

Intellectual Property as Business Loan Collateral: A Taxonomy on Institutional and Economic Determinants

By David Heller*, Leo Leitzinger† and Uwe Walz‡

Abstract

As a promising strategy, firms can use their intellectual property rights (IPR) as collateral to secure debt financing. Despite an ongoing shift to a more technology-based economy, the collateralizing of IPR is still trailing behind the use of more traditional asset classes. In this paper, we develop a new taxonomy on the key determinants of using IPR as collateral. The taxonomy defines two pillars that govern the use of IPR collateral that distinguish between institutional and economic determinants. The institutional determinants cover contract law, IPR registries, and banking regulation. The economic determinants constitute the influence of IPR characteristics on the trade-off between the economic costs and benefits of collateralizing IPR. We propose that IPR collateral can have significant advantages regarding signaling, agency issues, and the creation of pledgable income. We apply the derived taxonomy to the legal and economic status quo in several industrialized economies to identify potential impediments to IPR-backed debt financing. Taken together, our taxonomy can be viewed as the foundation for future research on IPR as loan collateral for businesses, both in the fields of law and economics.

*Max Planck Institute for Innovation and Competition; Marstallplatz 1, 80539 Munich, Germany. Phone: +49 (0)89 24246 565; E-Mail: david.heller@ip.mpg.de.

†Goethe University Frankfurt; Theodor-W.-Adorno-Platz 4, 60323 Frankfurt, Germany. Phone +49 (0)69-79834820; E-Mail: leitzinger@uni-frankfurt.de.

‡Goethe University Frankfurt; Theodor-W.-Adorno-Platz 4, 60323 Frankfurt, Germany. Phone +49 (0)69-79834821; E-Mail: leitzinger@uni-frankfurt.de.

1 Introduction

Financial constraints caused by a lack of collateral undermine the growth dynamics of firms, especially, for small, intangible-rich firms (see Berger and Udell 2006; Bottazzi *et al.* 2014). At the same time, the last decades were marked by an increasingly dominant role of intangible assets not only but also in technology-based small firms (e.g., Brynjolfsson *et al.* 2021; Dell’Ariccia *et al.* 2021). Despite this development, tangible assets thus far have remained as the most common mode to secure external financing and in particular bank loans (e.g., Falato *et al.* 2020). Lacking tangible assets is therefore one of the main causes for slow growth of many small firms (Hall and Lerner 2010). Hence, the question arises of whether and how the use of intangible assets, in particular intellectual property rights (IPR), as collateral for business loans can catch up with the traditional use of tangible assets.

In principle, pledging IPR as loan collateral provides firms with an additional source of financing, especially when other collateral is absent. Improving access to financing may form important incentives to obtain IPR particularly for small and medium-sized enterprises (see, e.g., Graham *et al.* 2009; EPO 2017), which are generally considered to have relatively limited access to external sources of financing (Berger and Udell 2006; Czarnitzki and Hottenrott 2011). The recent empirical evidence on US firms has indicated that certain borrowers are indeed able to use their patents and trademarks as loan collateral (Mann 2018; Hochberg *et al.* 2018; Graham *et al.* 2018). Yet, the market for IPR-backed loans is still underdeveloped and only a small share of the firms with IPR actually borrow against it (e.g., Kieninger 2020). This is particularly puzzling against the backdrop of the increasingly dominant role of intangibles in firm value. To illustrate, the contribution of IPR-intensive sectors to GDP ranges between 38 and 45% in European and Asian countries and the US (see Figure IA1, Appendix). In the absence of specific frictions, it should be most effective for rational agents to deploy their most valuable assets to obtain financing.

In this paper, we develop a new taxonomy on the determinants of collateralizing IPR to better understand the obstacles to more active use of IPR as collateral in lending. The taxonomy defines several institutional and economic determinants that are the basis for IPR as collateral. The institutional determinants contain three different elements: contractual law, IPR registries, and bank regulation. The first element defines the contractual law framework; it governs the legal transfer of IPR while leaving the usage right with the lender. The second element aims to strengthen the underlying property right and enhance the transparency of its potential transfer from the borrower to the lender. The third element defines the costs of lending via banking regulation. The three elements should have considerable effects on the structure and volume of transaction costs for IPR-backed loans. The economic determinants constitute the joint influence of IPR and industry characteristics on the trade-off between the economic costs and benefits that firms face when using IPRs as collateral. We argue that these determinants need to surpass a certain threshold in order to enable the occurrence of IPR-backed loans.

We apply the taxonomy to analyze the potential reasons for the relatively low prevalence of IPR-backed loans. We choose the German legal system as a starting point and then compare our findings to Japan, the US, and France. By doing this, we account for institutions that vary across countries. Our results show that these four legal regimes provide the basic requirements for the collateralizing of IPR. At the same time, for each of them we observe specific frictions which potentially act as obstacles towards a more frequent use of IPR as collateral.

We identify the certification and validation roles of a public IPR registry to be of highest importance. Since lending is generally associated with asymmetric information (prior and after loan provision), the information provided by a public registry represents institutional support behind the loan agreements. In addition, we consider the international regulatory requirements for business loan providers as stipulated by the Basel III Accords, which affect the supply of loans. Our analysis shows that IPR does not fulfill the collateral eligibility criteria under Basel III. This failure means that IPR-backed loans are designated as unsecured loans, which potentially increases borrowing costs.

Next, we discuss the economic role of collateral in debt contracts by focusing on the benefits and costs to firms when pledging their IPR as loan collateral. Most importantly, IPR collateral may act as a signaling or screening device that aims to overcome informational asymmetries between the lender and the borrower in which the IPR's value to the borrower matters. Furthermore, IPR collateral may compensate for a lack of other sources of pledgable income that makes the value of the IPR to the lender decisive. In contrast, the main costs of using IPR as collateral come from low redeployability, high valuation costs, and high liquidation costs (i.e., high transfer costs in case of default). Overall, we argue that this cost-benefit trade-off is jurisdiction-, firm-, and in particular asset-specific.¹

We deliver new and fundamental insights to the emerging academic literature on the use of IPR as loan collateral, which may be in particular useful for many small firms. The few other studies that empirically assess the use of IPR loans focus on single IPR types in very specific settings. For instance, Mann (2018) investigates the use of patents as loan collateral for a sample of large listed US corporations. Hochberg *et al.* (2018) study the collateralizing of patents by start-ups backed by venture capital in three tech industries. Graham *et al.* (2018) show that US firms may also use trademarks as loan collateral. In contrast to these studies, we have a complementary and much more fundamental goal in this paper: we develop a new taxonomy for the determinants of IPR-backed loans. This taxonomy covers central cornerstones that govern the use of IPR as loan collateral, that is, institutional and economic determinants.

With this paper, we provide a number of key contributions. First, we introduce a new taxonomy on the key determinants of collateralizing IPR. Second, our analysis demonstrates and evaluates the current state of these determinants in several countries. Third, we draw main

¹In order to translate this insight into a basis for future empirical work we derive in the appendix a number of testable hypotheses.

policy conclusions on the prevalence of collateralizing IPR. We hope to stimulate the discourse among policymakers, practitioners, and academics about the modernization of bank lending in line with an increasingly technology-driven economy. Our taxonomy can be viewed as the foundation for future research on IPRs as business loan collateral.

The paper is structured as follows: In Section 2, we define different IPR types, the principle benefits of loan collateral, and provide statistics on the actual use of IPR collateral. In Section 3, we define the institutional and economic determinants of our framework. We discuss the application of these determinants against the background of several large economies around the globe in Section 4. In Section 5, we summarize our main findings and provide a number of policy implications.

2 Intellectual property rights and their use as collateral

IPR can be distinguished based on differences regarding the underlying subject of protection. Our analysis focuses on the four most common types of IPR: trademarks, patents, designs, and copyrights. Table 1 specifies the basic criteria of and differences across these types. All IPR types grant their owner an exclusive legal right to use the protected object, product, service, or technology. Their common denominator is to promote economic activity in terms of inventive processes (patents and copyrights) or product quality and differentiation (trademarks and designs). Hence, all IPR types serve as protection against unlawful use or dissemination. Yet, IPR types differ with respect to their subject matter as well as other central aspects; such as i) the requirements for obtaining the respective rights, ii) the administrative steps that are required to activate protection, and iii) the duration of protection. These differences might have direct implications for the use of the respective IPR as collateral.

- *Insert Table 1 here* -

Once a firm holds an IPR, it can be deployed - in principle - in any market transaction, such as IP sales, licensing, or as loan collateral. Sales and licensing transactions provide firms with equity at the cost of forgoing the exclusive ownership right. In contrast, IPR pledges that secure loans provide firms with a lump sum payment without the risk of diluting or losing the exclusive right to appropriate the underlying intellectual property.

Despite an abundance of anecdotal evidence on the use of IPR as loan collateral, empirical evidence on this practice is scarce. Obtaining aggregate statistics on the use of IPR as loan collateral is difficult. As our analysis shows there is no obligation to report loan transactions in most jurisdictions worldwide. Plausibly, firms may decide not to publicly disclose the specificities of their loan contracts for strategic reasons. However, there are some exceptions such as several European countries (i.e., Belgium, Luxembourg, the Netherlands, Sweden, and France) where registration of IPR collateral is mandatory in the case of patents.

For the US, some studies show that specialized borrowers use patents as collateral in loan contracts (Mann 2018; Hochberg *et al.* 2018). Ciaramella *et al.* (2022) provide first encompassing evidence on the use of trademarks, patents, and designs as loan collateral exploiting IPR loan register entries in France for the years 1995-2018. They find that the majority of IPR used as collateral are trademarks (84%), followed by patents (26%) and designs (2%). Indeed, the distribution does not match the actual use of these IPR, which is much more balanced (see Figure IA1, Appendix). This suggests that IPR type-specific characteristics are important to determine its current use as loan collateral.

Because of the limited data availability, documenting the actual use of IPR as loan collateral is non-trivial. To exemplify the use of IPR collateral, we collect data on some of the aforementioned European countries and on one specific type of IPR, patents, for which data is most readily available, i.e., the Netherlands, Sweden, and France for the years from 2000 to 2018. On average, about 120 firms from these three countries pledge patents per year, with no particular time trend.² Given that IPR collateralization moves far beyond patents (e.g., Ciaramella *et al.* 2022), including of all IPR types will likely yield much higher numbers. In the US, these numbers are distinctively higher (see e.g. Mann 2018) However, specific loan vehicles, such as blanket liens, in which the entire asset portfolio is pledged, may drive these results, implying that IPR merely serve as add-on collateral. Taken together, these observations confirm the notion that the majority of loans still does not utilize IPR as collateral.

3 A taxonomy on the determinants of IPR-backed loans

In this section, we derive the taxonomy on the determinants of collateralizing IPR. At its core, the framework consists of two pillars as illustrated in Figure 1: one institutional and one economic. The two pillars comprise several determinants, which constitute the overall taxonomy. Each determinant in itself is viewed as necessary but not sufficient factor that needs to reach a minimum threshold in order for IPR to be a suitable means of collateral. Most broadly, the institutional pillar consists of three key determinants: 1) contract law, 2) IPR registries, and 3) international regulation in banking. The economic pillar contains the characteristics of IPR which determine the economic cost-benefit analysis of IPR as collateral. In the following, we describe the two pillars and describe each determinant in detail, including their bifurcations. This way, we develop our taxonomy on the determinants of IPR collateralization step-by-step.

- Insert Figure 1 here -

²These relatively small numbers are comparable to other major IPR-intensive economies, such as Japan. Data provided by the Japanese Patent Office shows that the number of patent pledges was between 120 and 193 for the years 2012 and 2017, respectively (Hara and Haga 2020).

3.1 Institutional Pillar

From an institutional perspective, the general legal framework marks the foundation of IPR-backed loan transactions. As contractual agreements, the mere existence of loans contracts is subject to the underlying legal setting. Hence, the legal framework is the *conditio sine qua non* for IPR to be used as loan collateral. In other words, if the law prohibits the use of all or specific asset classes as collateral, then there is no market for these assets. In fact, specific laws prohibit the use of certain IPR collateral types, such as the use of ungranted patents in Japan or collective trademarks in France. Hence, the fundamental legal framework is a prerequisite for lending that uses IPR as collateral, in particular, once they discriminate between collateral assets.

We define three main elements of the institutional determinants as illustrated in Figure 1: contract law, public registers, and banking regulation. In our view, these elements define the important dimensions to consider when collateralizing IPR. These dimensions relate to features most directly linked to borrowers and lenders but principally, they concern all stakeholders. Additionally, we can distinguish between direct and indirect implications of institutions. Without claiming completeness, we consider these institutional elements as important complements for the use of IPR as loan collateral. As opaque and uncertain assets, IPR are prone to incompleteness in contract law, registration requirements, and banking regulation.³ Hence, we argue that these institutional factors are particularly important in the context of IPR, despite their applicability for other non-IPR collateral assets. Most importantly, all three institutional factors should lead to a reduction of transactions costs for IPR-backed loans, if they are implemented in an efficient manner. In the following, we describe these three elements in more detail.

Contract law: Institutions are important in a very direct way because they steer the interactions of stakeholders. Most importantly, ownership rights need to be clearly defined. Specifically, domestic contract law provides the legal framework for private loan contracts which allow the use of specific asset classes as collateral. This law directly affects the relationship of borrowers and lenders in a loan contract by defining rights and obligations. For example, more precise contract law defines specificities regarding the collateralizing of IPR that facilitates the establishment of the contract between borrowers and lenders. In contrast, poor institutions fail to define specific aspects of contract law which introduces additional transaction costs.

For these reasons, we investigate to what extent does contract law help or impede the provision of loans that have IPR as collateral by considering different layers of the national legislative systems. This consideration includes aspects related to the establishment of the respective loan contracts and their termination. The potential limitations in contract law involve two factors:

³For illustration, consider the example real estate, as the asset class that is most typically used as loan collateral. First, contract law clearly defines the use of real estate as loan collateral, including an encompassing description of the rights and duties throughout the processes of establishing, maintaining, and resolving a loan agreement. Second, economies with a developed banking system typically have land registries to which both potential lenders and borrowers have access and which comprise up-to-date information on the assets' legal status. Third, according to international banking regulation, loans that are secured with real estate enjoy a pre-defined status as collateralized loan that defines lenders' opportunity costs of providing such loans.

a lack of specific rules and incomplete contracts.

Public registry: A major friction in debt financing is information asymmetries between borrowers and lenders (e.g., Hall and Lerner 2010). Information provided by trusted institutions are important as they can indirectly steer the collateralizing of IPR by influencing these asymmetries. Specifically, we focus on IPR offices as the key intermediary to communicate reliable and standardized IPR-related information to the public. This way, they can reduce information asymmetries. Access to this information induces transparency regarding the present and past statuses of an IPR. A timely and mandatory registration enhances the monitoring of IPR collateral prior and during the loan contract. In some IPR offices, this information includes details regarding the collateralizing of IPR. Therefore, institutions may be a valuable intermediary for collecting, processing, and communicating information via standardized repositories.⁴

Banking regulation: Institutions can shape the opportunity costs of IPR regarding the supply of and demand for loans. That is, bank regulatory rules have a potentially strong influence on the prevalence of certain types of loan collateral, since they affect the cost of lending. Banking regulation subjects banks to a set of rules, restrictions, or guidelines. Capital requirements are regulatory standards for banks that determine via capital requirements rules (e.g., Demirguc-Kunt *et al.* 2013) how much capital bank lenders have to withhold for different types of collateral. All else being equal, higher capital costs reduce banks' expected return on a loan and thus affect the supply of loans. Similarly, higher capital costs may lead to higher interest rates which reduce the demand for loans (Thakor 1996; Fraise *et al.* 2020). For these reasons, changes in capital requirements translate into a change in the opportunity costs for IPR-backed loans, especially if the rules vary across collateral types.

3.2 Economic Pillar

In principle, collateral is the claim of a lender (typically a bank) on the borrower's assets in case it defaults on the loan or files for bankruptcy (Tirole 2010). This secured interest generally gives the lender priority over other creditors in claiming proceeds from the respective liquidated assets. For the lender, interest payments are cash flows obtained from borrowers. Hence, collateral can be viewed an alternative source of loan repayment if the borrower is not able to cover the interest payments from other sources, in particular its operations. In economic terms, collateral thus reduces the cash flow risk of the lender. Thus, if a borrower has no collateral, then lenders may not be willing to provide a loan or may demand higher interest rates. Therefore, the provision of collateral is one way of improving access to external debt financing. Providing pledgeable income to the lender improves the borrower's conditions to secure funding.

The functioning of collateral can best be described as an additional source of information (see Boot *et al.* 1991). There is no need for collateral when the information between borrowers and

⁴This is in line with prior research showing that the public disclosure of IPR-related information through standardized, and centralized institutions supports transactions in the market for ideas (e.g., Gans *et al.* 2008; Hegde and Luo 2018).

lenders are perfectly symmetrical and both parties can use the potential collateralizable asset to the same extent.⁵ It follows that lenders use collateral to overcome asymmetric information. Hence, the decisive question is to what extent collateral may mitigate this problem. At the same time, collateral can also be the source of informational asymmetry. Both factors are particularly relevant in the context of IPR collateral, because here the question is to what extent IPR introduces additional frictions by itself.

In addition to the institutional pillar, the weighting of economic benefits and costs of using IPRs as collateral in business loans is pivotal for explaining the actual use of IPR collateral. The second pillar reflects the extent to which IPR may undertake the role of collateral in business loans and its main economic obstacles. The use of IPRs as collateral has a number of distinct benefits that are related to their reliability and signaling strength. At the same time, distinct IPRs carry inherent characteristics which are typically associated with higher costs in the context of loan contracts, such as a relatively high degree of uncertainty. The three main IPR characteristics at the core of the economic cost-benefit trade-off are the following: the ability to redeploy IPRs which is closely related to the asset-specificity of the respective IPR, uncertainty around the definition of IPRs as well as the scope of uncertainty (see also Gans *et al.* (2008)). Overall these benefits and costs result in specific settings which are especially conducive to the use of IPR as collateral but also to contexts in which they may clearly face limits.

Furthermore, these economic considerations are distinctively different to the one in the other pillar with regard to one specific characteristic; that is, the economic benefits and costs are endogenously determined by the institutional factors in the first pillar. More explicitly, in our taxonomy we propose that the institutional determinants directly affect the economic determinants, while the reverse is not necessarily true, that is, at least in the short- to medium-term. For example, institutions may directly affect the degree to which an asset can be redeployed but different degrees do not directly affect the design of institutions. As a consequence, direct changes in the IP law concerning the institutional framework - intentionally or unintentionally - translate into changes in the economic benefit-cost analysis on the feasibility of the use of IPR as collateral. While, as such, both the institutional factors and the economic argument in favor of (or against) the use of IPR collateral resemble two equally important requirements for enabling the collateralizing of IPR, their interrelationship is not symmetric.

Taken together, the above can be summarized in Figure 2, i.e., our taxonomy of IPR-backed loans. The taxonomy decomposes the two main pillars into a set of determinants which are interdependent. The economic determinants are based on the asset value from both the borrower's and the lender's perspective. Institutional determinants directly impact the economic weighting of benefits and costs and are itself rooted on an economic consideration – transaction costs.

- Insert Figure 2 here -

⁵This use illustrates that full information is not a necessary condition here. It is sufficient that borrowers and lenders have similar expectations on the distribution of a projects returns, and the returns from the collateralized assets are stochastic (see also Jimenez *et al.* 2006)

4 Application of the taxonomy

In this section, we discuss our taxonomy in detail by applying it to actual characteristics in legal frameworks of major economies worldwide. If necessary, we focus on country-specific frameworks first and then use these insights to draw inferences on a more general level. Our goal is to describe the status quo along the dimensions of institutional settings that shape the loans with IPR as collateral as of today and the associated economic benefits and costs for market participants.

4.1 Institutional determinants

4.1.1 Enabling IPR loans with domestic contract-law

Legal issues are tied to the country-specific legislative frameworks. We chose Germany as a benchmark scenario and subsequently compare our findings to other large industrialized economies: Japan, the US, and France. Germany is well-suited for benchmarking, because of its high IPR intensity (as illustrated in Section 2), its strong banking-based focus, and the relatively high importance of German law for other legal regimes (Porta *et al.* 1998). Comparing our benchmark findings to other major IPR-intensive economies is important to gain more detailed insights on whether and how the legal framework determines the use of IPR as collateral.

In Germany, the combination of the IP law with the general credit security law governs the framework for collateralizing IPR. There are two relevant approaches to securitize IPR: the pledge of rights and security assignments.⁶ For simplicity, we consider two party contracts between the IPR owners (the debtors) and a lending institution, which is typically a bank. In principal, German law provides relatively clear instructions for the establishment and resolution of IPR-backed loan contracts. It further formulates a general guidance for the time the loan contract is active. In the following, we discuss these three parts of a loan agreement separately.

Establishing a contract: The German system differentiates between the pledge of rights and the security assignment as the means to collateralize IPR.⁷ Both cases stipulate the use of trademarks, patents, utility models, and designs as loan collateral. Further, the borrower is able to continue using the IPR commercially throughout the entire duration of the contract.

Despite these commonalities, the two securitization modes are based on two different legal concepts with distinct rights and duties. In particular, a pledge of rights is an accessory right in which a secured claim on the respective IPR is a necessary prerequisite. The borrower maintains ownership and control of the pledged IPR, while the lender is granted an exploitation right in the case of default. This control allows the borrower to autonomously decide about the

⁶Further, there are also two other forms in which the IPR is only indirectly used as loan collateral. The first form is a security usufruct in which a person or group of persons uses the real property (often land) of others. However, this scheme is only applicable in a very limited number of jurisdictions, for example, Germany, France, or parts of the US. As a second alternative, security licenses can be applied to collateralize IPR. In this approach, royalty payments are securitized but not the IPR itself.

⁷As with any kind of private contractual agreements, specific loan details can be individually determined between the parties involved. For the establishment and the resolution of IPR-backed loan contracts, German law provides relatively clear instructions. For the time the contract is active, German law maps out several rules as a rather general guidance.

appropriation of the IPR. For example, a borrower might use the pledged right in other licensing or loan contracts without asking for the permission from the lender.

In contrast, a security assignment establishes a so-called fiduciary relationship between the borrower and the lender. Specifically, in this legal concept the owner and holder are split apart such that the lender becomes the owner of the IPR, while the borrower remains its holder. This is important, as the borrower cannot autonomously decide about the appropriation of the IPR during the loan contract. In practice, it is common to back-license the IPR (Brinkmann *et al.* 2020), such that the borrower is still able to exploit the IPR independently from the lender.

Maintaining a contract: During the term of the loan contract, different responsibilities arise to maintain the status of the IPR for both the borrower and lender. In order to perpetuate an IPR, its holders have to pay reoccurring renewal fees. For a pledged IPR, the borrower is responsible for paying these maintenance fees and ensuring that the respective right does not lapse.⁸ Similar to the maintenance responsibilities, the borrowing entity is obliged to defend the IPR in the case of infringements. However, if the borrower does not fulfill these responsibilities, the lender is authorized to step in and pay the maintenance fees or defend the collateralized IPR in court. These rules apply for both the pledge of rights and the security assignment.

Resolving a contract: In most cases, a loan contract ends with its fulfillment by the borrower, which results in a lapse of any exploitation rights (pledge of rights) or the release of the collateral (security assignment). In case of default, several scenarios are possible, but a common approach to collateralizing IPR is to add a post-default agreement to the private contract that specifies procedures and responsibilities in case of a loan default. If such an agreement is missing, German law governs certain aspects of the collateral. This arrangement applies for both the pledge of rights and the security agreement.

Legal scholars commonly differentiate between default in case of a borrower's insolvency and an outside insolvency default (e.g., Picht 2018; Brinkmann *et al.* 2020). The two cases differ with respect to the cause of the default. Borrowers file for insolvency if they are unable to pay their debt since the borrowers' liabilities exceed their assets. An outside insolvency default could occur due to insufficient liquidity on the borrower's side or for strategic reasons. The latter happens for example if the value of the collateral falls drastically below the credit amount (see, e.g., Guiso *et al.* 2013).

In case of insolvency, the collateral is transferred to a trustee. The task of the trustee is to liquidate the collateralized assets and eventually repay the lender by using those proceeds. From a legal perspective, there has not been a clear definition of whether the trustee or the creditor gains the IPR (Brinkmann *et al.* 2020). This differentiation may be important as it determines whether the trustee or the loan provider has the right to decide how to further proceed with the IPR collateral. Specifically, the appointed party can decide on whether, how, and to whom the

⁸This applies to all IPR types, irrespective of the specific obligation that perpetuates the right. For example, a trademark owner has the responsibility to continue using its trademark, since its validity may eventually lapse if it has not been used within a certain time span, such as five years in the US.

respective IPR should be sold. In practice, a common approach to mitigate this issue is that trustees and lenders specify a separate contract which governs these aspects in case of insolvency.

An outside insolvency default in a pledge of rights leads to a public auction of the IPR if not otherwise specified in the private contract. The proceeds from auctions are intended to cover the lenders' claims. Because the mean of collateral realization is codified by law, the lender cannot freely decide how to appropriate the collateral. This is often considered a weakness of the pledge of rights relative to the security assignment that does not incorporate such a standardized approach (Brinkmann *et al.* 2020).

To sum up, the German legal framework defines relatively precisely the establishment and resolution of IP-backed loan contracts as well as rights and duties for the time the contract is active. The parties involved can chose among two distinct ways of collateralizing IPR, namely the pledge of rights and the security assignment, allowing them to choose the strategy that is more appropriate for their needs. As an important element, the law allows the original owner to continue the exploitation of the IPR throughout the loan contract. This reduces the costs of engaging in IPR-backed loan agreements and, in principle, provides the ground for these transactions. Yet, the two-track system introduces certain inefficiencies, since potentially confusing security devices constitute indirect transaction costs (see Nguyen 2014).⁹ As another flaw, the disposal right in an insolvency scenario is still an unresolved issue in Germany. A standardized procedure could strengthen IP-backed lending by decreasing uncertainties as well as the associated transactions costs.

Comparing Germany with Japan, USA, and France: As a next step, we assess the key commonalities and differences of the German legal framework and IPR collateral laws in three other IPR-intensive economies, Japan, the US, and France, regarding both the establishment and the resolution of the loan contract. In principle, IP laws worldwide have been aligned to some extent over the past decades.¹⁰ Despite these harmonization efforts, some significant differences prevail (Hall and Helmers 2019) which might be relevant to using IPR as collateral. Therefore, to assess the effectiveness of IPR collateral laws, a comparison of different legal regimes is essential. Table 2 provides an overview of the legal frameworks regarding the use of IPR as collateral in the four jurisdictions discussed in this paper. See Kieninger (2020) for a comprehensive overview on IPR security laws worldwide.

- Insert Table 2 here -

In general, Japanese law and German law are fairly comparable regarding the establishment and resolution of IPR loan contracts. Still, some notable differences exist with regard to the potential of collateralizing IPR. In Japan, it is generally possible to collateralize all forms of a

⁹Notably, this issue is not specific to IPR collateral but applies to all forms of secured debt transactions. For more details on this, see Levitin (2013).

¹⁰For example, the American Inventors Protection Act (AIPA) was a major alignment of the US patent system enacted in 1999. Within Europe, the 2004 EU Enforcement Directive constituted a major legislative change that harmonized IPR law across member states.

registered IPR (trademarks, patents, utility models, and designs). Unlike in Germany, Japan also adds the use of copyrights as loan collateral. Similarly to Germany, the two legal approaches are the pledge and the security assignment (Hara and Haga 2020). As an important difference, in Japan a firm cannot collateralize the right to obtain an IPR, i.e., IPR prior to its granting (Hara and Haga 2020). In Germany, other European jurisdictions, and in the US, firms can use IPR as collateral prior to the grant. As a relevant side note, the Japanese Supreme Court has not yet faced a case where the security assignment of an IPR was disputed. Since it is governed by Japanese case law, the application of an IPR-backed security assignment could still entail a degree of uncertainty. Regarding the resolution of the loan contract, Japanese law does not demand a mandatory public auction (as in Germany) in the case of a loan default. IPR pledges are enforced privately and extrajudicially (Hara and Haga 2020).

In the US, IPR collateral is governed by the general rules of the Uniform Commercial Code. Further, IPR-related aspects are determined by specific federal IP laws. With regard to security devices, the US is unique since it only allows for one approach to secured transactions. As such, it reduces transaction costs by avoiding the potentially confusing multiple security vehicles. Similar to the German and Japanese pledge of rights scheme, the borrower remains the owner of the asset during the time of the pledge, while the lender can seize the collateral once the borrower defaults. Just like in Japan but unlike in Germany, in the US all registered IPRs and copyrights can be collateralized in the US. In the case of a loan default, a lender becomes the new owner of the collateral and can freely decide on the future of the IPR.

The French law also allows the collateralizing of patents, utility models, designs, copyrights, and trademarks (except collective marks). To establish a loan contract, two security devices are common in France, which are fairly similar to the structures in Germany. First, it is common to pledge an IPR equivalent to the pledge of rights in Germany. As a second alternative, loan contracts can be set up as a fiducia. In a fiducia, the borrower transfers the ownership of the IPR to one or more fiduciaries, who act as a third party guarantee. If the borrowers repay the loans in full, they receive the ownership of the respective IPR again. However, if the borrower fails to fulfill the loan contract, the lender becomes the new owner of the collateralized IPR. The fiducia is similar to a security assignment in Germany with the key difference being the transfer of ownership to a third party (the fiduciary).

4.1.2 Facilitating access to information: Public IPR registry

In this subsection, we apply the taxonomy to the second group of institutional determinants, public registers. By providing information regarding past and present IPR pledges, institutions have the potential to determine the availability of information. In particular, IP offices are a valuable provider of information for potential lenders since they gather relevant information on IPRs. In the first part, we describe the role of IP offices in collecting information relevant to IPR-backed loans. In the second part of this section, we apply the taxonomy to one specific reg-

istration type, e.i., the registration of pledges, in the previously described jurisdictions Germany, Japan, the US, and France.

Besides the domestic contract law governing IPR collateralization, government institutions play a crucial role in the use of IPRs as loan collateral. Loan agreements are typically shaped by asymmetric information which determine their scale and scope. By providing information regarding past and present IPR pledges, government institutions are able to lower these asymmetries and thus enhance the use of IPR collateral. Especially, IP offices are a valuable provider of information for potential lenders since they gather relevant information on IPRs.¹¹

IP offices collect information on the applicant and on the IPR itself throughout the entire lifespan of the IPR. For the lender, the valuation of IPRs is key to determining default probabilities and adequately risk-adjusting loan pricing. The lender therefore seeks to obtain information on value-related characteristics of IPR. Important factors could be its technological field, age, and the claims protected by an IPR. Further, a lender can reduce information asymmetries by assessing the previous behavior of the prospective borrower. As such, lenders are interested in information on firms' patent portfolios, such as the payment of renewal fees and unambiguous proof of ownership. In fact, information on the application or registration of an IPR, the grant decisions, and the fulfillment of maintenance duties are the most consistently gathered data. They are a by-product of the legal interactions between the IPR owner and the IP offices.

Yet, there are other types of events that affect parties outside the realm of the IPR office. This includes litigation cases, the transfer or licensing of IPR to another company, or the securitization of IPR to receive a bank loan. These events do not directly affect the work of the IPR office in granting rights. This is why they are not consistently collected. Specifically, it is not always mandatory for the parties involved to report these events nor are they incentivized to do so. This circumstance leads to inconsistent reporting standards across legal events, IPR types, and jurisdictions. Once information is not collected at all or in an inconsistent manner, lenders are not able to track the history and present status of borrowers' patent portfolios with certainty.

From a lender's perspective, reliable information on the actual ownership and the presence or absence of any third-party claims are important for the lenders' willingness to accept IPR as collateral. For example, for real estate it is mandatory in most developed countries to update the public land register in a timely and thorough manner. This way changes in ownership can be traced fairly easily and reliably. A similar construct for IPR would be desirable, such that lenders are better informed about the current status of an IPR over time.

Comparing Germany with Japan, USA, and France: In the following, we describe how registration requirements differ across Germany, Japan, the US, and France. In Germany, the registration of pledges at the German Patent and Trademark Office (DPMA) is possible but not mandatory. This is different to other asset classes for which the registration of ownership-

¹¹For example, one of the key advantages of real estate as loan collateral stems from the fact that the information on real estate used as collateral is documented in public registries.

related obligations is binding. The absence of mandatory registrations to secure IPRs might impose frictions, especially in relative comparison with other asset classes. The absence of such registries mark a potential source of information asymmetries between borrowers and lenders. Eventually, those asymmetries may be detrimental to the willingness to accept IPRs as collateral.

In Japan, the registration of the security assignments for trademarks, patents, utility models, and designs is mandatory in order for the contract to become effective. This rule does not apply to IPR pledges. However, claims against third parties cannot be ensured without such registrations, such that strong incentives to register exist. These inconsistent requirements are able to soften information asymmetries only to a limited extent.

US law does not require IPR pledges to be registered in order to become effective, just like in Germany and Japan. However, in order to perfect a loan registration is necessary. This requirement provides fairly strong incentives for lenders to register collateralized IPR. At the same time, there is no central registry in the US. Specifically, inconsistencies across federal and state law introduce uncertainty about which law governs the effective registration of IPR pledges (see Jacobs 2011). On the one hand, the United State Patent Office (USPTO) provides a method for recording security interests with trademarks and patents.¹² On the other hand, each state provides a filing system via UCC financing statements, where all types of collateral can be registered. Although there are strong incentives to register IP pledges, which US authorities to register with is not always evident (Jacobs 2011). It is therefore questionable whether the registries that exist in the US today are effective in mitigating information asymmetries.

Still, aggregate statistics from the US suggest that IPR loans are commonly applied, exceeding IP-backed lending activities in Europe by large (see Ciaramella *et al.* 2022). One potential reason for this is that the US allows for so-called blanket liens, which are general collection of corporate assets in security agreements. In such a case, IPR are pledged by default, not by choice. This practice is not allowed in several other jurisdictions, in particular, in Europe (e.g., Aretz *et al.* 2020), implying that IPR used as collateral has to be deliberately stated in loan agreements.

As a last example, the French system has relatively thorough registration requirements in place. The law states that the designation of the secured debt as well as the quantity, type, and nature of the IPR collateral must be registered (Séjean and Binctin 2020). This requirement applies for both the pledge and the fiducia. Unlike in the above mentioned jurisdictions, the publication of registration in France is mandatory for the validity of the loan contract.

4.1.3 Cost drivers of IPR securitization: bank regulation

As a final institutional determinant, we consider banking regulation. To describe how these regulations currently may affect the collateralizing of IPRs, we assess the regulatory capital requirements of IPR loans relative to loans that do not use IPRs as collateral. In general, the Basel III Accords stipulate the capital requirements in most countries around the globe, including

¹²This includes design patents, whereas security interests in copyrights are reported at the US Copyright Office.

the US and all EU member states. The Basel III Accords stipulate that banks hold a minimum capital buffer that equals 8% of risk-weighted assets. Risk weights can be calculated using two different approaches: an internal ratings based (IRB) approach in which banks need to receive supervisory approval, or a standardized approach. In both cases, capital requirements are a function of two main components, the probability of default and the exposure amount, that is, the loss-given-default. Since these two components are independent from the specific characteristics of the examined assets, we can conclude that capital requirements do not discriminate between tangible or intangible assets, per se.

First, the IRB allows banks to use internal estimates of risk components to calculate capital requirements for a given exposure. This approach thus allows banks to determine the probability of default using an internal rating firms' own discretion. It appears plausible that valuable asset portfolios improve the internal rating. Hence, valuable IP portfolios may be recognized by banks that use IRB to calculate default probabilities.

However, a more detailed perspective on the regulatory framework provides a potentially discriminating factor. The IRB approach demands that banks provide an own estimate of the loss-given-default that they can adjust depending on the provision of eligible collateral. As the most basic case, eligibility criteria only define financial assets and physical property as potential loan collateral, such as cash, receivables, or real estate. Loans secured against these assets require less capital as compared to unsecured loans. These discounts can be quite substantial and have risk weights that range between 0% and 25%. Importantly, intellectual property is not explicitly acknowledged under IRB that means IPR-backed loans do not have a mitigating effect on banks' regulatory capital but carry a risk weight of 100% (i.e., no discount) - just like unsecured loans. Even if banks indeed recognize the value of debtors' IPRs, this aspect may indeed drive a wedge between banks' willingness to provide IPR loans and those secured with eligible collateral.¹³

Second, banks may use a standardized approach which is structured quite differently from the IRB. The standardized approach generally assigns firms with a risk weight of 100% but allows for a variable risk weight if the borrowing entity received an external rating by an official institution that assesses credit. This is an important feature for our assessment, since external rating agencies can be expected to acknowledge valuable IPR portfolios in their ratings. In turn, banks can be expected to recognize the value of borrowers' IPR portfolios using the standardized approach. However, this approach does not explicitly refer to the use of IPRs as loan collateral.

Further, the standardized approach allows banks to apply a set of mitigation techniques for credit risk, such as the assignment of collateral.¹⁴ Yet, collateral is restricted to financial collateral, such as cash or debt securities. Unlike the IRB approach, it does not take any further

¹³In specific instances, banks can apply for an advanced IRB that allows them to reduce the risk weight of secured and unsecured loans. At maximum, financial institutions may lower risk weights for unsecured loans down to a floor rate of 25%. Still, relative to loans secured with real estate (10%) or other physical collateral (15%), the lower bound of risk weights for IPR-backed loan transactions remains preferential to tangible assets.

¹⁴Other mitigation techniques, such as on-balance sheet netting, guarantees/credit derivatives, or maturity mismatch, are not relevant for our analyses.

assets into account irrespective of whether they are of tangible or intangible nature. Hence, this relatively strict aspect of the standardized approach does not allow for discrimination among asset classes.

These considerations show that regulatory capital requirements do not discriminate among tangible and intangible assets such as IPR that are pledged in loan contracts, per se. However, as one notable exception, IPR-backed loans qualify as unsecured loans for banks using an IRB approach. This feature introduces a discriminatory factor in the current institutional framework. However, additional specifications (i.e., the advanced IRB approach) may mitigate this difference. Overall, banking regulation might have only a modest, but rather negative effect on the use of IPR as collateral.

4.2 Economic determinants: Cost-benefit trade-off of collateral

In the following, we discuss the economic benefits and costs of using IPR as collateral in business loans. We thereby focus on three main IPR characteristics: redeployability, asset-specificity, and the uncertainty of claims.

4.2.1 Economic benefits of IPR as collateral

One of the most prominent benefits of collateral is to mitigate adverse selection that hence, overcomes potential credit rationing (Bester 1985). Collateral may induce a self-selection mechanism which avoids (non-price) credit rationing à la Stiglitz and Weiss (1981). The underlying mechanism is the idea that it is less costly for low-risk borrowers to provide collateral as compared to high-risk borrowers. Lenders can exploit this relationship between the expected costs of collateral and risk-type to offer separating contracts which help to overcome credit rationing. Therefore, collateral may serve as an instrument to circumvent a main friction in the credit market, that is, asymmetric information which leads to non-price credit rationing.¹⁵

The screening and/or signaling mechanisms should potentially function even better with an IPR than with conventional tangible collateral such as real estate. With tangible assets, the relationship between the ability to put up collateral and the quality of the projects undertaken is less stringent than with IPRs. It is much harder (and more costly) for firms with low capabilities to pretend high capabilities via IPRs.¹⁶ Further, offering an IPR as collateral should be viewed as a valid signal, because the value of the collateralized asset is clearly more important for the borrower than for the lender. For example, the threat of losing the collateralized asset means forgoing a core asset for the borrower's business operations. Given the potential wide wedge between the value of IPR to the lender as compared to the borrower, this difference makes this mechanism specifically powerful. This mechanism functions particularly well if the IPR is

¹⁵See Besanko and Thakor (1987a; 1987b) on the very related signaling character of collateral.

¹⁶Notwithstanding, higher mimicking costs do not mean that pretending is not possible at all. For example, firms may choose to obtain a large but low-quality IPR portfolio. However, this portfolio appears as a fairly unlikely strategy, since large portfolios incur significant costs (e.g., Gill and Heller 2022). Therefore, firms would have to anticipate that their portfolio costs are offset by lower costs of capital.

specific to the borrower's operations. Then, bad borrowers have a significantly lower incentive to pledge the valuable asset since they face a higher probability of losing it.

Second, another benefit of collateral is that it allows firms to compensate for a lack of other sources of pledgeable income (Bolton and Scharfstein 1990 and Hart and Moore 1998). In this context, collateralizing assets is beneficial, since it incentivizes management to generate sufficient pledgeable income from the project's returns in order to avoid restructuring measures in which management foregoes at least some of their control rights (Tirole 2010). The threat of losing a collateralized asset in case of default is a strong incentive for the borrower to undertake significant efforts to service the debt and avoid any measures that divert assets and pledgeable income. Another benefit of collateralizing assets is that it boosts pledgeable income per se.

For the purpose of incentivizing repayments, the value from the borrower's perspective is decisive. The larger the value for the borrower, then the larger the incentive to repay. The collateral value for the lender plays the key role with the purpose of boosting pledgeable income per se. Since this latter purpose is often the crucial one, the wedge between the borrowers' and the lenders' valuations of IPR collateral comes into play. The pledging of collateral is costly to the extent that lenders may value the collateral less than the borrower and so transferring it to lenders involves a deadweight loss. This deadweight loss may be particularly pronounced for collateralized IPR, because of the inherent informational frictions (e.g., Hall and Lerner 2010). This wedge is particularly pronounced if there is significant uncertainty and asymmetric information on the scope of the IPR as well as on the definition of the IPR.

4.2.2 Economic costs of IPR as collateral

There are a number of other costs that lead to deadweight losses which clearly impose economic barriers for IPR to be used as collateral in business loans. A key aspect for the value of collateral to generate pledgeable income in case of default is the degree to which the IPR can be redeployed that is closely related to its firm-specificity. Assets which are more easily redeployed provide higher liquidation values (see Williamson 1988 and Shleifer and Vishny 1992) and are thus associated with lower credit spreads (Benmelech and Bergman 2009). This is consistent with the idea that easier redeployability increases the expected income available to lenders in case of the borrower's default. In turn, lower redeployability means higher costs of credit in the loan contract, which is particularly problematic in the case of IPRs, such as patents (see Hochberg *et al.* 2018). IPRs are predominantly internally generated (Peters and Taylor 2017) and thus relatively often specifically target their owners' purposes, all of which decreases their redeployability. This is in particular the case if the IPR is attached to the human capital of the inventors which is non-alienable. Furthermore, in case of default this specificity may lead to pronounced renegotiation that eventually creates a hold-up problem that may severely limit the pledgeable value of the IPR collateral. Overall, it is important to note that the issue of redeployability and owner-specificity of IPRs is not a barrier for their use as business collateral

per se but rather of degree: IPR is on average more likely to be confronted with such issues as compared to tangible assets. Further, the degree of redeployability strongly depends on the IPR itself, both across and within IPR types. In principle, IPRs protecting specific technologies (e.g., patents) should be less applicable to other uses than IPRs that protect consumer goods (e.g., trademarks, designs). Similarly, some IPRs protect very specific ideas or technologies and therefore cannot be easily redeployed, while others are known to protect general purposes and are therefore easier to redeploy.

Despite its importance, valuing IPRs is actually inherently challenging. The main reasons are the high degree of asymmetric information and uncertainty of returns (e.g., Hall and Harhoff 2012) as well as the highly skewed distribution of the economic importance, that is, the IPR value (Harhoff *et al.* 1999; Arora and Gambardella 2010). The more pronounced the degree of uncertainty and asymmetric information regarding the definition of the IPR as well as of its scope, then the more challenging the valuation exercise for the lender is. Especially in the context of SMEs, the prevalence of information asymmetries between borrowers and lenders may also depend on their relationship. As such, relationship-lending or local banking may lower transfer costs associated with the exchange of (informal) information and, in turn, reduce these information asymmetries (see Berger and Udell 2006; Bellucci *et al.* 2019).

For identifying potential IPR collateral, it is important to identify those IPRs that indeed carry meaningful value. Loan providers (i.e., banks) do not necessarily have the expertise for such a specialized assessment, which often requires industry-specific knowledge. Therefore, this assessment requires that the lender has an appropriate in-house department or the parties involved need to commission specialized agencies to value IPRs.

The measures developed in the academic literature for IPR quality may serve as first indications. For the valuation of individual IPRs, however, these measures of the economic scope of the IPR are far too qualitative and imprecise to serve as sensible inputs into the valuation of patents as collateral. This is particularly true when the technology or products use a number of different IPRs (types), such as patent thickets (Shapiro 2000), which applies to some of the most IPR-intensive industries like software, semiconductors, or pharmaceutical sectors.

However, public agencies have to actively maintain IPRs. The actively held stock of IPRs is a credible signal for the scope of the IPR. It is costly (direct and indirect costs) to manage an IPR portfolio. The value of an IPR is IP type-specific. Trademarks are valuable if they are used. Patents and designs are valuable if they are novel. Only if IPRs are valuable, will they then be active several years after initial filing. Hence, this signal provides a relatively clear picture of whether a firm holds a valuable portfolio.

A further problem associated with the valuation of IPRs as collateral is their partial incompleteness which can be challenged via invalidity claims. This process takes place via the respective government body in the case of trademarks or design patents, or via courts in the case of patents. Depending on the particular setting, these claims can be filed by any party

involved. In this context, a very important difference arises from the actual registration requirements (see also Table 1). While some IPRs, such as copyrights, are activated at the existence of the underlying IP, other require registration (trademarks and designs) or thorough assessment (patents). Hence, while there are strict patenting requirements that already entail a substantial analysis of their quality, the same is not true with regard to other IPR types, such as trademarks, designs, or copyrights.¹⁷ It follows then that the degree of the impartiality of the IPR granted through the application or the registration process is more pronounced with registered rights as compared to patents. The search process and the certification function of the government agencies shifts in the case of non-patent IPR types to the potential lender thereby exacerbating the value challenge even further.

Another potential cost associated with IPR as collateral in business loans is shared by many assets which are only partially owned by the party using it: improper maintenance of the asset, i.e. the moral hazard that leads to underinvestment in the proper maintenance of the asset. For instance, Igawa and Kanatas (1990) show that there is underinvestment relative to first best in maintenance of the pledged assets which is a problem that can only be overcome with over collateralizing. However, this approach requires the availability of collateral and also comes with extra costs. One of the key maintenance issues with IPRs is the necessity of a renewal of IPRs and the associated renewal fees. Obviously, one potential way forward is that automatic renewal is contracted between the parties but this automatic procedure in turn would potentially mean excessive maintenance.

Weighting of costs and benefits: In essence, the individual weighting of costs and benefits from the perspectives of both borrowers and lenders are decisive for collateralizing IPR. This weighting applies even if the institutional framework provides for a most conducive environment for this usage. Only if the benefits exceed the costs to the parties directly involved in the loan contract can it be concluded.

Our analysis has shown that this cost-benefit trade-off is jurisdiction-, firm-, and in particular asset-specific. In order to show the use of this analysis in future empirical research we derive in the appendix a number of testable hypotheses which may lay the ground for future empirical work in this context.

5 Conclusion

In this paper, we develop a taxonomy that allows us to address a puzzling observation: Despite a long-standing shift towards a knowledge-driven economy in which IPR constitute a major share of firm values, firms' use of IPR as collateral in loan contracts is relatively scarce around the globe. We first define two main pillars that comprise the main institutional and economic determinants for collateralizing IPRs. We argue that the key institutional determinants are

¹⁷Notably, there are some important requirements for trademarks too. For example, trademarks that are active several years after registration are proven to be used in business activities, as they would otherwise be invalidated.

the contract law, public registries, and international regulation in banking. These elements address the borrower-lender relationship both directly and indirectly and determine potential transaction costs significantly. The economic determinants consist of the interplay between economic benefits and costs of IPR collateral. We propose that IPR collateral can have significant advantages regarding signaling, agency issues, and pledgeable income. We suggest that both pillars, i.e., all determinants need to reach a certain threshold to effectively support and enable the collateralizing of IPRs.

Our taxonomy allows for a detailed analysis of the main underlying mechanisms of IPRs as business loan collateral. Further, it enables us to formulate policy implications as well as hypotheses for specific conditions under which the use of IPR collateral should be applicable. We consider both decisive elements towards a better understanding of the role of IPR as an input in corporate (and entrepreneurial) finance. Moreover, we intend to spur the discourse among policymakers, practitioners, and academics about the modernization of bank lending in line with an increasingly technology-based economy.

Policy Implications: Our discussions lead us to the following main policy implications. First, our analysis shows that the general contractual law set-up in most countries provides the legal basis which allows (or does not impede) the inclusion of IPR as collateral in business loans. While the main stage is set for the inclusion of IPR, our descriptions indicate that a more standardized approach would strengthen IPR-backed lending by decreasing uncertainties and the associated transactions costs. In addition to this, we acknowledge that there is still plenty of room for improvement in building capacity. Institutions require adequate human resources and infrastructure to determine the pledgeability and value of IPRs. A lack of these resources inhibits the collateralizing of IPRs. Second, we show that public registries for IPRs play a decisive role as certification devices for IPRs. While IPR registries are established in all main jurisdictions, we see the need for improvements in the permanent updating of requirements of such registry. To improve the current system, the establishment of IPR collateral registries would be a valuable addition. Such institutionalized registries based on a mandatory reporting regime for IPR collateral of all kinds could help reduce asymmetric information and hence frictions that are associated with IP-backed lending. Third, our analysis on the banking regulatory framework shows that capital requirements and in particular the calculation of risk weights does not discriminate among IPR and other assets per se. Still, IPR-backed loans do not qualify as secured debt in all risk weighting approaches. Leveling this imbalance or even discriminating positively in favor of IPRs as collateral has to be carefully weighed against the costs of financial (in-)stability.

References

- ARETZ, K., CAMPELLO, M. and MARCHICA, M.-T. (2020). Access to collateral and the democratization of credit: France’s reform of the napoleonic security code. *The Journal of Finance*, **75** (1), 45–90.
- ARORA, A. and GAMBARDELLA, A. (2010). The market for technology. *Handbook of the Economics of Innovation*, **1**, 641–678.
- BELLUCCI, A., BORISOV, A., GIOMBINI, G. and ZAZZARO, A. (2019). Collateralization and distance. *Journal of Banking & Finance*, **100**, 205–217.
- BENMELECH, E. and BERGMAN, N. K. (2009). Collateral pricing. *Journal of financial Economics*, **91** (3), 339–360.
- BERGER, A. N. and UDELL, G. F. (2006). A more complete conceptual framework for SME finance. *Journal of Banking & Finance*, **30** (11), 2945–2966.
- BESANKO, D. and THAKOR, A. V. (1987a). Collateral and rationing: sorting equilibria in monopolistic and competitive credit markets. *International economic review*, pp. 671–689.
- and — (1987b). Competitive equilibrium in the credit market under asymmetric information. *Journal of Economic Theory*, **42** (1), 167–182.
- BESTER, H. (1985). Screening vs. rationing in credit markets with imperfect information. *The American economic review*, **75** (4), 850–855.
- BOLTON, P. and SCHARFSTEIN, D. S. (1990). A theory of predation based on agency problems in financial contracting. *The American economic review*, pp. 93–106.
- BOOT, A. W., THAKOR, A. V. and UDELL, G. F. (1991). Equilibrium analysis, policy implications. *The Economic Journal*, **101** (406), 458–472.
- BOTTAZZI, G., SECCHI, A. and TAMAGNI, F. (2014). Financial constraints and firm dynamics. *Small Business Economics*, **42** (1), 99–116.
- BRINKMANN, M., RÜTHER, D. and SCRABACK, B. (2020). Security rights in intellectual property in germany. In *Security Rights in Intellectual Property*, Springer, pp. 395–431.
- BRYNJOLFSSON, E., ROCK, D. and SYVERSON, C. (2021). The productivity j-curve: How intangibles complement general purpose technologies. *American Economic Journal: Macroeconomics*, **13** (1), 333–72.
- CIARAMELLA, L., HELLER, D. and LEITZINGER, L. (2022). Intellectual property as loan collateral. Available at SSRN 4260877.
- CZARNITZKI, D. and HOTTENROTT, H. (2011). R&d investment and financing constraints of small and medium-sized firms. *Small business economics*, **36** (1), 65–83.
- DELL’ARICCIA, G., KADYRZHANOVA, D., MINOIU, C. and RATNOVSKI, L. (2021). Bank lending in the knowledge economy. *The Review of Financial Studies*, **34** (10), 5036–5076.
- DEMIRGUC-KUNT, A., DETRAGIACHE, E. and MERROUCHE, O. (2013). Bank capital: Lessons from the financial crisis. *Journal of Money, Credit and Banking*, **45** (6), 1147–1164.
- EPO (2017). Unlocking untapped value – EPO SME case studies on IP strategy and IP management. <https://www.epo.org/learning-events/materials/sme-case-studies.html>, (accessed: 13/03/2018).
- and EUIPO (2019). Intellectual property rights intensive industries and economic performance in the European Union, Industry-Level Analysis Report, September 2019, Third edition. <https://www.epo.org/service-support/publications.html?pubid=201#tab3>, (accessed: 2021/29/10).

- FALATO, A., KADYRZHANOVA, D., SIM, J. and STERI, R. (2020). Rising intangible capital, shrinking debt capacity, and the us corporate savings glut. *Journal of Finance*, forthcoming.
- FRAISSE, H., LÉ, M. and THESMAR, D. (2020). The real effects of bank capital requirements. *Management Science*, **66** (1), 5–23.
- GANS, J. S., HSU, D. H. and STERN, S. (2008). The impact of uncertain intellectual property rights on the market for ideas: Evidence from patent grant delays. *Management science*, **54** (5), 982–997.
- GILL, A. and HELLER, D. (2022). Leveraging intellectual property: The value of harmonized enforcement regimes. Available at SSRN 4278423.
- GRAHAM, S. J., MERGES, R. P., SAMUELSON, P. and SICHELMAN, T. (2009). High technology entrepreneurs and the patent system: Results of the 2008 Berkeley patent survey. *Berkeley Technology Law Journal*, **24** (4), 1255.
- GRAHAM, S. J. H., MARCO, A. C. and MYERS, A. F. (2018). Monetizing marks: Insights from the uspto trademark assignment dataset. *Journal of Economics & Management Strategy*, **27** (3), 403–432.
- GUISSO, L., SAPIENZA, P. and ZINGALES, L. (2013). The determinants of attitudes toward strategic default on mortgages. *The Journal of Finance*, **68** (4), 1473–1515.
- HALL, B. H. and HARHOFF, D. (2012). Recent research on the economics of patents. *Annu. Rev. Econ.*, **4** (1), 541–565.
- and HELMERS, C. (2019). The impact of international patent systems: Evidence from accession to the european patent convention. *Research Policy*, **48** (9), 103810.
- and LERNER, J. (2010). The financing of r&d and innovation. In *Handbook of the Economics of Innovation*, vol. 1, Elsevier, pp. 609–639.
- HARA, M. and HAGA, Y. (2020). Security rights in intellectual property in japan. In *Security Rights in Intellectual Property*, Springer, pp. 469–485.
- HARHOFF, D., NARIN, F., SCHERER, F. M. and VOPEL, K. (1999). Citation frequency and the value of patented inventions. *Review of Economics and statistics*, **81** (3), 511–515.
- HART, O. and MOORE, J. (1998). Default and renegotiation: A dynamic model of debt. *The Quarterly Journal of Economics*, **113** (1), 1–41.
- HEGDE, D. and LUO, H. (2018). Patent publication and the market for ideas. *Management Science*, **64** (2), 652–672.
- HOCHBERG, Y. V., SERRANO, C. J. and ZIEDONIS, R. H. (2018). Patent collateral, investor commitment, and the market for venture lending. *Journal of Financial Economics*, **130** (1), 74–94.
- IGAWA, K. and KANATAS, G. (1990). Asymmetric information, collateral, and moral hazard. *Journal of Financial and Quantitative Analysis*, **25** (4), 469–490.
- JACOBS, B. W. (2011). Using intellectual property to secure financing after the worst financial crisis since the great depression. *Marquette Intellectual Property Law Review*, **15** (2), 449–464.
- JIMENEZ, G., SALAS, V. and SAURINA, J. (2006). Determinants of collateral. *Journal of financial economics*, **81** (2), 255–281.
- KIENINGER, E.-M. (2020). Security rights in intellectual property: General report. In *Security Rights in Intellectual Property*, Springer, pp. 1–45.
- KIIPPO (2019). Korea Institute of Intellectual Property (KIIP): Analysis on Economic Contribution of IP-Intensive Industries (English summary). <https://ecck.or.kr/wp-content/uploads/2019/03/190325-Analysis-on-Economic-Contribution-of-IP-Intensive-Industries-ECCK-Summary.pdf>, (accessed: 2021/29/10).

- LEVITIN, A. J. (2013). The paper chase: securitization, foreclosure, and the uncertainty of mortgage title. *Duke LJ*, **63**, 637.
- MANN, W. (2018). Creditor rights and innovation: Evidence from patent collateral. *Journal of Financial Economics*, **130** (1), 25–47.
- NGUYEN, X.-T. (2014). Financing innovation: Legal development of intellectual property as security in financing, 1845-2014. *Ind. L. Rev.*, **48**, 509.
- PETERS, R. H. and TAYLOR, L. A. (2017). Intangible capital and the investment-q relation. *Journal of Financial Economics*, **123** (2), 251–272.
- PICHT, P. G. (2018). *Vom materiellen Wert des Immateriellen: Immaterialgüterrechte als Kreditsicherungsmittel im nationalen und internationalen Rechtsverkehr*, vol. 230. Mohr Siebeck.
- PORTA, R. L., LOPEZ-DE SILANES, F., SHLEIFER, A. and VISHNY, R. W. (1998). Law and finance. *Journal of political economy*, **106** (6), 1113–1155.
- SÉJEAN, M. and BINCTIN, N. (2020). Security rights in intellectual property in france. In *Security rights in intellectual property*, Springer, pp. 373–393.
- SHAPIRO, C. (2000). Navigating the patent thicket: Cross licenses, patent pools, and standard setting. *Innovation policy and the economy*, **1**, 119–150.
- SHLEIFER, A. and VISHNY, R. W. (1992). Liquidation values and debt capacity: A market equilibrium approach. *The Journal of Finance*, **47** (4), 1343–1366.
- STIGLITZ, J. E. and WEISS, A. (1981). Credit rationing in markets with imperfect information. *The American economic review*, **71** (3), 393–410.
- THAKOR, A. V. (1996). Capital requirements, monetary policy, and aggregate bank lending: theory and empirical evidence. *The Journal of Finance*, **51** (1), 279–324.
- TIROLE, J. (2010). *The theory of corporate finance*. Princeton University Press.
- USPTO (2016). Intellectual Property and the U.S. Economy: 2016 Update. <https://www.uspto.gov/sites/default/files/documents/IPandtheUSEconomySept2016.pdf>, (accessed: 2021/29/10).
- WILLIAMSON, O. E. (1988). Corporate finance and corporate governance. *The journal of finance*, **43** (3), 567–591.

Tables from the main part

Table 1: Intellectual property rights: Definitions and Occurrences

IP right	Trademark	Patent	Design	Copyright
Subject matter	Disinct signs that distinguish companies (i.e., brands, words, drawings, and/or symbols)	Technical invention	Aesthetic creative forms and non-functional product features	Author right, rights of personality
Conferred rights	Exclusive right to use the trademark and prevent use for similar goods/services	Exclusive right to make, use, and sell the patented invention	Exclusive right to use the design	Exclusive right to use, reproduce communicate to the public, or licensing of rights
Requirement	Distinctiveness, use in commerce	Novelty, material, non-obviousness, industrial application	Similar to patents (lower threshold)	Originality of the work, irrespective of its literary or artistic merit
Activation	Register entry (unexamined)	Examination	Register entry (unexamined)	Automatic upon creation
Protection length	10 years	1 year	1 year	70 years (for authors: lifetime plus 70 years)
Max. renewals	indefinite	20 years	25 years	-
Maintenance/ activation costs	low	high	high	none
Benefits	Promotes quality and competition; information provider	Incentive to innovate; Knowledge protection and diffusion	Provides means for product differentiation	Induce creativity by providing protection

Notes: The table defines the four most common IP right types, i.e., trademarks, patents, designs, and copyrights. For comparability, distinct 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 number of renewals, i.e., the maximum protection length, and a qualitative assessment of the average costs to activate and maintain the IP right. All of these definitions comprise IP rights filed and registered in Europe, i.e., at the EPO, EUIPO, or national IP offices. In general, these features also apply in other main IP jurisdictions, such as the US, Japan, or South Korea. The only notable difference is that in the US, trademarks ownership is not granted on a first-to-file but on a first-to-use approach. Further, US trademarks are subject to a formal examination process.

Table 2: Intellectual property rights as loan collateral across the world

	Germany	Japan	USA	France
Pleadable IP types				
Industrial property	Yes	Yes	Yes	Yes (no collective TMs)
Copyrights	No	Yes	Yes	Yes
Common security vehicles				
Pledge of rights	Yes	Yes	Yes	Yes
Security assignment	Yes	Yes ('mortgage')	No	Yes ('fiducia')
Establishing a contract				
Registration	No requirements	Pledge: mandatory Mortgage: not possible	Mandatory for some states and IP types	Mandatory for most IPR; advisable for lender
Exploitation rights	With borrower (automatically or via back-licensing)	Pledge: with lender Mortgage: with borrower	With lender	With borrower
Maintenance duties	With borrower	With borrower	With borrower	With borrower
Resolving a contract in default				
Outside Insolvency	Pledge: public auction Security: free choice	Free choice	Public auction	Free choice
In Insolvency	Debated	Free choice	Public auction	Free choice

Notes: The table provides an overview on the legal framework of IPR as collateral in for jurisdictions, i.e., France, Germany, Japan, and the US. It first shows four commonly pledgeable IP types for each country i.e., trademarks, patents, designs, and copyrights. Followed by the most frequent security vehicles in each jurisdiction: pledge of rights and security assignment. In the second half of the table, the establishment as well as the resolution of loan contracts collateralized by IPR. First, the establishment of such a loan contract results in certain (maintenance) duties and (exploitation) rights. Second, the resolution in case of a default brings up the question of whether the lender is allowed to freely decide on the future of the seized IPR.

Figures from the main part

Figure 1: Two pillars as the basis for the taxonomy of IPR collateralization

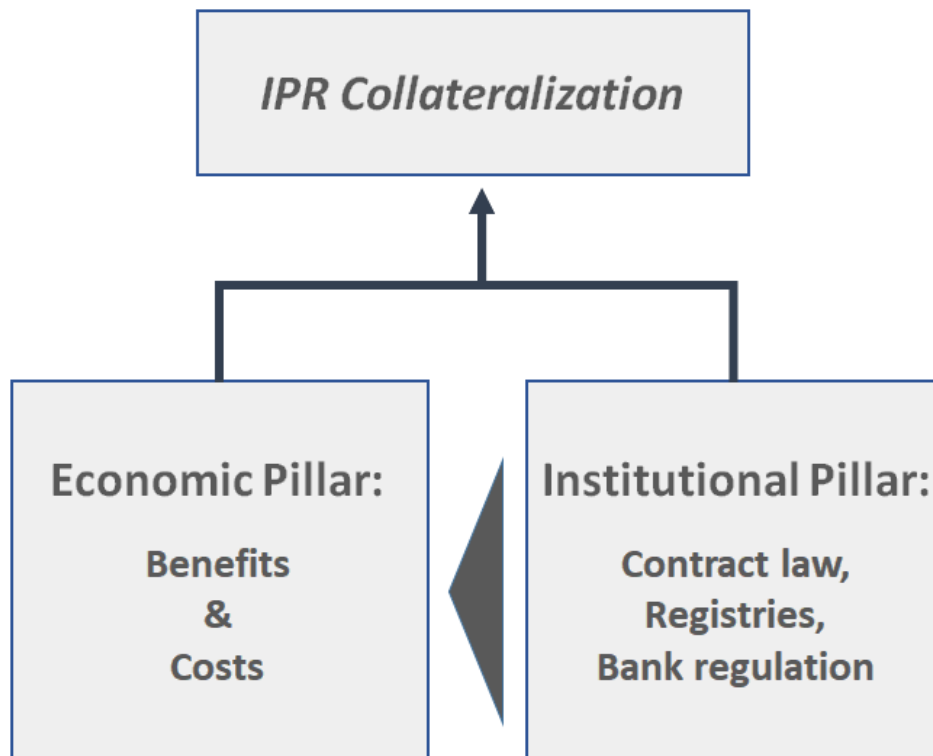
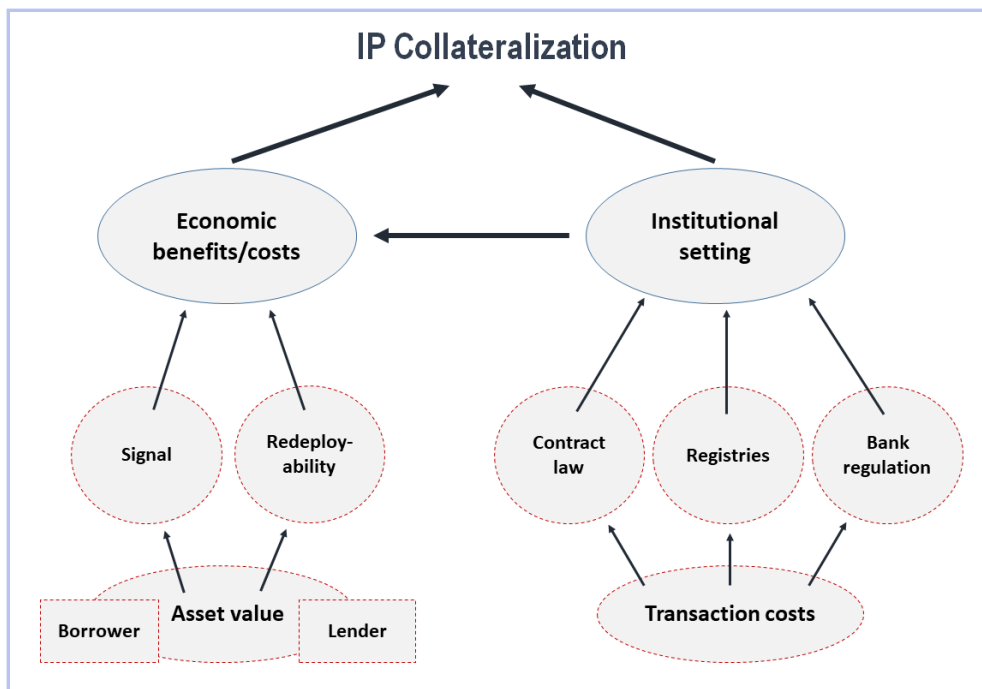
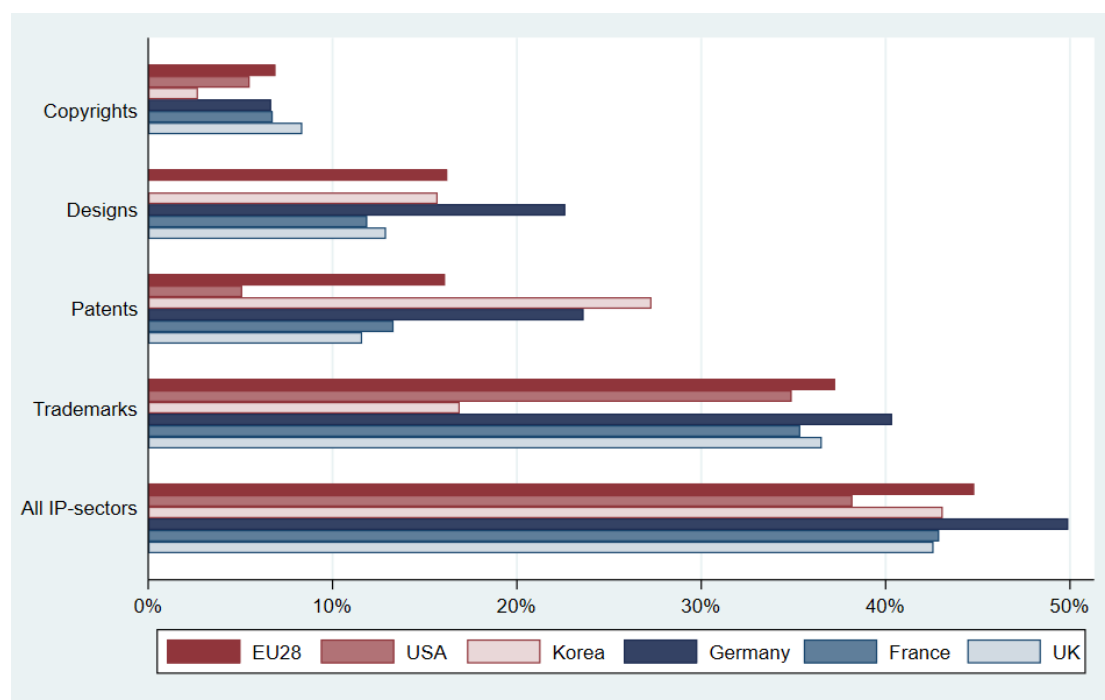


Figure 2: A taxonomy of IPR-backed loans



Appendix

Table IA1: IPR intensive sector contribution to country-level value added



Notes: The graph displays the value added (GDP) of IPR-intensive sectors as a fraction of total GDP for the EU28 countries, the US, Korea, Germany, France, and the UK. For EU28 and the three European countries we use 2014-2016 averages obtained from EPO and EUIPO (2019). For the US, 2014 values are used from USPTO (2016). For the Korean data, we use 2015 values obtained from KIIPPO (2019). The three sources define IPR-intensive sectors in detail. Values are computed for the four main IPR categories separately and the total of all IP-intensive sectors. GDP shares do not identify overlaps in the contribution to total GDP. For the US, no data on the design-intensive sectors were available.

Hypotheses

Our analysis enables us to determine under which circumstances IPR collateral might be particularly suited to attract debt financing. As such, we have shown that the actual cost-benefit trade-off is jurisdiction-, firm-, and, in particular, asset-specific. Based on these considerations, we derive a number of hypotheses in the following.

By comparing four IP-intensive jurisdictions, we highlight both commonalities and differences across legal regimes. One important variation is the number of security devices. While multiple security devices allow firms and banks a certain flexibility to choose among respective devices, it is also prone to introduce confusion and unnecessary layers of complexity. The latter may create additional frictions in IPR-backed lending. IPRs are more likely to be used as collateral in a legal regime that defines clear rules and avoids confusing security devices:

Hypothesis 1 *We predict that collateralizing IPR is most common in legal regimes with the least complex security devices, such as the US with their uniform collateral regime.*

IPR offices collect and provide information on IPRs. However, they seldom record certain information that is highly relevant to collateralizing IPRs. Such information includes not only IPR pledges themselves but also reliable ownership information published by an official source. Without this information, lenders potentially consider IPR collateral as risky due to increased information asymmetries. Thus, IPRs are more likely to be used as collateral in a jurisdiction which registers relevant IPR-related events:

Hypothesis 2 *We predict that the collateralizing of IPRs is most common in a jurisdiction where the IPR office provides reliable ownership information and registers the collateralized IPRs. Hence, in jurisdictions like Germany which does not register IPR pledges, the use of IPR as collateral should be uncommon.*

We compare the regulatory capital requirements of IPR loans relative to loans that use non-IPR collateral. Overall, we find that the regulatory framework does not distinguish between IPRs and other asset classes per se. However, IPR-backed loans are classified as unsecured loans under the IRB approach, although this specification can be mitigated by applying an advanced IRB approach. Similarly, IPR is not acknowledged as eligible collateral under the standardized approach:

Hypothesis 3 *Banks that deploy an advanced internal-ratings-based approach are more likely to issue IPR-backed loans as compared to banks that use either the standardized approach or the regular internal-ratings-based approach.*

Our analysis of the economic costs and benefits shows that a main driver of the potential to use an IPR as loan collateral is its value to the borrower (which uses it as a signaling device):

Hypothesis 4 *A higher signaling value of the IPR should increase the likelihood that it will be used as collateral. For instance, we expect borrower-specific and value relevant patents to be add-on ingredients in collateral contracts together with other assets.*

In addition, its potential use as a source of pledgeable income in the case of default makes collateralizing IPRs more attractive. This aspect is more pronounced the higher the level of redeployability and the lower the asset specificity of the IPR are. We expect that IPR which is more specific (e.g., related to specific technologies) and less easily redeployed enters with lower probability into loan contracts as collateral:

Hypothesis 5 *Hence, less specific IPRs (such as trademarks in consumer-goods industries) or with a track record of being redeployed (previous ownership transfers, licensing deals, securitizations) are more likely to be used as collateral.*

Furthermore, we argue that for the purpose of collateralizing IPRs, proper valuation is key. We have pointed out that a high degree of uncertainty and asymmetric information regarding the definition of the IPR as well as of its scope makes the valuation exercise more challenging for the lender:

Hypothesis 6 *The easier it is for the lender to value the IPR (e.g., single-item patents) the more often we expect the IPR to be used in loan contracts as collateral. Similarly, we conjecture that IPR bundles are likely to be jointly valued and pledged, such as patent thickets or products protected by multiple IPR types.*