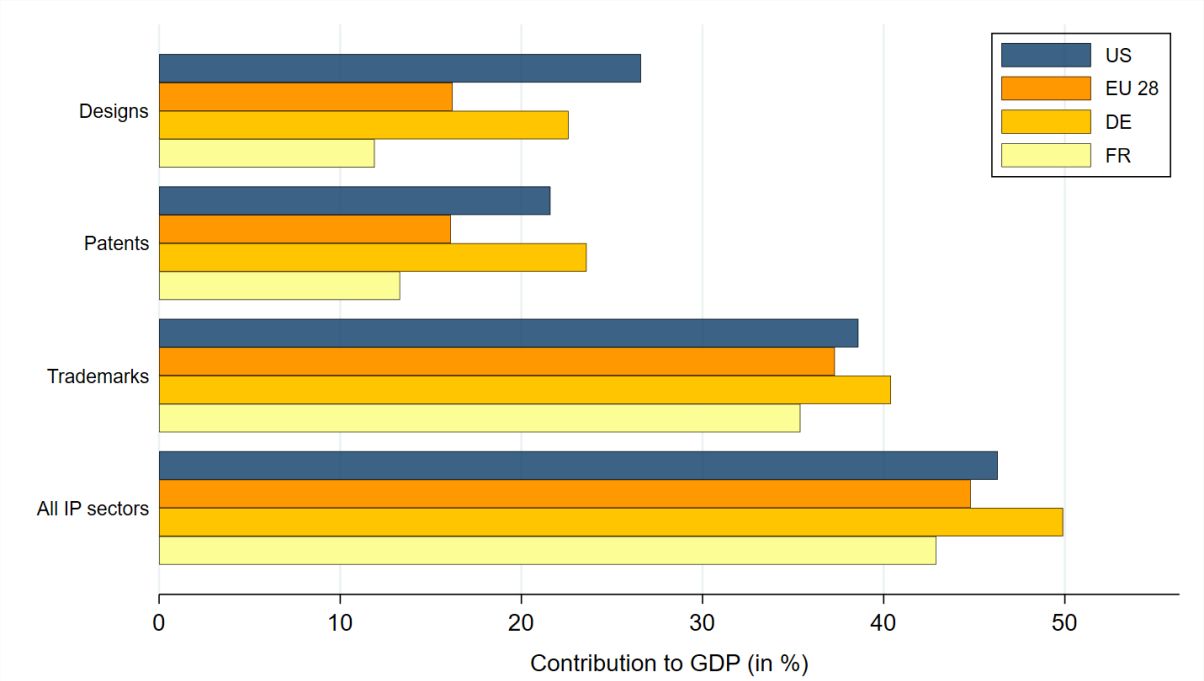
Notes: The table reports robustness tests to the estimates displayed in Table 5. All variables and model specifications are defined accordingly. Panel A is equivalent to before but uses the full sample. Panel B restricts the sample to 2002–2009, following Aretz *et al.* (2020). Panel C reports logistic regressions for patent and trademark pledges as in Columns I and IV of Table 5, i.e., using an indicator of patent and trademark pledge as dependent variable. The specifications are estimated for each of the three different sample periods as indicated at the bottom of the table. Standard errors (in parentheses below coefficients) are clustered at the firm level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table IA11: Robustness tests: alternative patent value measures

Dep. variable	I(*AnyCit*)	*FwdCits*(5*yrs.*)	*FwdCits*(12*yrs.*)	*Originality*	*Generality*
	I	II	III	IV	V
$\text{Tan}^{\text{high}} \times \text{Post}^{\text{Ord.}}$	0.045^{*}	0.590^{*}	1.214^{**}	1.779^{**}	0.022^{**}
	(0.025)	(0.308)	(0.540)	(0.691)	(0.011)
Additional controls:					
Firm-level	yes	yes	yes	yes	yes
Industry-Year FE	yes	yes	yes	yes	yes
Timing FE	yes	yes	yes	yes	yes
R^2	0.582	0.112	0.189	0.214	0.387
N	1,119	1,119	1,119	1,119	1,119

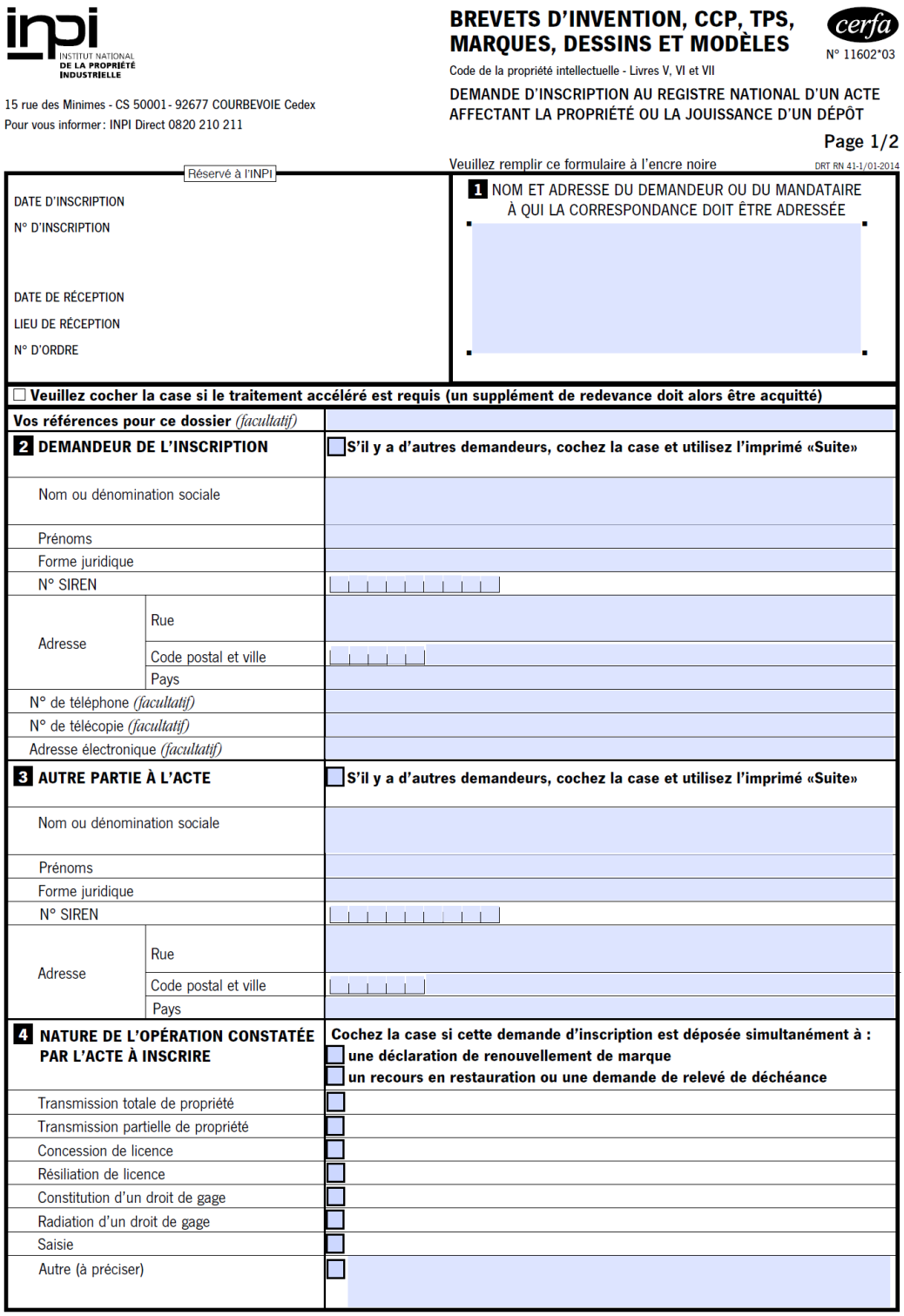
Notes: The table reports robustness tests to the estimates displayed in Panel B of Table 5. All variables and model specifications are defined accordingly, only here, we use different dependent variables to measure patent quality, i.e., value. Originally, we used the total number of forward citations and the size of the patent family as two commonly applied measures of patent value. Now, we use a dummy equal to one if the patents have received a citation (Column I), the total number of forward citations received within 5 and 12 years (Columns II and III) and a measure of patent originality and generality (Columns IV and V). As before, all values are averaged on over the patent portfolio. Standard errors (in parentheses below coefficients) are clustered at the firm level. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

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 United States, 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 United States 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

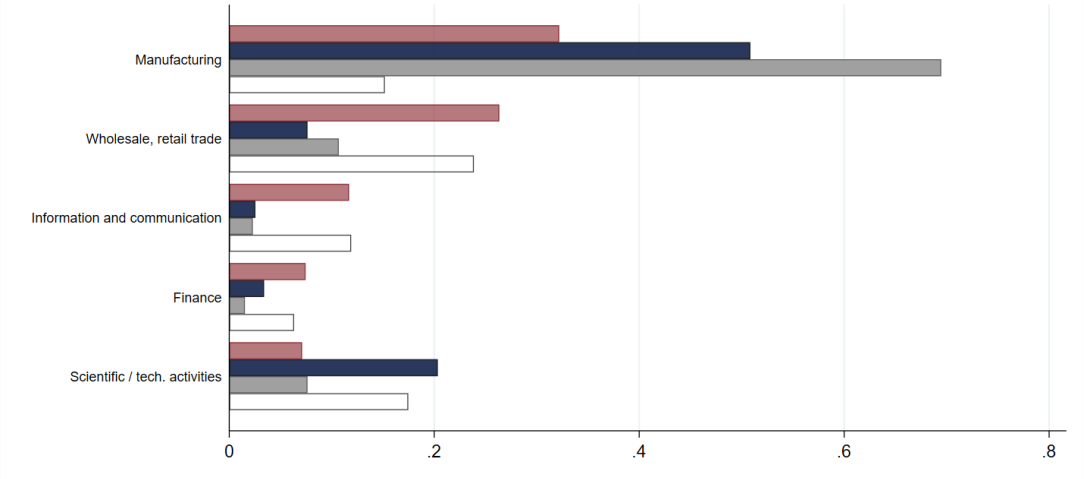
☐ Veuillez cocher la case si le traitement accéléré est requis (un supplément de redevance doit alors être acquitté)

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)		☐

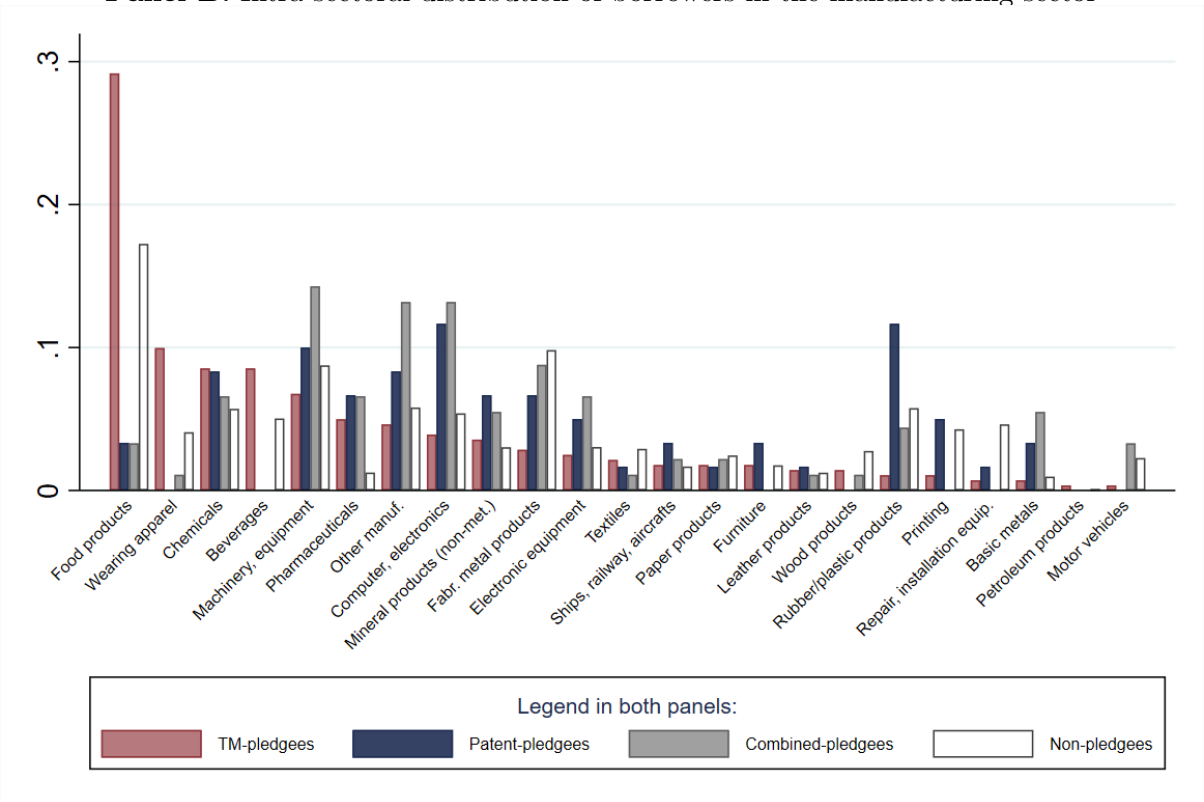
Notes: The figure displays the first page of the form sheet for IP-related legal changes at the French IP office (INPI). IP owners are asked to indicate any changes in ownership, which are specified under point 4. Specifically, pledges of trademarks, patents, and designs are indicated by *Constitution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

Figure IA3: Borrower characteristics: Industries, lenders, and locations,

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

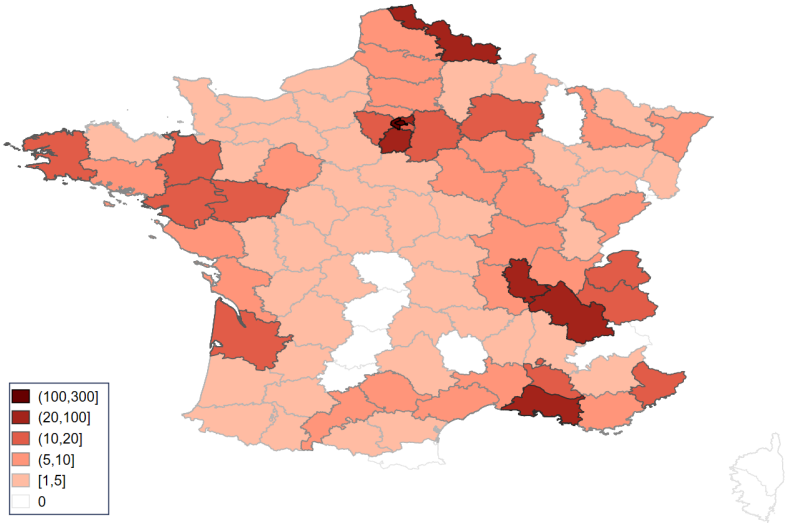


(*Continued on next page*)

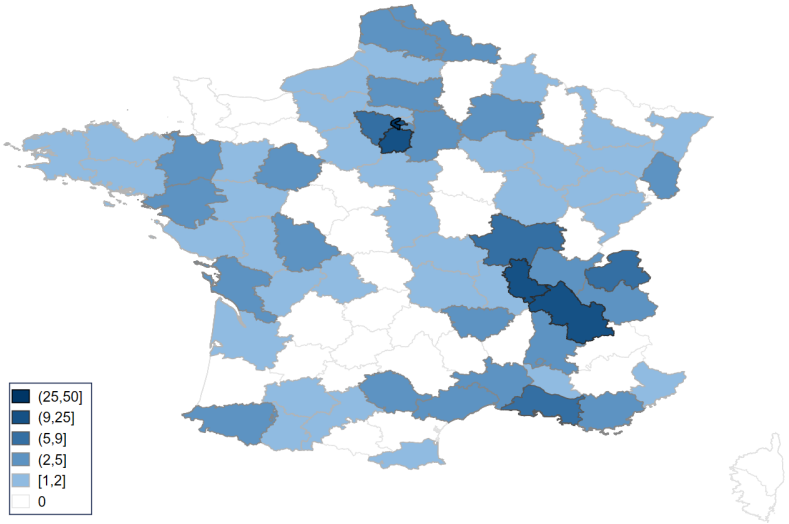
Figure IA3 (continued)

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

Trademarks:

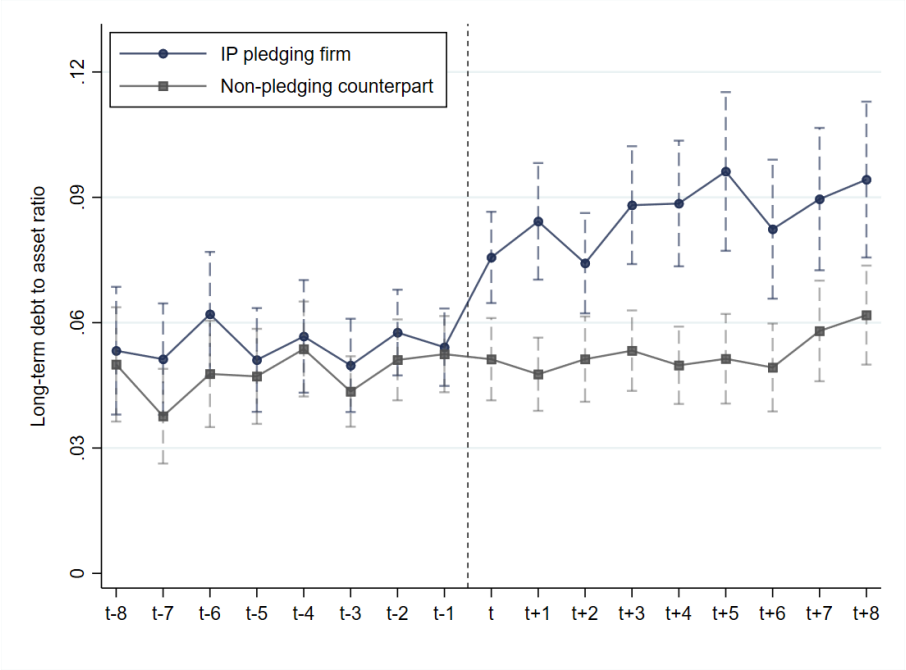


Patents:



Notes: These figures reports general characteristics of IP-pledging firms. Panel A reports the five NACE sectors with the highest share of IP-pledging firms, distinguishing between trademark, patent, combined, and non-pledges. Panel B reports the intra-sectoral distribution of borrowers within manufacturing, by the same pledge categories. Panel C reports the locations of French firms pledging trademarks (left) and patents (right).

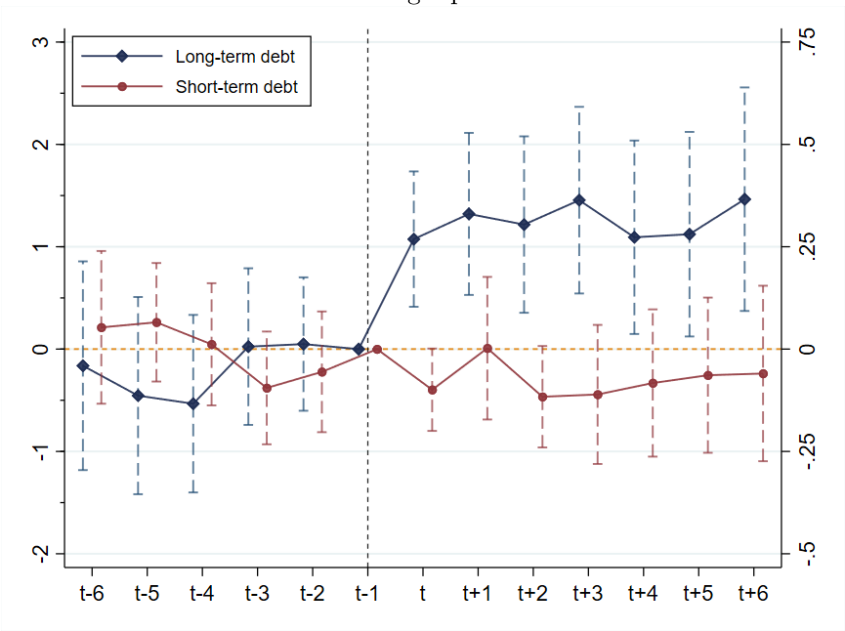
Figure IA4: Mean plots of long-term debt-to-asset ratios relative to pledge year



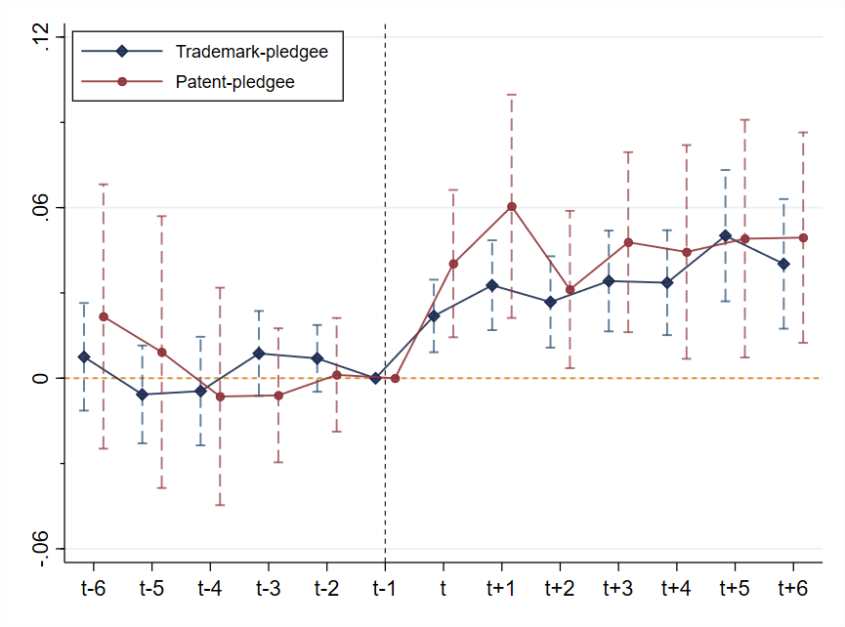
Notes: The figure plots mean values of firms' total debt-to-asset ratios in a symmetric time window of eight years around the initial pledge. The graphs differentiate between IP-pledging firms and matched non-pledging firms from the comparison group. The whiskers span the 95 percent confidence intervals.

Figure IA5: Event-study regression design: Robustness tests

Panel A: Log. specifications

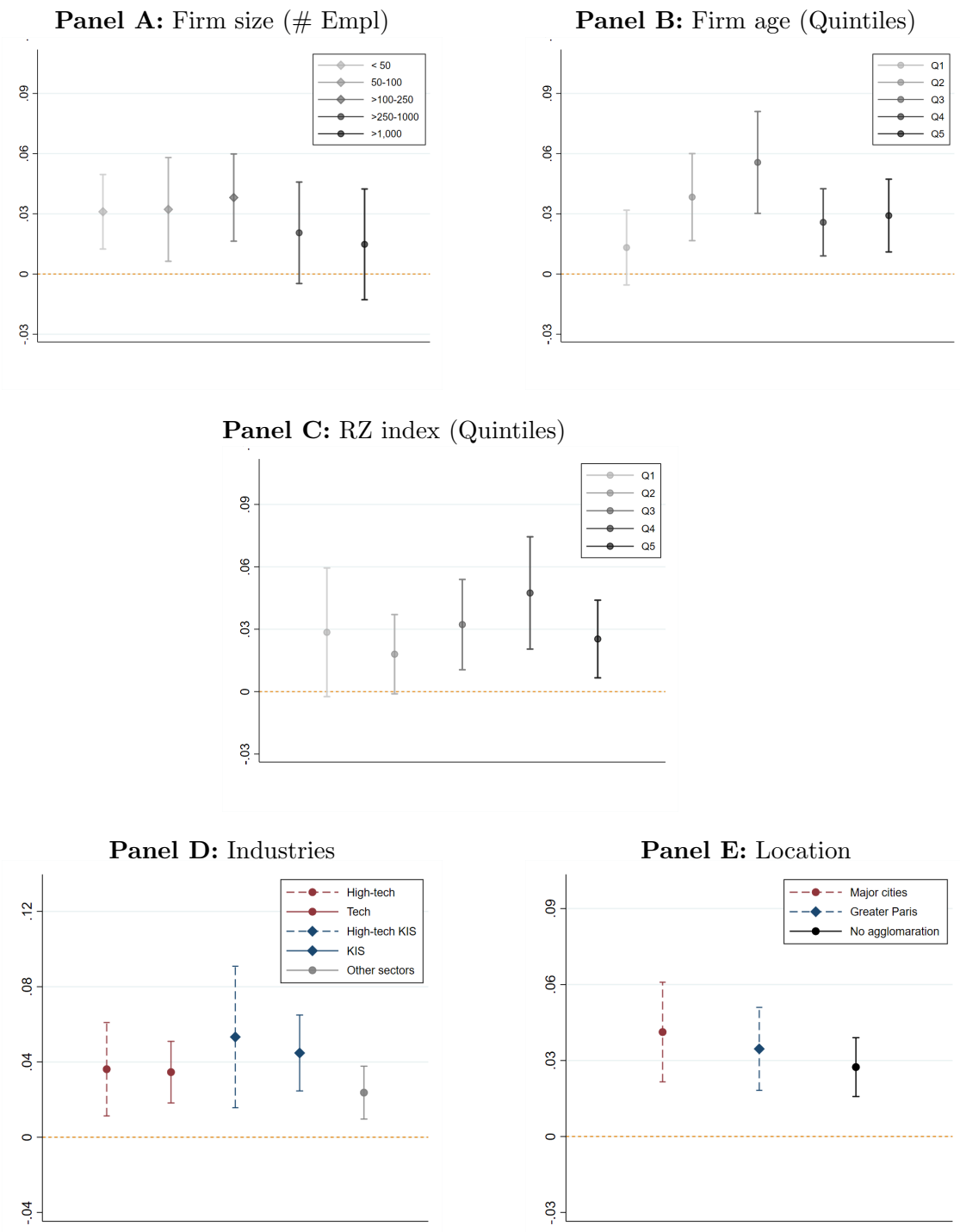


Panel B: Separating TM and patent pledges



Notes: The graph plots the dynamic treatment effects similar to Figure 3. In Panel A, the dependent variables are the log. specifications (instead of the asset-ratios). Long-term (short-term) debt is indexed on the left (right) y-axis. In Panel B, the dependent variable is again the long-term debt-to-asset ratio but coefficients are estimated separately for IP pledges that include trademarks and patents, respectively. Whiskers span the 95 percent confidence intervals.

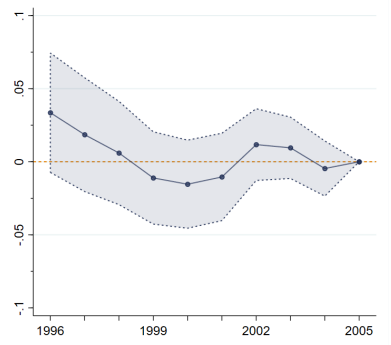
Figure IA6: Plausibility test—differential effects of IP pledges across firm-types



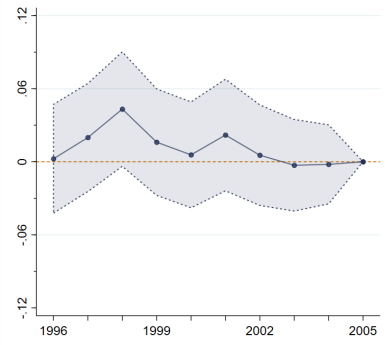
Notes: The figures plot the coefficients of the interaction term $IP \times Pledge$, capturing the effect of IP pledges on firms' long-term debt-to-asset ratios, as defined in Equation (1). Each panel presents estimates on different subsamples that are based on the firm-level categories: size (measured as the number of employees), age (splitting the age distribution into quintiles), dependence on external financing (splitting the RZ index distribution into quintiles), different industry sectors, and firm locations; 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). Sectors are defined 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. Locations refer to firms headquarters, using three groups of urban versus rural areas: 1) Paris, Lyon, or Marseille; 2) the Greater Paris area; and 3) locations not classified in 1-2. In all panels, the whiskers span the 90 percent confidence intervals.

Figure IA7: Testing parallel trends of key variables before the Ordonnance

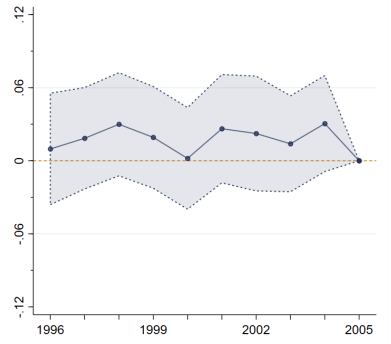
Panel A: *Tangibility*



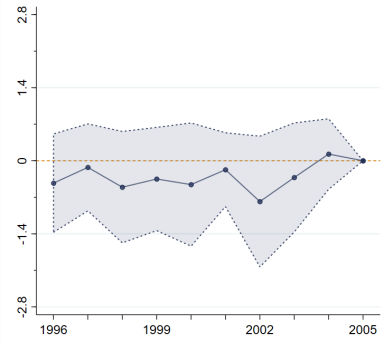
Panel B: *Profitability*



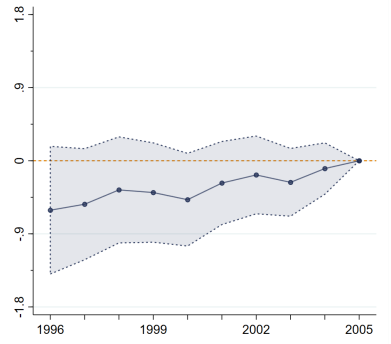
Panel C: *CashFlow*



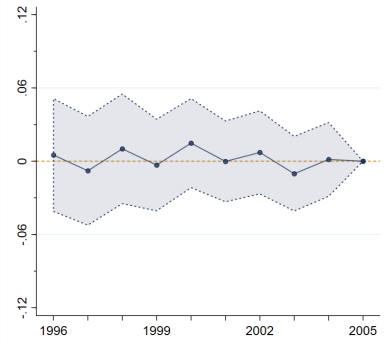
Panel D: *CurrentRatio*



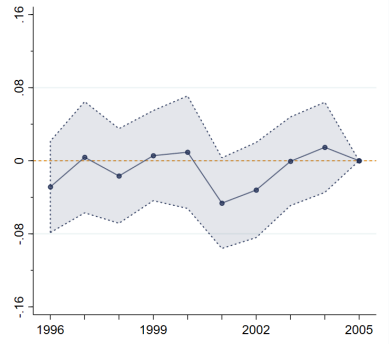
Panel E: log(*ttlAssets*)



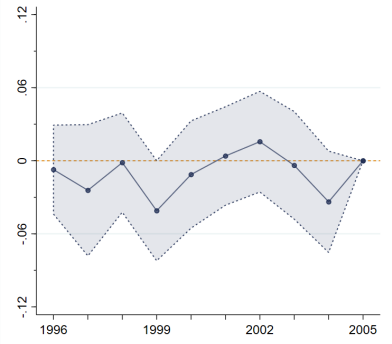
Panel F: $LongTermDebt^{ratio}$



Panel G: I(*TMpledge*)



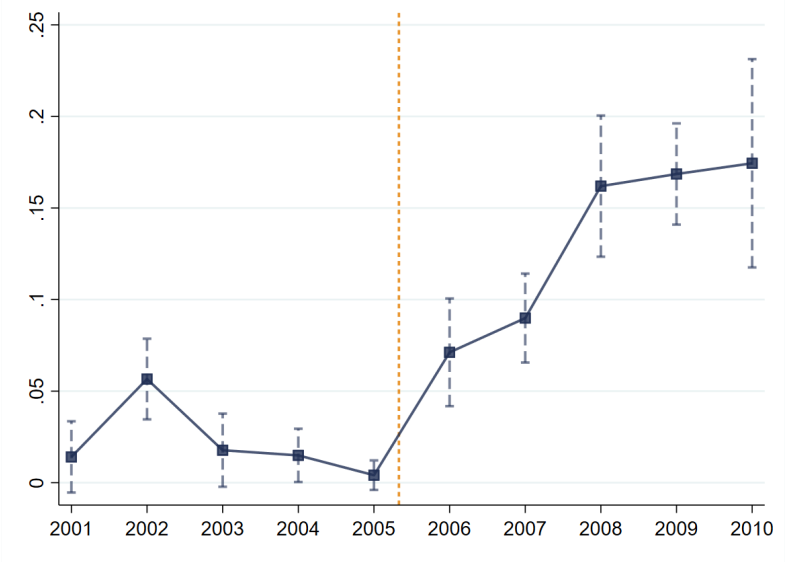
Panel H: I(*PatentPledge*)



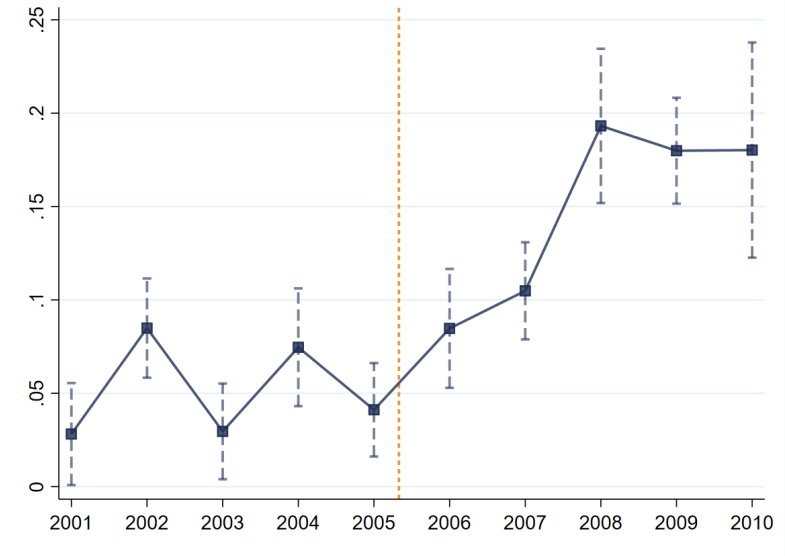
Notes: The figure displays coefficient plots from event study type regressions, testing the parallel trends assumption in the context of the adoption of the Ordonnance in 2006. The Panels A–H plot 10-year pre-reform trends for the main outcome and control variables: tangibility, profitability, cash flow, current ratio, firm size (log. assets), long-term debt, trademark pledges, and patent pledges. All variables are defined in Table IA2 (Appendix) . Estimates are based on Equation (2) using the sample period 1996–2005 each year-dummy is interacted with the Tan^{high} indicator. All specifications include timing fixed effects and industry-year fixed effects as well as time-variant balance sheet and IP characteristics as controls. Shaded areas indicate 95% confidence intervals.

Figure IA8: The share of patents used as collateral related to machinery and equipment

Panel A: Patent collateral with CPC technology classes on machinery and equipment



Panel B: Alternative CPC definitions, including other tangible fixed assets



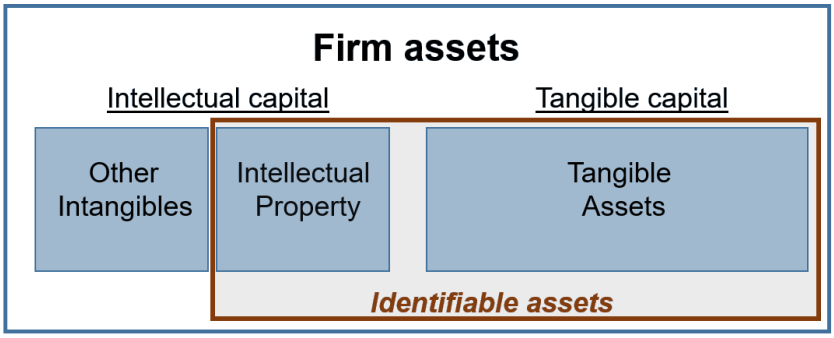
Notes: The figure displays the patent collateral composition before and after the Ordonnance. Specifically, it plots the share of patents used as collateral that have at least one CPC technology class related to machinery and equipment among all patents used as collateral for each of the five years before and after the implementation of the Ordonnance in March 2006. In Panel A, the corresponding classes are F01, F02, F03, F04, F15, F16B, F16C, F16D, F16F, F16H, F16M, and F16P. Panel B uses a broaded definition and additionally considers the CPC classes B21, B23, B24, B27, and B30. The whiskers span the 95% confidence intervals.

Appendix B:

Monetization strategies of IP: As outlined in the main part, identifiability of assets is the fundamental criterion, determining whether an asset can potentially be used in contractual agreements. However, identifiability does not directly imply pledgeability, or, more generally, usability of IP for monetization strategies. Instead, inherent characteristics of IP assets determine the degree of usability. Overall, there are three main strategies for monetizing IP, summarized in Table B1.

Table B1: 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

Notes: This table provides a conceptual overview of monetizing IP rights. Panel A illustrates the terminology of identifiable (i.e., bankable) assets, distinguishing IP from other intangibles and tangible assets. Panel B summarizes and compares the key characteristics across the three main monetization strategies–transfers, licensing, and collateralization.

First, selling IP has the benefit of obtaining a lump sum fee that may help firms to cover financing demands on the spot. It is a rational option for IP owners once the transfer price

exceeds the expected private return to its owner. Still, 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 (see Serrano, 2010; Ciaramella *et al.*, 2017). If the selling firm operates on the downstream market, buyers are likely to be competitors. They can also be non-practicing entities (NPEs) 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 license to 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 and Gambardella, 2010). 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 obtains 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 not limited to granting the use of an IP; rather, the tacit knowledge required for proper use of the right is also transferred (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 (see Kelchtermans *et al.*, 2022).

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 of mitigating adverse selection issues in external financing transactions by both providing asset values that can be liquidated in case of loan default and acting 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. Firms may also exploit IP rights (via signaling) to raise external equity financing, such as venture capital. Unlike for external debt financing, external equity financing is mostly relevant for high-growth startups and implies a dilution of their equity stakes (see Robb and Robinson, 2014). Given these considerations, IP collateralization appears as a promising monetization strategy, which is applicable for a wide range of firms, does not threaten loss of tacit knowledge or ownership stakes, and warrants the future appropriation of respective IP rights.

IP-level pledgeability determinants: Next, we outline distinct IP-level characteristics that are key determinants for the pledgeability of trademarks and patents. Specifically, we outline measurement approaches for the redeployability, cash flow attribution, and value of IP rights.[1] In this context, we do not consider design rights as they are exclusively pledged together with other rights and are not considered in the main empirical analyses.

Although the implications of these attributes are similar across trademarks and patents, these asset types have conceptual differences such that their distinct legal specificities require us to use different measurement approaches. Still, the intuition behind the pledgeability determinants is mostly comparable across the two IP types and distinct dimensions necessary for collateralization can be assigned to them. Below, we describe in detail different ways on how to approximate the value, redeployability, and cash flow attribution of trademarks and patents. These attributes are certainly not mutually exclusive but rather overlapping concepts. For example, a previous IP transfer indicates the availability of a secondary market for that specific

[1] Additionally, the registration of a trademark and the grant of a patent validates their status as an identifiable asset. As a baseline requirement, one must therefore distinguish between registered and not-yet-registered trademarks ($TM\_Registered$) as well as granted and pending patent applications ($Granted$).

asset (i.e., its redeployability), while transfers provide actual market prices, facilitating their actual valuation. Table B2 summarizes the key concepts and measurement approaches.

Table B2: Overview on the key IP characteristics and pledgeability determinants

Determinant	Approximation concept	Variable name (hyp. relationship)
Trademarks:		
Identifiability	Formal establishment via registration	$TM\_Registered$ (+)
Value	Commercial value as indicated by its relevance to the owner	$CorporateMark$ (+), $Renewal$ (+)
Redeployability	The breadth of the legal right and and availability of market values	$Transferred$ (+), $NiceClasses$ (+)
Cash flow	Trademark types determining cash flow link and indication of use in commerce	$ConsGoods$ (+), $IndicationUse$ (+)
Patents:		
Identifiability	Formal establishment upon grant	$Granted$ (+)
Value	Technological and commercial value	$FwdCits$ (+) , $FamilySize$ (+)
Redeployability	Breadth of the legal right and ease of reassigning ownership rights,	$IPC4Classes$ (+), $BwdCits\_pat$ (+)
Cash flow	Ability to assign cash flows, value relevance, and technological complexity	$PatentAge$ (+), $Applicants$ (–)

Notes: The table summarizes the different determinants of pledgeability and lists the IP-level measures described in this section. The signs in the parentheses next to the measures display the assumed relationship.

Measures of value: We first consider different measures for IP value. Starting with trademarks, it is possible to explore differences in value depending on the specific trademark type. As such, corporate trademarks represent the organization that stands behind the products or services provided to consumers and are highly value relevant (Sandner and Block, 2011; Agostini *et al.*, 2015). Their pledgeability should be particularly high relative to other types of trademarks. This logic does not apply for patents, which protect inventions embodied in tangible assets, such as machinery and equipment.

As an alternative value measure for trademarks, we build on the fact that IP rights have to be renewed on a regular basis in order to extend their validity. Renewed IP rights thus most likely have some value to their owner and have an existing track record that facilitates

the evaluation of revenue streams arising from the underlying product or service and it directly indicates that an IP rights is used in commerce (Heath and Mace, 2020; Nasirov, 2020; Hsu *et al.*, 2022). In Europe, trademark renewals are due every ten years. To operationalize their use in commerce, it is possible to count the number of previous renewals ($Renewal$).

For patents, a common approach to measure technological quality and, hence, value is the impact on subsequent innovation. The intuitive measure for this is the number of forward citations used to quantify this impact (see e.g., Hall *et al.*, 2005). Moreover, prior research on patent pledges in the U.S. document that patents receiving more citations are more likely to be used in financial transactions (Mann, 2018; Farre-Mensa *et al.*, 2020). Hence, we conjecture that patents with more citations are still significantly more likely to be pledged. Note that we do not consider citations in the case of trademarks. While this approach is certainly promising from trademarks from some jurisdictions, such as the U.S. (Chiu *et al.*, 2022), in the case of European trademarks, such measures cannot be generated since they do not contain information on prior senior registrations.

As an alternative measure of patents value, it is possible to count the number of active jurisdictions, i.e., the family size. Patent protection is a jurisdiction-based right. The number of jurisdictions a patent is active in can be referred to as the patent's family size ($FamilySize$). Importantly, patents seeking protection in several legal jurisdictions are likely to be of higher relevance of the underlying technology for many markets and larger associated revenues. Therefore, a larger family size indicates a higher economic value of a patent (see Harhoff *et al.*, 2003).

Measures of redeployability: Next, we consider different measures for asset redeployability. In general, prior use in market transactions reflect the redeployability of trademarks and patents. In line with prior literature (e.g., Hochberg *et al.*, 2018), such transactions can refer to prior transfers. To operationalize this feature, we use a dummy variable equal to one for trademarks already transferred before the first IP pledge ($Transferred$), and zero otherwise. Since patent transfers are often not well documented, we refrain from using this measure for patents.

Furthermore, it is possible to approximate the potential of IP rights to be transferred in the future. As a direct measure, the number of product or service categories (trademarks) or technology classes (patents) of trademarks and patents, respectively, can be used. They measure captures the legal boundaries of IP rights and reflect the limits of exploitation of the exclusive right (Cabral, 2000; Graham *et al.*, 2018). Broader trademarks and patents should be transacted on secondary markets more easily, i.e., have a higher redeployability. The number of product/service classes or technology classes should indicate IP breadth, i.e., relate positively to their pledgeability. To operationalize this, it is possible to count the number of different NICE classes of trademarks ($NiceClasses$) or the number of distinct technology classes of patents ($IPC4Classes$). As an alternative patent-related measure of technological breadth, it is also possible to count the number of backward citations in the patent literature ($BwdCits\_pat$).

Measures of cash flow attribution: The attribution of an IP right to cash flows should vary depending on whether the subject matter is more or less closely linked to revenues. For example, prior research shows that product trademarks can be directly linked to sales while linking service trademarks to revenues is difficult (Block *et al.*, 2015). In fact, the NICE classes explicitly differentiate service and product trademark classes. With these classes, one can distinguish service trademarks from product trademarks and, in particular, consumer goods trademarks which likely have disproportionately high cash flow attribution ($ConsGoods$), e.g., by using a dummy variable equal to one if a trademark is listed in any service mark category and zero otherwise.

As another dimension of cash flow attribution applicable for both trademarks and patents is their potential use in commerce. For trademarks, an indicator on their use in commerce is information on adjustments to their legal status. Specifically, it is possible to count the number of changes in the owner's address, legal oppositions, and licensing agreements ($IndicationUse$). These entries provide a good indication of whether the trademark is used in commerce (Sandner and Block, 2011). For patents, their age ($PatentAge$) is a direct indicator of the certainty about

the associated cash flows. In Europe, patents have to be renewed each year after filing. Due to the more frequent renewal of patents relative to trademarks, we can track the precise age of patents, which have a limited lifespan of usually 20 years. Patents are filed at the early stages of the inventive process (Hsu *et al.*, 2022), rendering younger patents especially unlikely to be relevant for cash flows. Conversely, older patents have a longer track record of past revenue streams associated with them.

In addition to this, the number of distinct patent co-applicants (*Applicants*) can serve as important patent-level measures of cash flow attribution. 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 pledgeability.

Appendix C : Perfecting IP loans in France

Establishing the contract: 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). In this context, 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 a set of movable properties as security for an obligation. It provides the lender, who accepts the respective IP as collateral, with 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 pledgeable 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 industry.

For all loan agreements, the contract must contain a written description of 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 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 their ownership right in court.

Resolving the contract: There are generally three possible scenarios for ending a loan agreement, each of which has 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, in the case of a default without insolvency 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 required outstanding repayments, the borrower receives the excess amount. In the third scenario, after a default caused by an insolvency of the borrower, a collective proceeding is opened aiming to satisfy the claims of all affected creditors, 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 loan agreement resolutions in other jurisdictions with strong enforcement regimes, like the United States.

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