NBER WORKING PAPER SERIES

PERSONAL BANKRUPTCY LAW AND INNOVATION AROUND THE WORLD

Douglas Cumming
Randall Morck
Zhao Rong
Minjie Zhang

Working Paper 32826
http://www.nber.org/papers/w32826

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
August 2024, Revised June 2026

We are grateful for helpful comments from seminar participants at Tsinghua University, Peking University, Chinese University of Hong Kong, Kyoto University, Australia National University, University of Delaware, Stevens Institute of Technology, Shandong University, Zhongnan University of Economics and Law, and Thammasat University. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

Personal Bankruptcy Law and Innovation around the World
Douglas Cumming, Randall Morck, Zhao Rong, and Minjie Zhang
NBER Working Paper No. 32826
August 2024, Revised June 2026
JEL No. G33, G5, K35, O3, O4, P1, P50

ABSTRACT

Creditors financing risky entrepreneurial firms often require founders to pledge personal assets, effectively contracting around corporate limited liability. Personal bankruptcy law (PBL), which governs individuals' access to debt discharge following failure, therefore shapes innovation incentives. Difference-in-difference tests across 33 non-U.S. economies from 1990 to 2002 show that debtor-friendly PBL reforms significantly increase patent filings, subsequent patent citations, and new patenter débuts. These effects are concentrated among firms without large legacy patent portfolios, consistent with creditors primarily demanding personal guarantees from unestablished innovators. Critically, debtor-friendly PBL reforms reallocate innovation away from industries with low innovation potential to industries with high innovation potential, whereafter productivity growth spikes. These findings suggest debtor-friendly PBL reforms improve the cross-industry allocative efficiency of innovation, perhaps by encouraging disruptive entrants.

Douglas Cumming
York University
douglas.cumming@gmail.com

Randall Morck
University of Alberta
Alberta School of Business
Department of Finance
and NBER
randall.morck@ualberta.ca

Zhao Rong
Zhongnan University of Economics
and Law
Wenlan School of Business
zhaobryanrong@outlook.com

Minjie Zhang
University of Windsor
Odette School of Business
mjzhang@uwindsor.ca

1. Introduction

Creative destruction – that is, radical innovations repeatedly displacing existing technologies with new high-productivity technologies – powers long-run prosperity in high-income economies (Fogel, Morck, and Yeung, 2008; Aghion, Antonin, and Bunel, 2021). Established firms, though open to incremental innovation (Garcia-Macia, Hsieh, and Klenow, 2019), eschew radical innovations, which destroy their existing human and physical capital (Schumpeter, 1911). Consequently, important productivity-increasing innovations often enter the economy via new, initially small, founder-entrepreneur-controlled firms (Acs and Audretsch, 1988; Knott and Vieregger, 2020). Such firms often fail (Xie, Zhang, and Zhang, 2021), for innovation is risky (Audretsch, 1995; Moshirian et al., 2021). This can prevent external capital from flowing to impecunious entrepreneurial founders with innovations awaiting development (Cosh, Cumming, and Hughes, 2009).

Incorporation limits founders' liability in patent infringement lawsuits, so patent applications are almost always filed by corporations, not individuals. However, incorporation also limits entrepreneurial founders' liability to external capital providers, which can raise their corporations' costs of external capital and can even sever their access to external capital entirely (Stiglitz and Weiss, 1981). To counter this, entrepreneurial founders often contract around limited liability in corporate bankruptcy law (CBL) by pledging personal assets to guarantee their firms' obligations to capital providers (Fan and White, 2003; Armour and Cumming, 2008).

Many prominent firms' founders began with personal loans. Walt Disney borrowed against his insurance to finance the first Mickey Mouse cartoon and to finance Snow White (Barrier, 2007, p. 5 & 152). Lululemon founder Chip Wilson borrowed personally and against his home (Wilson, 2021, p. 91). Case, Shiller, and Weiss financed their eponymous real-estate index with second mortgages (Bhidé, 2024, p. 176). Empirical studies affirm SME founders' extensive reliance on personal loans, second mortgages, and personal guarantees (Avery, Bostic, and Samolyk, 1998; Mann, 1998; Moon, 2009; Coleman and Robb, 2009; Robb and Robinson, 2014). Small Business Credit Survey data (2019ab) show most SMEs rely on personal credit to some extent.

Karen Mills (2018), former head of the U.S. Small Business Administration, writes: "Over twothirds of businesses less than two years old were started using funds from one or more personal sources. Venture capital is important for a certain segment of startups with high-growth potential" (p. 59) but is "barely on the radar of most other types of new firms" (p. 69).

After individually surveying the founders of successful startups, those in the Inc. 500, Bhidé (2024, p. 191) reports, "Most of the Inc. founders I studied also bootstrapped their ventures with meager personal savings and borrowings or funds raised from families and friends. Twenty-six percent started with less than five thousand dollars, 21 percent raised more than fifty thousand dollars, and just two raised more than one million dollars. Most founders did not even attempt to raise outside equity. Nearly a third (32 percent) tried and failed. Just 5 percent secured venture capital and 7 percent funding from arm's-length angel investors." Personal bankruptcy law (PBL) governs the discharge (forgiveness) of bankrupt individuals' debts, including such guarantees. More debtor-friendly discharge reduces the value of founder-entrepreneurs' personal guarantees, increases their firms' costs of capital, which impedes innovation. But less debtor-friendly discharge increases entrepreneur-founders' personal costs of failure, which deters entrepreneurship. Landier (2005) and Ederer and Manso (2011) show that radical entrepreneurial success often follows a series of failures, so less debtor-friendly PBL can also impede innovation. Consistent with the fresh-start mechanism, Ederer and Manso (2013) provide experimental evidence that tolerance for early failure combined with long-term rewards is effective in motivating innovation.

Whether more or less debtor-friendly PBL would increase the pace of innovation depends on the current imbalance of these offsetting arguments. We find that debtor-friendly PBL reforms precede sharp increases in patenting by firms not previously holding large portfolios of patents, in the importance of those patents, and in the number of first-time patenters, which we call new patenter débuts. These effects are independent of and as economically significant as those associated with CBL reforms found by Acharya and Subramanian (2009).

Innovation outcomes, from Hall, Jaffe, and Trajtenberg (2001), are successful patent applications, that is, patent applications filed with and subsequently granted by the United States Patent and Trademark Office (USPTO) – by firms in 33 non-U.S. economies in 1990 through 2002. Citation records after 2002 allow assessment of patent importance. We interpret USPTO filings by foreign patenters as measures of innovations sufficiently substantial to justify registration abroad. Eighteen of the economies have major debtor-friendly PBL reforms in 1990 through 2002.

We measure innovation outcomes for a country-industry-year by three variables: patent counts, subsequent citations of those patents, and new patenter débuts. We interpret patent counts and subsequent citations as measuring innovation intensity and importance in each industry from each economy. New patenter débuts count the first-time appearances of patenters in the USPTO records.

Because productivity growth arises from creative destruction, disruptive innovations that depreciate the value of legacy physical and human capital are especially of interest. We hypothesize that established firms with large patent portfolios are likely to be able to borrow without personal guarantees from their principals, to be more heavily invested in legacy technologies, and to be predisposed not to pursue innovations that might erode the value of their capital. We therefore drop large legacy patentholders, called $L(N)$ firms, defining large as holding $N \geq 500$ patents in 1990, the first year of our data. We find that debtor-friendly PBL reforms elevate all three innovation measures. Our results become stronger for successively lower values of N. However, an effect on L firms is evident, perhaps reflecting intensified pressure on large legacy patentholders to innovate faster when PBL reforms stimulate small firms to innovate.

Our identification assumption is that PBL reforms are plausibly exogenous to industry-level innovation outcomes because they are typically motivated by political, distributive, or consumer-protection concerns rather than by technology- or industry-specific conditions. Moreover, PBL reforms apply uniformly to individuals rather than selectively to particular firms or sectors. The political motivations behind each reform are documented in detail in Appendix Table A2. The dynamic tests in Panel A of Table 7 provide additional support: the patenting indicators at t=−4, the periods furthest before reform, are not statistically significant, consistent with no pre-existing trends driving the results. As a further check, Table 9 shows that PBL reforms have little effect on the innovation of large legacy patentholder firms, which are unlikely to rely on personal guarantees; this supports the interpretation that the mechanism runs through the personal guarantee channel rather than through some correlated country-level shock. Our difference-in-differences (DID) tests use Poisson regressions, appropriate where the explained variables are non-negative integers, including controls and year and country-industry fixed effects, to show how debtor-friendly PBL reforms affect the three innovation measures.

Our key findings, which survive a battery of robustness checks, are:

1. Debtor-friendly PBL reforms significantly intensify innovation across all industries. These reforms herald industry average increases of 36.5% in patent counts, 34.3% in subsequent citations, and 16.1% in new patenter débuts relative to the same industries in the same years in non-event countries. Prior work linking debtor-friendly PBL reforms to increased self-employment (Armour and Cumming, 2008) does not unambiguously indicate intensified innovation because self-employment can be involuntary (disguised unemployment) and not innovative entrepreneurship (Kautonen, Down, and Welter, 2011). Our results affirm that PBL reforms intensify innovation.
2. Debtor-friendly PBL reforms reallocate innovation toward industries with higher innovation potential, improving the efficiency of innovative effort. The average PBL reforms increase patent counts, subsequent citations, and new patenter débuts by 33.9%, 30.1%, and 21.1%, respectively, more in industries with innovation potential at the 75th percentile than in those at the 25th percentile. This reallocation of innovation efforts driven by PBL reform is our paper's most novel contribution. Recent evidence suggests that certain technologies play foundational roles in generating future innovation and growth (Tham, Baslandze, Sojli, and Liu, 2026), implying that such reallocations may have consequences that extend beyond contemporaneous increases in patenting activity.
3. These effects are stronger in firms without large legacy patent portfolios. Firms with large legacy patent portfolios also respond, perhaps because of an increased threat from upstart innovations.
4. The increased innovation following debtor-friendly PBL reforms tends to be radical innovations, which tend to be especially important.
5. Debtor-friendly PBL reforms predict productivity spurts and more functionally efficient investment across industries. Such reforms predict elevated total factor productivity (TFP), consistent with innovations having positive spillovers all over the economy. Tobin (1984) argues that, while the

financial sector is unlikely to allocate capital perfectly efficiently (i.e., directing capital unerringly to its highest value-creating uses), investment that better approximates this can be deemed more functionally efficient. We follow Wurgler's (2000) use of the simple correlation of investment with value-added across industries to proxy for functional efficiency and find that debtor-friendly PBL reforms predict significantly more functionally efficient investment.

The above results also sharpen prior findings and suggest avenues for additional research. Acharya and Subramanian (2009) find that creditor-friendly CBL reforms reduce innovation. An important stream of research further links CBL to various dimensions of institutional development (Djankov et al., 2002; Belenzon and Berkovitz, 2010; Brown, Martinsson, and Petersen, 2013; Hsu, Tian, and Xu, 2014; Moshirian et al., 2021). Our findings show the impact of PBL reforms on innovation to be independent of that of CBL reforms.

2. Hypothesis Development

PBL varies across countries and over time. English common law began granting bankrupt individuals discharge (voiding) of their personal debts in the 17th century, and common law legal systems worldwide tend towards debtor-friendly PBL. In contrast, civil code legal systems historically treated bankrupt individuals as criminals (Di Martino, 2008). Common law legal systems worldwide likewise tend towards more debtor-friendly CBL than do civil law systems, and these historical patterns persist despite individual countries' CBL reforms (La Porta et al., 1998).

The PBL reforms we study all grant individual debtors readier debt discharge. The literature highlights two political motivations for such reforms, each with opposite implications for creditors versus debtors. First, economic crises over the past century or more were often attributed to fraudulent, overly speculative, or excessively risky borrowing and therefore precipitated pro-creditor PBL reforms (Di Martino, 2008). Second, in more recent decades, left-leaning policymakers have argued that pro-debtor PBL reforms help the poor (Fan and White, 2003; Berkowitz and White, 2004) and mitigate income inequality (Gala, Kirshner, and Volpin, 2013).

Neither political motivation is obviously valid. First, all else equal, debtor-friendly PBL raises borrowing costs and reduces loan supply (Berkowitz and White, 2004). Second, during pre-crisis credit bubbles, cost-insensitive behavioral forces are thought to drive borrowing and lending (Shiller, 2000).

However, an unintended consequence of debtor-friendly PBL reforms might be a boost to radical innovation. This follows from three observations. First, entrepreneur-founders with radical new ideas behave as if their expected returns distributions have very large positive tails (Koellinge, Minniti, and Schade, 2007; Landier and Thesmar, 2008), and so may be less sensitive to increased borrowing costs (Berkowitz and White, 2004) than are borrowers in general. Second, by reducing or eliminating the likelihood of personal ruin, debtor-friendly PBL reforms may encourage potential entrepreneurs to develop more radical innovations. Perceived probabilities of financial ruin correlate negatively with business startup rates (Koellinger et al. 2007) and persistence (Rosokha and Younge 2020). Third, by forgiving entrepreneur-founders for their past failures, debtor-friendly PBL reform permits them "fresh starts" (Landier, 2005; White, 2005; Ederer and Manso, 2011).[1] Faster entrepreneurial re-entry is important (Georgakopoulos, 2002; Landier, 2005; Ayotte, 2007) because major entrepreneurial success often follows repeated failures and "fresh starts" (Baird and Morrison, 2005; Stam, Audretsch, and Meijaard, 2008; Lee et al., 2011; Fossen, 2014; Jia, 2015).

This reasoning motivates five testable hypotheses. H1: Debtor-friendly PBL reforms stimulate innovation, measured directly using patent counts; increase the importance of innovation, measured by patents' subsequent citations; and increase innovator entry, measured by new patenter débuts. H2: These effects are concentrated among firms without large prior patent portfolios, which are most reliant on personal guarantees to access debt financing. H3: Debtor-friendly PBL reforms reallocate innovation toward industries with higher ex-ante innovation potential, improving the efficiency of innovative effort. H4: Debtor-friendly PBL reforms disproportionately stimulate radical innovation, consistent with the theoretical link between fresh-start provisions and willingness to pursue high-risk projects. H5: The effects of PBL reforms on innovation are attenuated in countries with minimum capital requirements for new firms, which act as barriers to entrepreneurial entry. All are observed in the data.

We test additional hypotheses about the nature of innovation brought into the economy by new

[1] This amounts to giving individuals an insurance option (Jackson, 1985; Alder, Polack, and Schwartz, 2000; Frouté, 2007; Cerqueiro and Penas, 2017).

firms versus large established firms. Schumpeter (1911) argued that long-run economic growth arises from a process of creative destruction: initially, small new upstart firms create new technologies that destroy, partially or completely, large established firms that were themselves once small upstarts. When young and beginning his career, Schumpeter (1911) deemed small, new upstart firms essential because large established firms, having substantial physical, intellectual, and human capital investment in legacy technologies, eschew radical innovation that would destroy those investments and favor, instead, incremental innovation that augments their value. An older, established Schumpeter (1942) saw more older, established firms as having more cash flows to spend on innovation in general, and thought this the driver of long-run prosperity. The younger Schumpeter finds support in substantial work linking faster-paced creative destruction to faster technological progress and more sustained productivity growth (see e.g. Winter 1984; Aghion and Howitt 1992; Fogel et al. 2008; Bloom, Schankerman, and Van Reenen, 2013; Aghion, Akcigit, and Howitt, 2015; Faccio and McConnell, 2020; Aghion et al. 2021).

PBL reforms are likely less consequential to large established firms, which can tap corporate debt and equity markets, than to new, initially small startups, whose founders may personally guarantee debt financing. This reasoning motivates several further questions. First, debtor-friendly PBL reforms might encourage more innovation by initially small, new firms, but not by established, large firms. Second, the innovation debtor-friendly PBL reforms encourage might be radical, rather than incremental. Third, debtor-friendly PBL reforms might herald productivity growth spurts. All of these are observed.

3. Variables Construction

Table 1 provides summary statistics for the innovation measures, PBL reform indicator, and control variables used in the regressions. The subsequent subsections explain the data used and construction of each.

3.1. Innovation measures

3.1.1 Construction of the innovation intensity database

The NBER Patents Data File (Hall et al., 2001) includes all successful (subsequently approved) patent filings with the USPTO from 85 countries, including the United States. Patents by U.S. residents allow estimation of baseline industry patenting distribution measures. USPTO filings by foreign residents are used to assess innovation intensity in each other country each year.

We are interested in private-sector patents with business applications. The NBER data classify patents by assignee, and we retain patents with assignee codes 2 (U.S. non-government organizations, mostly firms) and 3 (non-U.S. non-government organizations, mostly firms). These comprise 47% and 31%, respectively, of all patents.[2]

Our tests use country-industry-level data, so we must associate each patent with a primary industry code. USPTO patent examiners assign patents to United States Patent Classification (USPC) technology classes and subclasses, which we match to the Standard Industrial Classification (SIC) codes used in financial databases. The USPTO's Office of Technology Assessment and Forecast (OTAF) provides a 2008 Concordance Table, which matches each of the 216,606 USPC subclasses to from one to seven of 42 SIC Sequence Numbers (SICSN) industry codes, listed in ascending numerical order.[3] Most SICSNs correspond to one 3-digit SIC code, but others are matched to two or more SIC codes. The SIC codes run from 200 to 390, spanning all manufacturing industries.

In cases where USPC subclasses are linked to multiple SICSNs, some prior studies match to the first (numerically lowest) SICSN. However, this may not be its most important SICSN. We, therefore, use machine learning to match each patent to one *primary* SICSN using the patent's title and abstract. Specifically, we train alternative machine learning algorithms on randomly selected subsamples of single SICSN patents, test their accuracy using alternative subsamples of single SICSN patents, and use the neural net that performs best out-of-sample to assign a primary SICSN to each patent linked in the database to multiple SICSNs. Online Appendix B describes the machine learning matching process, and the concordance is listed in Table OA15. Online Appendix B also reports the out-of-sample accuracy of the classifier and confirms that classification errors are distributed approximately uniformly across country-

---

2 A patent class for foreign individual assignees is rarely used, containing only 0.25% of all USPTO patents. Prior incorporation may help limit personal liability in patent infringement lawsuits.

3 Hirabayashi (2003) describes how USPTO examiners manually review the USPC categories and assign them to a set of industry-based product fields based on 1984 SIC codes. Updated databases such as PatentsView, although providing more recent patent records, do not offer a concordance table that allows patents to be consistently mapped into industry classifications.

years, mitigating concerns that misclassification could be systematically correlated with reform timing.

3.1.2 Dropping legacy-technology firms

In constructing our sample, we drop large legacy patentholders (L) firms for three reasons. First, established firms with large portfolios of existing patents are unlikely to need personal guarantees to obtain external financing, and so are unlikely to be directly affected by PBL reforms. Including them would cause attenuation bias. Second, although PBL reforms are usually politically justified as measures to help the poor, corporate lobbying can affect legal reforms. Recent work in finance focuses on reactions of smaller firms to the U.S. state-level legal reforms, arguing that large firms predominate in political lobbying, so legal reforms are more defensibly exogenous for smaller firms (Dal Bó, 2006; Hill et al., 2013; Karpoff and Wittry, 2018). Third, firms heavily invested in legacy technologies are also likely to undertake incremental, rather than radical, disruptive innovations to avoid creative self-destruction of their existing physical, intellectual, and human capital. In contrast, small, upstart entrants are important generators of the radical, disruptive innovation associated with rapid productivity growth spurts.

We define firms with 500 or more existing patents in 1990, the first year of our data window as *legacy* (L) firms. These 211 L firms have roughly half as many patents as the remaining 136,546 firms, which we use as the sample in our baseline tests. Robustness checks below compare alternative samples excluding alternatively defined L firms.

3.1.3 Innovation intensity variables

The first innovation intensity variable, $patents_{i,c,t}$, is the number of successful (i.e., subsequently granted) patent applications by firms in industry i in country c in year t = 1990 through 2002. Patent counts can be an imperfect measure of innovation because individual patents can vary substantially in quality. Because foreign applicants plausibly seek the U.S. patents for innovations they deem more important, using USPTO data mitigates this concern. This integer variable measures general innovative intensity.

Our second innovation intensity variable, $cites_{i,c,t}$, directly addresses patent quality heterogeneity. Following Hirshleifer, Low, and Teoh (2012) and Bena and Li (2014), we count citations of each successful patent application filed by firms from 1990 to 2002 in all subsequent patent filings in all years through 2016 using the 2018 PATSTAT database[4]. The variable $cites_{i,c,t}$ is the subsequent-citation-weighted count of all successful patent applications by firms in industry i in country c in year t = 1990 through 2002. $cites_{i,c,t}$ measures general innovation importance. Using 1990 through 2002 leaves at least 14 years (2016 minus 2002) for citations to accumulate, mitigating citation truncation bias (Hall et al., 2001).

Our third innovation measure, $débuts_{i,c,t}$, counts the number of patenters from each country filing their first-ever USPTO patent in each industry each year. A new patentor's first appearance in the international USPTO system plausibly flags innovations entrepreneurial founders deem worth protecting abroad as well as in their own countries. This measure isolates how new innovation entrants react to PBL reforms. This distinction matters because disruptive innovation is associated with entrants and with productivity acceleration.

Table 1 provides summary statistics for our three measures of innovation. We interpret $patents_{i,c,t}$ and $cites_{i,c,t}$ as gauging general PBL-dependent innovative activity and its importance, and $débuts_{i,c,t}$ as a more focused measure of innovation by outsiders, which potentially might be more disruptive and consequential.

3.2. Personal bankruptcy law reform indicator

Our data on PBL reforms extend those of Armour and Cumming (2008), who track PBL changes in 15 countries, and encompass PBL changes in all other patent-active countries, defined as countries with total patent counts of over 100 in the sample period. We end this exercise in 2002, so a sufficiently large number of subsequent years' citations can be used to assess patent quality. Reading each economy's PBL laws and regulations and consulting other relevant legal documents where possible, we identify where and when meaningful changes in discharge accessibility and delay (years from bankruptcy to discharge) occurred.

This yields 18 economies with PBL reforms and 15 without in 1990 to 2002. Panel B of **Table 1**

[4] PATSTAT provides broad coverage of patents filed at multiple patent offices worldwide, allowing us to count citations from patents subsequently granted across different jurisdictions. Nevertheless, when counting patents, we still rely on USPTO patents to ensure a more comparable and consistent standard of patent quality and examination across countries

presents these 33 economies' patenting information and PBL reform years. We denote country c's PBL reform implementation year as t_c. All the reforms in our data make PBL more debtor-friendly.

One may be concerned that bankruptcy reforms are likely to follow economic downturns, as unemployment, default, and closures rise during these times. The increase in new ventures and their innovation might naturally follow the recovery of the economy. Hence, giving a detailed context of when and why these PBL reforms took place in each economy is important. Appendix **Table A2 Panel A** summarizes the detailed information and references about PBL reforms from 1990 to 2002 for all 18 event economies in our sample. Our main purpose of grouping those PBL reforms is to focus on those economies who have gone through major PBL reforms, which will be more debtor-friendly following two key criteria: either the reform will create or expand a structured personal insolvency regime that gives ordinary individuals a clear path to discharge or restructure debts, or it will significantly relax conditions for relief, for example, by reducing barriers to debt discharge or introducing protective stays. All 18 event economies have such features in their PBL reforms, respectively.

From these country-level PBL chronologies, we construct a PBL post-reform binary indicator

$$[1] \quad \delta_{c,t}^{XPBL} = \begin{cases} 1 & \text{if } t \geq t_c \\ 0 & \text{otherwise} \end{cases}$$

set to one for country c after t_c, the year its PBL reform is implemented, and to zero otherwise. This variable is zero throughout for countries without PBL reforms. **Table 1** provides summary statistics.

Legal reforms typically occur well after a government's intention to change laws becomes public information. **Figure 1** graphs mean-adjusted Google n-grams yearly frequencies from searches for each economy's PBL reform in its primary language or English from four years before to four years after its reform. Google n-grams provides the frequency of a phrase as a fraction of all phrases of similar length in all publications in its database for each language. Consequently, these frequencies provide a time-varying measure of attention to each economy's PBL reform. Counts increase somewhat the year before the reform occurs.

We therefore construct a second binary indicator

$$[2] \quad \delta_{c,t}^{TPBL} = \begin{cases} 1 & \text{if } t \in \{t_c - 2, t_c - 1\} \\ 0 & \text{otherwise} \end{cases}$$

set to one in the transition period, two years and one year before country c's PBL reform year t_c, and to zero otherwise. This variable is zero throughout for countries without PBL reforms.

3.3. Control variables

Following Moshirian et al. (2021), we subsume all time-invariant country-industry-level latent variables by including country-industry dummies and subsume all global business cycle latent variables by including year dummies. We also control for several industry-level and country-level characteristics that may be correlated with PBL changes and/or innovation.

First, to account for time-varying comparative advantages (Acharya and Subramanian, 2009), we include the ratio of value-added in industry i to the total value-added of country c in year t, denoted $value\text{-}added_{i,c,t}$.[5]

Second, innovators in countries exporting more to the U.S. might disproportionately seek U.S. patents to protect their intellectual property in the U.S. market. This could distort our innovation measures, which are based on foreigners' patents recorded at the USPTO. To address this potential bias, we control for industry i's imports from and exports to the U.S., expressed as fractions of country c's total imports from and total exports to the U.S., respectively, in year t. Denoted $exports_{i,c,t}$ and $imports_{i,c,t}$, both are constructed using data from Feenstra, Romalis, and Schott (2002).

Third, wealthier and larger economies may innovate more (Liang, 2018). To address this, we control for the natural logs of real GDP per capita and population of country c in year t and denote these $\ln(pcGDP_{c,t})$ and $\ln(pop_{c,t})$. Changes in per capita GDP also reflect changes in innovation associated with asynchrony in business cycles across countries.

Fourth, innovation opportunities can vary across industries and time (Hall et al., 2001). Cohen, Nelson, and Walsh (1996) argue that U.S. patenting intensity in an industry reflects the fundamental technological characteristics of that industry. Therefore, we follow Rajan and Zingales (1998), Acharya and Subramanian (2009), and others in using U.S. innovation as a proxy for each industry's innovative potential. Denoted $pot_{i,t}$, this is the natural log of the mean USPTO patent counts for U.S. firms in industry i in year t.

[5] The dataset, from Nicita and Olarreaga (2006), provides value-added by 3-digit ISIC codes, with a 3-digit SIC code concordance table.

We also control for variations in creditor rights in CBL. We take Acharya and Subramanian's (2009) change in credit rights index, denoted as $CRI_{c,t}$, because we wish to assess the marginal importance of PBL reforms over and above the effects they find for this measure of CBL changes. For details, see Acharya and Subramanian (2009).

4. Estimation Results

4.1. The main effect of PBL reforms on innovation

To examine the relationship between a country's PBL reform and its industries' subsequent innovation, we estimate the following fixed-effects Poisson regressions of the form[6]

[3] $$E[\pi_{i,c,t}] = \mathrm{e}^{\lambda_0\, \delta_{c,t}^{XPBL} + \lambda_1 \delta_{c,t}^{TPBL} + \sum_{k=1}^{K} \beta_k X_{k,\cdots,t-1} + \mu_{i,c} + \tau_t}$$

The subscripts *i*, *c*, and *t* denote industry, country, and year. The explained variable, $\pi_{i,c,t}$, is one of the three innovation measures described in detail in section 3.1: $patents_{i,c,t}$, $cites_{i,c,t}$, or $débuts_{i,c,t}$. The expectation is conditional on the values of the explanatory variables in the exponent term on the right-hand side. Poisson regressions are designed to explain integer count variables.

The key explanatory variable is the PBL post-reform indicator $\delta_{c,t}^{XPBL}$, whose coefficient λ_0 quantifies differences in innovation $\pi_{i,c,t}$ associated with differences in PBL and is our primary interest.

Collectively denoted $X_{k,\cdots,t-1}$ in [3], and described in detail in section 3.3, the control variables are industry innovative potential, $pot_{i,t}$, industry value-added as fraction of national value-added, $value\text{-}added_{i,c,t}$, industry exports to the U.S. as fraction of national exports to the U.S., $exports_{i,c,t}$, industry imports from the U.S. as fraction of national imports from the U.S., $imports_{i,c,t}$, log of national per capita GDP, $\ln(pcGDP_{c,t})$, log of national population, $\ln(pop_{c,t})$, and change in credit rights index, $CRI_{c,t}$. In the regression, all controls are lagged one year except $CRI_{c,t}$, which is concurrent to align with the PBL reform indicator $\delta_{c,t}^{XPBL}$. All of the regressions subsume all time-invariant country-industry-level latent factors and time-varying global latent factors with country-industry fixed effects $\mu_{i,c}$ and year fixed effects τ_t, respectively. Statistical significance tests cluster bi-directionally, by country and by industry.

---

[6] Cohn, Liu, and Wardlaw (2022) show that OLS regressions explaining natural logs of count measures can be biased and recommend Poisson regressions. OLS regressions, available on request, nonetheless give very similar results.

Table 2 summarizes the results. For each explained variable, $patents_{i,c,t}$, $cites_{i,c,t}$, or $débuts_{i,c,t}$, regressions 2.1, 2.4, and 2.7, respectively, include only the PBL post-reform indicator $\delta_{c,t}^{XPBL}$, the PBL transition indicator $\delta_{c,t}^{TPBL}$, and industry innovation potential, $pot_{i,t}$; then 2.2, 2.5, and 2.8 include all the controls except change in creditor rights index, $CRI_{c,t}$; and finally 2.3, 2.6, and 2.9 include all controls. Note that the sample sizes differ for different explained count variables because Poisson estimation optimally drops observations with no variation in a fixed effect category (Silva and Tenreyro, 2010, 2011). With all controls, the coefficient λ_0 on the PBL post-reform indicator is positive and statistically significant at 5%, 1%, and 10%, respectively. This associates the typical PBL reform with significantly increased innovation. As all the PBL reforms make debtor discharges more accessible, these DID regressions can be interpreted as evidence that readier PBL discharge boosts innovation.

The magnitudes of the point estimates for λ_0 show these positive effects to be economically significant as well. The marginal effects, $e^{\lambda_0} - 1$ in Poisson regressions, of the typical reform having been enacted are 36.5% $= e^{0.311} - 1$ more patents, 34.3% more subsequent patent citations, and 16.1% more new patenter débuts using coefficients from 2.3, 2.6, and 2.9, which include all controls.

There are increases from the transition period as well. The values of λ_1, the coefficient of the reform transition indicator $\delta_{c,t}^{TPBL}$, in 2.3, 2.6, and 2.9 show patents, patent citations, and new patenter débuts rising by 12.5%, 7.5% (insignificant), and 13.0%, respectively, in the transition period. The general conclusion from Table 2 is that PBL reforms are associated with statistically and economically significant increases in innovation.

Consistent with Acharya and Subramanian (2009), higher CRI (i.e., less debtor-friendly CBL) is associated with less innovation. However, comparing the second and third regressions explaining each of the three innovation measures shows that accounting for changes in creditor rights or not leaves the coefficients on the PBL post-reform indicator essentially unchanged. This is consistent with PBL reforms having an independent effect on innovation.

The significant coefficients of the control variables are unremarkable. Higher GDP per capita, larger population size, being in an industry that imports from the U.S., and being in an industry-year with a higher innovation potential are all positively associated with innovation. A higher U.S. export ratio is sporadically significant, with positive signs, suggesting local patenting is associated with importing from the U.S., as well as exporting to it. Prior competitive advantage, as captured by value-added ratios, is marginally significant and positive.

4.2. Effects of PBL reforms in varying with industry innovation potential

Specification [3] tests for PBL reforms affecting innovation uniformly across industries. However, innovations can arise and diffuse across different industries with different economic impacts (Acharya and Subramanian, 2009; Moshirian et al., 2021). Recent research further shows that some technological domains generate foundational innovations that facilitate subsequent innovation and long-run growth (Tham et al., 2026). Consequently, the allocation of innovative effort across industries may be as important as its aggregate quantity. We therefore explore heterogeneity in how PBL reforms affect innovation in industries with different innovation potential using a varying coefficients model. Innovation potential, $pot_{i,t}$, is proxied by the intensity of innovation in the U.S. in industry i in year t. Specification [3] is thus modified by changing the coefficients on the post-reform and trans-reform indicators, $\delta_{c,t}^{XPBL}$ and $\delta_{c,t}^{TPBL}$, from λ_0 and λ_1 to $\lambda_0 + \mu_0\, pot_{i,t}$ and $\lambda_1 + \mu_1\, pot_{i,t}$, respectively. The resulting specification is

$$[4] \qquad E\left[\pi_{i,c,t}\right] = \mathrm{e}^{(\lambda_0+\mu_0\, pot_{i,t})\,\delta_{c,t}^{XPBL}+(\lambda_1+\mu_1\, pot_{i,t})\,\delta_{c,t}^{TPBL}+\sum_{k=1}^{K}\beta_k X_{k,\cdots,t-1}+\mu_{i,c}+\tau_t}$$

All else is as in [3]. For brevity, we present only analogs to Table 2 regressions using all control variables – that is, 2.3, 2.6, and 2.9.

Table 3 summarizes these results. **Panel A** shows the main effects of PBL reform, the λ_0 coefficients on $\delta_{c,t}^{XPBL}$ are negative, indicating that innovation falls in a theoretical baseline industry with zero innovative potential. The positive μ_0 coefficients on its interactions with $pot_{i,t}$ indicate that the impact of PBL reforms on innovation rises statistically and economically significantly with innovation potential.[7]

The Poisson regression coefficients' implications for the economic significance of PBL reform

[7] Interaction significance tests can be problematic in nonlinear estimation. However, the significance of the coefficient of an interaction of a continuous variable with a dummy in a Poisson regression is precisely the significance of the interaction term in the Poisson regression.

require transforming the coefficients as follows: In an industry with minimum innovation potential ($pot_i = 0$), patent counts fall by 24% ($e^{\lambda_0+\mu_0\, pot_i}$ = $e^{-0.279 + 0.535 \times 0} - 1$). In an industry at the first quartile of the industry innovation potential distribution ($pot_i = 0.511$), patent counts fall by 0.6% ($e^{-0.279 + 0.535 \times 0.511} - 1$). Analogous calculations show patent counts rising by 11%, 33%, and 112%, respectively, in industries at the median, third quartile, and maximum innovation potential. Patent counts rise by 16% in the mean industry, consistent with the positive average effect evident in Table 2.

Panel B of **Table 3** summarizes these calculations for all three innovation measures. **Figure 2** graphs these changes alongside the analogous calculations. Across all three measures, PBL reforms are associated with innovation dramatically realigned to innovation potential. At the mean industry innovation potential, $cites$ and $d\acute{e}buts$ also both rise by 12.9% and 32.5%, respectively, affirming their positive average effects in Table 2.

The economic significance of the redistribution of innovative activity can be summarized by a difference in differences calculation: the time difference in innovation (before versus after the reform) in the cross-sectional difference in innovation across industries with different innovation potential. The difference in patent counts for industries at the 25th versus 75th percentiles of innovation potential widens after PBL reform by 33.9% ($e^{0.535*(1.057-0.511)} - 1$). The comparable widenings for citations and new patenter débuts are 30.1% and 21.1%, respectively.

Overall, Table 3 and Figure 2 summarize evidence supporting PBL reforms making debt discharge more readily available boosting innovation more in industry-years with high innovation potential and not greatly affecting innovation in industry-years with low innovation potential.

4.3. Robustness checks

Our main results, Tables 2 and 3, are highly robust. The Online Appendix (OA) provides tables summarizing robustness check regressions. In general, the robustness checks lead to qualitatively similar results, meaning identical patterns of signs and significance and roughly comparable point estimates. Where the results are not qualitatively similar, implications for interpreting the main results are explained. The robustness checks are as follows.

One possible concern is that our results are driven by improvements in intellectual property protection (IPP), which might correlate with both PBL reforms and innovation. Four countries (Austria, Ireland, Israel, and Russia) reformed their IPP in our sample period (Acharya and Subramanian, 2009). Dropping these four countries and rerunning our baseline regressions yields results qualitatively similar to those in the previous tables (see **Table OA1**). This is inconsistent with IPP reforms driving our main results.

We aggregate USPTO patent technology classes to 3-digit SIC codes. An alternative approach, following Hsu et al. (2014), is to use USPTO class-level variables. **Table OA2** describes these alternative versions of our three explained variables, denoted $patents^{*}_{i,c,t}$, $cites^{*}_{i,c,t}$, and $débuts^{*}_{i,c,t}$, and the innovation potential measure $pot^{*}_{i,c,t}$ (U.S. patenting), by 3-digit USPTO classification code each year. Because they are industry-level variables, *value-added*, *exports*, and *imports*, are dropped. As **Table OA2** shows, qualitatively similar results ensue.

Innovation potential is taken as the average patent counts for U.S. firms each industry-year. We also rerun our regressions using Japanese, rather than U.S., firms' average patent counts to construct the innovation potential benchmark. We then exclude Japan from the regressions. Qualitatively similar results ensue (see **Table OA3**).

To further address the possibility that CRI changes might affect our results, we exclude four event countries (Canada, Finland, Israel, and Sweden) with CRI changes in our sample period and rerun the regressions. Qualitatively similar results ensue (see **Table OA4**).

We also rerun our regressions by redefining the PBL trans-reform period as the year before and the year of the reform, and the PBL post-reform period as years after the PBL reform. Qualitatively similar results ensue except that the main effect on new patenter débuts turns insignificant (see **Table OA5**).

Another approach uses indicators (one if count > 0, zero otherwise) rather than counts as LHS variables. These regressions can be interpreted as extensive margin tests (tests for some innovative activity where there was previously none) that exclude intensive margin effects (more innovation where there was some innovation previously). Linear probability regressions explaining zero-one dummies for $patents_{i,c,t} > 0$, $cites_{i,c,t} > 0$, and $débuts_{i,c,t} > 0$ generate uniform insignificance for $\delta^{XPBL}_{c,t}$ and its interaction with $pot_{i,t}$ (see **Table OA6**). Logit and probit regressions generate results similar to linear probability models. This robustness check shows that debtor-friendly PBL reforms affect innovation's intensive, rather than extensive, margin.

Another concern is citations truncation bias (Hall et al., 2001). We track citations through to 2016, so a 1990 patent, filed at the start of our 1990-2002 sample, has 26 years to accumulate citations, whereas a 2002 patent has only 14 years. A minimum 14-year period largely ameliorates this problem because most citations occur within this period, and we include year fixed effects to further mitigate this concern. As a further robustness check, we implement an approach devised by Hirshleifer et al. (2012) that avoids throwing away later years' data. We normalize each patent's citations by the average citation count of all patents in the same technology class and year. We then calculate a normalized citation count, denoted $ncites_{c,i,t}$, for each industry in each country each year. Additionally, we also use a rolling 14-year window, so all patents have the same number of years to accumulate citations and generate $cites\_14y_{c,i,t}$ for each industry in each country each year. Rerunning the citation count regressions using these two alternative measures yields qualitatively similar results (see **Table OA7**).

An additional concern is whether our main results also apply to radical innovation, as predicted by our theory. We thus estimate the effect of PBL reform on radical innovation using two new measures. Following Balsmeier, Fleming, and Manso (2017), our first measure is $radical\_1_{i,c,t}$, defined as the number of successful patent applications filed by firms in country *c*'s industry *i* in year *t* whose citation counts rank in the top 10% of all USPTO patents in that industry that year. Following Griffith and Macartney (2014), our second measure is $radical\_2_{i,c,t}$, defined as the number of successful patent applications by firms in country *c*'s industry *i* in year *t* that cite at least one non-patent literature (NPL). Rerunning the patent count regressions using these two alternative measures yields qualitatively similar results (see **Table OA8**), suggesting that our major results are also valid regarding radical innovation.

A new patenter may file more than one patent application in its first year, and these patents may fall in different SICSNs. Our variable $débuts_{i,c,t}$ counts a new patenter with three new patents, two in one industry and one in another industry, as one new patenter in both industries. This would inflate the aggregate number of new patenters (a figure we do not use); but is defensible in accurately recording one innovative début in both industries. However, as a robustness check, we consider another alternative measure. The number of patenters filing their very first successful patent application, denoted $débuts\_1_{i,c,t}$, counts only new patenters' unique first patent and that patent's SICSN, and thus counts each new patenter only once. Rerunning the new patenter début regressions using this alternative measure yields qualitatively similar results (see **Table OA9**), showing that our main results for new patenter débuts are unlikely driven by the patenter inflation.

One may also be concerned that our main results are driven by one country, especially one with heavy patenting, such as Japan and Germany. To address this concern, we employ a leave-one-country-out ("jackknife") robustness check by re-estimating the baseline sequentially excluding Germany and Japan, respectively, in **Table OA10**. The average effect for new patenter débuts is disproportionately influenced by Germany, although the interaction effect persists even when it is excluded. Germany's PBL reform is the most sweeping in our sample: the time to discharge falls from 47 to 5.5 years (Table A2 Panel B), so it mechanically receives disproportionate weight in pooled average-effect estimates. As Table 11 shows, high-intensity reforms drive substantially larger effects than low-intensity reforms, so Germany's outsized influence on the average débuts coefficient is itself consistent with the paper's PBL-intensity mechanism rather than a sign of fragility. Crucially, the interaction effect between PBL reform and industry innovation potential remains statistically significant even after Germany is excluded, as reported in **Table OA10**. One plausible explanation is that Germany represents a non-typical case of introduction that created a meaningful discharge regime where essentially none existed before, rather than a marginal adjustment on discharge periods, which mechanically receives substantial weight in pooled specifications[8]. When Japan is dropped, the average effect turns marginally significant, but the interaction effect persists. Overall, readers should interpret the average effect on new patenter début with caution[9], while placing

[8] Germany disproportionately contributes to the average effect on new patenter débuts is also consistent with theory that entry margins respond most strongly when reforms relax binding constraints. German SMEs and innovative start-ups rely heavily on relationship banking and personal guarantees in its bank-based financing system, making PBL particularly important for entry decisions.

[9] PBL reforms differ substantially in scope and baseline institutions. The average DID coefficient mechanically reflects a weighted average of country-specific treatment effects. The estimated average effect on new patenter débuts should be interpreted as a reduced-form average across reforms that differ markedly in their baseline legal environment and economic importance.

more weight on our robust interaction effects. In contrast, for the other two innovation measures, dropping either country leaves the results qualitatively unchanged[10].

We also conduct a leave-one-year-out exercise, sequentially omitting one year at a time to address the concern that a particular year might be driving the main results. The estimates remain qualitatively unchanged regardless of which year is excluded (see **Table OA11**).

4.4. Robustness regarding identification

To ensure that the effect of PBL reforms is causal, we conduct three additional tests. Now we rely on the interaction effect to draw conclusions.

4.4.1. Controlling for the effects of financial and institutional development

Tables 2 and 3 include country-industry and time fixed effects, which fully subsume all time-invariant latent factors with variation across country-industries and all time-varying latent factors with no variation across country-industries. This leaves time-varying country-, industry-, or industry-country-level latent factors requiring control variables. This subsection considers potential control variables along these lines.

Table 4 modifies model [4] by including interactions of innovation potential with the control variables in the RHS exponent, alongside the control variable main effects. This specification allows the control variables to have different effects in industry-years with different innovation potential. The coefficients μ_0 are slightly reduced in magnitude, but still highly statistically significant. The control variables largely track the pattern in Table 3. One exception is innovation potential, attracting a negative coefficient in explaining new patenter débuts $debuts_{i,c,t}$. This is difficult to interpret economically alongside its many interaction terms.

PBL reforms and innovation may be associated with general financial development, deemed a major driver of sustained economic growth (King and Levine, 1993; Rajan and Zingales, 1998; Hsu et al., 2014). Financial development is associated with legal and regulatory changes to securities, corporations, corporate governance, and accounting law, all of which interact with bankruptcy law (Beck and Levine,

[10] Compared to patent counts and subsequent citations, new patenter débuts is a noisier extensive-margin outcome. As such, its average effect is more sensitive to influential reform episodes, whereas intensive-margin responses are more precisely estimated.

2005). Indeed, PBL reforms may be associated with general institutional development, which might also foster innovation (Klenow and Rodriguez-Clare, 1997). Much variation in financial and institutional development may have roots in countries' overarching legal systems, one of English common law, the French Civil Code, Scandinavian law, or the German Civil Code (La Porta, Lopez-de-Silanes, and Shleifer, 2008).

We therefore rerun our tests, including additional control variables: $findev_{c,t}$, the IMF's overall financial development indicator, developed by Svirydzenka (2016), $instdev_{c,t}$, a general measure of institutional quality from Bekaert, Harvey, and Lundblad (2005), as well as interactions of all of the above with innovation potential. We also control for interactions of innovation potential with indicator variables for each of the four legal origins (La Porta, Lopez-de-Silanes, and Shleifer, 2008). Because the legal-origin dummies are time-invariant within a country, they are already subsumed by the country-industry fixed effects.

In **Table 5**, we augment the regressions of Table 4 with all these additional control variables to subject our main results to maximal pressure. The coefficients of $\delta_{c,t}^{XPBL} \times pot_{i,t}$ remain positive and statistically significant in all three columns, suggesting that our main results are unlikely to be driven by financial or institutional development. When $débuts_{i,c,t}$ is examined, the coefficient of $findev_{c,t} \times pot_{i,t}$ is positive and statistically significant, consistent with the above-mentioned findings associating entrepreneurial innovation with financial development.

To address the issue of time-varying country-level latent factors generally, we then rerun our regressions of Table 3, replacing year fixed effects with country-year fixed effects. This subsumes the main effects of all time-varying country-level factors, such as changes in government research funding, venture capital or angel financing availability, and other country-level policy shocks. To avoid curse of dimensionality problems from too many fixed effects, we also replace country-industry dummies with industry dummies. **Table 6** summarizes the results. By including country-year fixed effects in regressions of Table 3, the coefficient of $\delta_{c,t}^{XPBL} \times pot_{i,t}$ retains significance with similar point estimates. Overall, these robustness tests suggest our main results are unlikely to be driven by omitted latent variables.

4.4.2. Dynamics of innovation

In Table 2, the PBL reform transition period dummy $\delta_{c,t}^{TPBL}$ is substantially more prominent in explaining new patenter débuts than in explaining patent numbers or subsequent citations. To explore timing differences in more detail, we follow Bertrand and Mullainathan (2003) and, with t_c the year in which country c implements its PBL reform, define seven indicator variables $\delta_{-4,c,t}$, $\delta_{-2,c,t}$, $\delta_{-1,c,t}$, $\delta_{0,c,t}$, $\delta_{1,c,t}$, $\delta_{2,c,t}$, and $\delta_{\geq 3c,t}$, as follows

[5] $$\delta_{s,c,t} = \begin{cases} 1 & \text{if } t = t_c + s \\ 0 & \text{otherwise} \end{cases} \qquad \forall\, s \in \{-4,-2,-1,0,1,2\}$$

[6] $$\delta_{\geq 3,c,t} = \begin{cases} 1 & \text{if } t \geq t_c + 3 \\ 0 & \text{otherwise} \end{cases}$$

leaving the baseline (omitted) category for assessing the significance of the above indicators the period $t = -3$.

For each event country *c* with a PBL reform in year t_c, we drop observations more than four years before or after that year. We first rerun the regressions 2.3, 2.6, and 2.9 of Table 2 replacing the reform indicator variables $\delta_{c,t}^{TPBL}$ and $\delta_{c,t}^{XPBL}$ with the seven indicator variables. These regressions assess changes in innovation relative to the period from three years before each country's PBL reform.

Panel A of Table 7 summarizes these three regressions. Patent counts and citation counts begin rising somewhat during the two years before the reform takes effect, consistent with pre-announcement attention documented in Figure 1. Crucially, the indicator at *t*=−4 (the baseline period farthest from reform) is not statistically significant for both measures, providing evidence that the results are not driven by pre-existing trends. Larger coefficients on later time dummies show this pattern growing increasingly economically significant in subsequent years.

In contrast, the pattern is much less pronounced for new patenter débuts. This weaker dynamic pattern is consistent with our baseline results, where the average effect on new patenter débuts is only marginally significant at the 10% level. Together, these results suggest that PBL reform has a clearer effect on the scale and quality of innovation than on the average level of new patenting entry. A possible interpretation is that, at the extensive margin, the reform mainly induces a reallocation of entrepreneurial effort from less innovative industries to more innovative ones, rather than a large aggregate increase in entry. Given limited entrepreneurial resources, such a switching effect may be economically important even if the average effect on new patenter débuts remains modest. **Panel A of Figure 3** conveys the same message visually.

We then rerun the regressions of Table 3, replacing the reform indicator variables $\delta_{c,t}^{TPBL}$ and $\delta_{c,t}^{XPBL}$ and their interactions with $pot_{i,t}$ with the seven indicator variables and their interactions with $pot_{i,t}$.

Panel B of Table 7 summarizes these three regressions. Three innovation measures began rising in proportion to industry innovation potential around the year of the reform. Innovation intensification in proportion to industry innovation potential sets in across all three innovation measures with different timing: This effect appears first for patent counts, then for citations, and débuts the latest. Nevertheless, larger coefficients on later time dummies interacted with innovation potential for all three innovation measures show this pattern growing increasingly economically significant in subsequent years. **Panel B of Figure 3** graphically summarizes the key takeaway: actual innovation grows increasingly correlated with innovation potential after PBL reforms.

4.4.3. Event study

Another approach to clarifying timing is to study changes in innovation in the years surrounding each country c's PBL reform year, t_c. We thus rearrange the data in event time, retaining data for the seven years surrounding each PBL reform and ordering observations in event time and dropping countries without PBL reforms. Thus, for a country with PBL reform year t_c, we retain data for $(t_c - 4, t_c - 3, t_c - 2, t_c - 1, t_c, t_c + 1, t_c + 2)$ only.

Table 8 summarizes regressions paralleling Table 3 but using this sample and dropping *CRI*. As we have deleted all non-event countries, we are unable to reliably estimate its coefficient. The coefficient of $\delta_{c,t}^{XPBL} \times pot_{i,t}$ is positive and statistically significant across all regressions in the table.

Expanding the event window from the seven years surrounding each PBL reform to the nine surrounding years generates similar results. See panel A of **Table OA12**. Including *CRI* also generates similar results. See panel B of **Table OA12.** The coefficients of *CRI* turn less significant, confirming our concern that its effect may not be reliably estimated in this setting.

4.4.4. Pre-reform innovation potential

Following the literature, we exploit industry-level variation from the country-level shock using $pot_{i,t}$, defined as the average number of U.S. firm patents in industry *i* in year t. Since this variable is time-varying, it captures the global technological shocks and trends, which, however, may be correlated with and thus confound our innovation outcome measures. To mitigate this concern, we construct a pre-reform measure $pot\_pre_{c,i}$, defined as the average number of U.S. firm patents in industry *i* in the year prior to the reform of event country *c*; it is equal to zero for non-event countries. This measure is admittedly a coarse proxy for industry heterogeneity, but it provides a useful way to capture pre-existing cross-industry differences in innovation potential without directly loading on contemporaneous global trends. We then treat $pot\_pre_{c,i}$ as a time-invariant country-industry characteristic and interact it with the country-level reform dummy to study differential responses to a common reform shock, rather than interacting the reform with a time-varying global series.

Table OA13 estimates the interaction effect of PBL reform on innovation by using $pot\_pre_{c,i}$ instead of $pot_{i,t}$. Panel A reruns the baseline regressions using the full sample. Panel B restricts the sample to a balanced event window for each event country (from t_c−5 to t_c+4). Panel C further constructs a normalized measure $n\_pot\_pre_{c,i}$ by ranking $pot\_pre_{c,i}$ within each country to avoid cross-year comparison. Across all three specifications, the coefficient on the interaction term remains significantly positive. These results alleviate concerns that our baseline interaction effects are primarily driven by confounding global technological trends.

Overall, these tests affirm that innovation not only increases but becomes more aligned across industries with innovation potential.

5. PBL reform, large legacy patentholders firms, and innovation

This section explores three further dimensions of heterogeneity: firm size, minimum capital requirements, and PBL reform intensity. These are of interest because entrepreneurs must often form new firms to develop radical and disruptive innovations that could erode the value of established firms' existing assets and technologies. Most newly founded firms are initially small, so larger firm size can loosely capture reliance on existing assets and technologies, and thus coolness towards disruptive innovations. Minimum capital requirements are legal size thresholds imposed on new firms in countries' laws and regulations and can function as barriers to entry that protect incumbents from competition, perhaps especially from disruptive entrants (Djankov et al., 2002). If our story is true, one should expect the effect to be more pronounced when the PBL reform is more intensive.

5.1. Large legacy patentholders versus other firms

As **Section 3.1.2** explains, our patent and citations count variables exclude patents by large legacy patenters (L-firms), defined as having over ≥ 500 patents in 1990, the first year of our patent data window, because these firms are unlikely to require personal guarantees from their principals to borrow and are therefore unlikely to be directly affected by PBL reforms. To assess robustness to this choice, we redefine L-firms using alternative cutoffs ranging from 1 to 1,000 patents in 1990. For each cutoff, we estimate regressions explaining patent counts and subsequent citation counts separately for non-L firms and L firms. **Table 9** summarizes the results by listing the coefficients on $\delta_{c,t}^{XPBL} \times pot_{i,t}$ and their significance for each threshold. The non-L firm coefficients in the 500-patent threshold row reproduce the Table 3 baseline coefficients for comparison.

The non-legacy patentholder firms' interaction coefficients remain uniformly positive and statistically significant across all alternative cutoffs, confirming that our main finding is not driven by the particular threshold used to define L-firms. The declining coefficients as the threshold for culling legacy patenter firms increases are consistent with higher thresholds including more PBL-insensitive firms in the patent and citation counts, which attenuates the coefficients.

The regressions explaining L-firms' new patent counts and their subsequent citations suggest these firms react less positively, or even more negatively, to PBL reforms. Their new patent counts realign only slightly – about one-tenth as much as non-L firms – towards higher innovative potential industries. This effect diminishes as the threshold for defining L-firms rises, losing statistical significance at thresholds of 300 or more legacy patents and becoming insignificantly negative at thresholds of 500 or more. This validates our use of 500 patents as the baseline definition of large legacy patenters.

Post-PBL reform citation counts to L-firms' new patents show no realignment towards higher innovative potential at low thresholds and, as the threshold for defining L-firms rises past 400 legacy patents, show significantly negative realignment. That is, L-firms' citations increasingly disproportionately accrue in industries with lower innovative potential. A 500-patent threshold corresponds to a qualitative difference in L- versus non-L firms' innovation responses to PBL reforms.

Together, these results show that firms with more legacy patents, following PBL reforms, acquire modestly more patents in sectors with greater innovative potential, but that these new patents are less important. These results are consistent with PBL reforms intensifying competition in higher innovative potential sectors by opening those sectors to previously financially constrained new and smaller firms, which diminishes the traction of L-firms' innovations. Overall, Table 9 shows that the main results are robust to alternative definitions of L firms and that the post-PBL reform realignment effect is more positive amongst firms that are more clearly distinct from large legacy patenters. The evidence from both patent counts and citation counts further suggests that the 500-patent threshold provides a reasonable baseline for separating firms sensitive to PBL reforms from those insensitive to it.

5.2. Minimum capital requirements for start-ups

Minimum capital requirements, the legal minimum amounts of capital new firms must meet to be legally registered, can serve as a barrier to entry and, along with other regulatory barriers to establishing a new firm, are implicated in stalled economic development (Djankov et al., 2002). Our minimum capital requirement (MCR) measure is the country's regulatory minimum capital requirement, scaled by income per capita. The World Bank provides MCRs from 2004 on, postdating our 1990-2002 sample period. This ratio changes slowly over time within countries in the available data, so we use the 2004 value to partition the 18 countries with PBL reforms by whether each has MCRs.

Six of the countries with PBL reforms have no MCRs. Others have MCRs ranging from 9.3% (Argentina) to 74.9% (Japan). We employ two indicator variables, δ_c^{NOMCR} set to one for the former six countries and zero for all others, and δ_c^{MCR} set to one for the latter 12 countries and zero for all others. We then explore how the presence or absence of an MCR affects the extent to which innovation increasingly aligns with industry innovation potential after PBL reforms.

Table 10 revisits **Table 3** but includes two interactions of the post-reform indicator with innovative potential, one for PBL reform countries with an MCR and another for PBL reform countries with no MCR.

In all regressions (10.1 to 10.3), the coefficients of the interaction $\delta_c^{MCR} \times \delta_{c,t}^{XPBL} \times pot_{i,t}$, which measures the PBL reforms alignment effect in the presence of an MCR, are smaller than those of $\delta_c^{NO\ MCR} \times \delta_{c,t}^{XPBL} \times pot_{i,t}$, which measures the effect where there is no MCR. Chi-square tests show that the differences between the two are all significant (10.4 to 10.6).

5.3. PBL reform intensity

All PBL reforms might not be equally consequential. Every PBL reform in our data increases downside risk sharing, but some reduce debtors' costs of failure more and thus constitute more insurance to innovative firms and entrepreneurs. To explore possible PBL heterogeneity, **Table 11** partitions reform countries into low-intensity and high-intensity PBL reform groups and lets the post-reform alignment effect on innovation output differ across groups.

Following Armour and Cumming (2008), we partition the 18 reform economies into those with high- versus low-intensity reforms. High-intensity reforms substantially shift PBL procedures and debt discharge conditions to favor debtors. Low-intensity reforms are administrative, procedural, or other reforms that favor debtors, but without substantial changes, such as more lenient discharge periods. **Panel B of Table A2** lists the countries in each category.

Panel A of **Table 11** shows the post-PBL reform industry realignment to be evident after both categories of reforms, but far larger after high-intensity reforms than after low-intensity reforms. Panel B calculates percentage changes implied by the variables of interest in the Poisson regressions. **Figure 4** graphs these economic effects, revealing that high-intensity reforms most dramatically outpace low-intensity PBL reforms in amplifying innovation in very high innovation potential industries.

Additional significance tests reveal this differential amplification to be statistically significant for patents (p = 0.00), but not for subsequent citations to those patents (p = 0.18) or new patenter débuts (p = 0.36). Thus, we cannot reject the hypothesis that all PBL reforms are equally effective in better realigning patent importance and new innovator entry to match innovation potential.

Taken together, these results imply that stronger PBL reforms amplify the reallocation of innovative effort toward high-potential industries, but that this amplification is more clearly visible for overall patenting activity and, to a lesser extent, patent quality, than for new patenter débuts. One possible explanation is that the main channel operates more through the extensive margin than through the intensive margin. High-intensity PBL reforms may primarily encourage existing patenters to enter or remain in high innovation potential industries, rather than sharply increasing the number of new patenters within those industries.

Overall, Table 11 reinforces the central argument that PBL reform improves the alignment of innovation with industry innovation potential, while also suggesting that this effect is stronger when the reform provides more substantial downside-risk protection. At the same time, the weaker evidence for new patent débuts cautions against interpreting the effect as uniform across all innovation margins.

6. PBL Reform, Investment Efficiency, and Productivity

The above results show debtor-friendly PBL reforms economically and statistically significantly increased innovation, especially among firms not previously prominent as patent filers. This section explores broader economic changes potentially stemming from PBL reforms for capital allocation efficiency and TFP at the country level.

6.1. PBL reform and the functional efficiency of investment

Tobin (1984) argues that, although the financial sector is unlikely to allocate capital perfectly efficiently, that is, to direct investment to its highest value-creating uses, investment that better approximates this distribution can be regarded as more functionally efficient. Wurgler (2000) argues that the correlation of investment with value-added across an economy's industries provides a rough but workable proxy for functional efficiency.

The prior sections show that PBL reform better aligns the distributions of innovation intensity and innovation potential across sectors. This section explores whether PBL reform also better aligns the distribution of investment across sectors with the distribution of value-added across sectors.

These tests use country-year-level data analogous to the industry-country-year data in the tests above. We use two alternative approaches to assessing the correlation of investment with value-added across 28 industries in country c in year t. The first measure, denoted $\rho_{(\ln VA_{c,t},\ \ln I_{c,t})}$, is the correlation of the natural log of value-added with the natural log of investment. This closely approximates Wurgler's (2000) measure, but the sample size is slightly smaller because logarithms of the sporadically negative value-added are undefined. The second measure, $\rho^{rank}_{(VA_{c,t}\ ,\ I_{c,t})}$ is the rank correlation of value-added with investment.[11]

To see if PBL reforms increase functional efficiency, we estimate OLS regressions of the form

$$[7] \qquad \rho_{c,t} = \lambda_2\, \delta^{XPBL}_{c,t} + \lambda_3\, \delta^{TPBL}_{c,t} + X^1_{c,t-1}\beta_k + \mu_c + \tau_t + e_{c,t}$$

The explained variable $\rho_{c,t}$ is one of the two functional efficiency proxies defined above. The key explanatory variable is the PBL post-reform indicator $\delta^{XPBL}_{c,t}$ whose coefficient λ_2 quantifies difference in functional efficiencies associated with a difference in PBL. Collectively denoted $X^1_{c,t-1}$, the control variables are the log of national per capita GDP $\ln(pcGDP_{c,t})$, the log of national population $\ln(pop_{c,t})$, and the CRI change indicator $CRI_{c,t}$. Consistent with the tests in the prior tables, the first two controls are lagged by one year but $CRI_{c,t}$ is current. The model subsumes country and year fixed effects, denoted μ_c and τ_t, respectively.

Table 12 Panel A presents the summary statistics of all these country-year variables. The correlations of value-added with investment, $\rho_{(\ln VA_{c,t}\ ,\ \ln I_{c,t})}$ and $\rho^{rank}_{(VA_{c,t}\ ,\ I_{c,t})}$ are close to one. However, both functional efficiency proxies nonetheless exhibit substantial variation around their means. The summary statistics of the other variables are comparable to those of their industry-country-year analogs in Table 1.

Panel B summarizes these regressions, which show PBL reforms heralding statistically and economically significant increases in functional efficiency. The post-reform indicator $\delta^{XPBL}_{c,t}$ attracts a statistically significant and positive coefficient in either case. The 0.043-point estimate on the post-PBL reform indicator in regression 12B.1 implies an increase of over one-third of one standard deviation (0.112) of $\rho_{(\ln VA_{c,t}\ ,\ \ln I_{c,t})}$, the explained variable. The point estimate of $\delta^{XPBL}_{c,t}$ in regression 12B.2, which

[11] The related data, from Nicita and Olarreaga (2006), report value added and gross fixed capital formation for 28 manufacturing industries. Value added is defined as "the value of shipments of goods produced (output) minus the cost of intermediate goods and required services (but not including labor), with appropriate adjustments made for inventories of finished goods, work-in-progress, and raw materials". Gross fixed capital formation is used to proxy investment, which is defined as "the cost of new and used fixed assets minus the value of sales of used fixed assets, where fixed assets include land, buildings, and machinery and equipment".

explains the corresponding rank correlation, $\rho^{rank}_{(VA_{c,t}\ ,\ I_{c,t})}$, also indicates an economically significant effect, statistically significant at the 5% level.

To explore the timing of the above changes in more detail, we again follow Bertrand and Mullainathan (2003), denoting years in event time with t_c, the year in which country c implements its PBL reform, and examine seven subsequent time intervals captured by the indicator variables $\delta_{-4,c,t}$, $\delta_{-2,c,t}$, $\delta_{-1,c,t}$, $\delta_{0,c,t}$, $\delta_{1,c,t}$, $\delta_{2,c,t}$, and $\delta_{\geq 3c,t}$. For each country *c* with a PBL reform in year t_c, we drop observations more than four years before or after that year. Regressions 12B.3 and 12B.4 summarize regressions analogous to 12B.1 and 12B.2, but replacing the PBL reform indicators $\delta^{TPBL}_{c,t}$ and $\delta^{XPBL}_{c,t}$ with the seven time indicators above. These two allocative efficiency measures jump in the reform year, remain positive in the following years. **Figure 5** graphically summarizes the key takeaways: functional efficiency increases after PBL reforms.

6.2. PBL reform and productivity

Innovation is associated with productivity growth, the primary driver of sustained economic growth in developed economies (Aghion et al. 2021). Consequently, the policy relevance of PBL reforms includes its implications for productivity.

We focus on country-year-level TFP as a rough proxy for productivity growth. It is TFP at constant national prices (2011=1), provided by the World Bank database. Regressions predicting TFP spurts are at the country level, and only controls at the country level are included. **Table 13** summarizes these regressions. The post-reform indicator $\delta^{XPBL}_{i,c,t}$ attracts significantly positive coefficients in regressions 13.1 (without C*RI*) and 13.2 (with *CRI*), indicating a generally elevated incidence of productivity growth after PBL reforms. The coefficient on CRI is significantly negative, which is consistent with its sign when innovation measures are examined. The coefficient of $\delta^{XPBL}_{i,c,t}$ 0.02 in regression 13.2 indicates a 2% higher TFP after PBL reforms than the default.

To explore timing differences, we again follow Bertrand and Mullainathan (2003). Regression 13.3 replaces the reform indicator variables $\delta^{TPBL}_{c,t}$ and $\delta^{XPBL}_{c,t}$ in 13.2 with the seven indicator variables $\delta_{-4,c,t}$, $\delta_{-2,c,t}$, $\delta_{-1,c,t}$, $\delta_{0,c,t}$, $\delta_{1,c,t}$, $\delta_{2,c,t}$, and $\delta_{\geq 3c,t}$. For each country *c* with a PBL reform in year t_c, we drop observations more than four years before or after that year. Productivity spurts are evident the year after the reform and several years on. **Figure 6** graphically summarizes the key takeaway: TFP jumps after PBL reforms, and this does not reverse.

These results could reflect innovation spillovers rapidly spreading growth opportunities beyond the industries in which new technologies are actually implemented. One firm's innovation can elevate productivity in other sectors by reducing costs and increasing product quality in other industries in its supply chain (Forni and Paba, 2002) and by providing new solutions to old problems in entirely unrelated industries (Enkel and Gassmann, 2010).

7. Conclusion

Debtor-friendly personal bankruptcy law reforms ease insolvent individuals' access to discharges from their obligations. Difference-in-differences tests show such reforms to have four statistically and economically significant consequences. First, debtor-friendly PBL reforms increase innovation intensity measured by the number of new patents, subsequent citations, and new patenter débuts. Second, debtor-friendly PBL reforms reallocate innovation intensity across a country's industries to more closely resemble their distributions across U.S. industries, which we take as approximating innovation potential across industries. Third, debtor-friendly PBL reforms are particularly important in stimulating radical innovations.

Debtor-friendly PBL reforms direct innovative effort toward higher-potential industries only in firms without large accumulations of prior patents. Indeed, positive realignment is weakened markedly or turns negative in firms with large accumulations of prior patents (L firms). Consistent with prior work associating more radical innovation with entrants, further tests link debtor-friendly PBL reforms to increased radical patents. Also consistent with PBL reforms boosting innovation by entrants, our results are attenuated in countries that subject new corporations to minimum capital requirements, which can act as barriers to entry. Fourth, after PBL reforms, value-added growth spurts occur across diverse industries, not only those in which innovation intensifies, and investment becomes more functionally efficient (Tobin, 1984; Wurgler, 2000); that is, capital flows more reliably to higher value-added sectors.

A key limitation of our study is that it relies exclusively on USPTO patent data to proxy for innovation output across countries. By focusing on foreign firms that file patents in the U.S., we capture only a subset of innovative activity—typically larger, more successful, and better-financed firms with the capabilities and incentives to seek protection in a major foreign market—while underrepresenting purely domestic innovators and early-stage or small startups that do not patent abroad. As a result, our measures provide at best a partial and potentially selected view of how PBL reforms shape the overall innovation landscape in each country. Moreover, our analysis centers on "innovative firms" who patent, thereby abstracting from non-patenting forms of productive entrepreneurship, including ventures that leverage technology without seeking formal IP protection. Consequently, we are unable to speak to the impact of PBL reform on non-patent-based innovation. Future research combining domestic patent office data, business registry information, and survey-based measures of entrepreneurship would be valuable to assess the generalizability of our results beyond the subset of internationally patenting firms analyzed here.

Several public policy implications follow. First, policymakers seeking to boost innovation, especially innovation by entrants and more radical innovation, and to better direct innovative effort to industries with greater potential to stimulate economic growth and improve capital allocation efficiency, may wish to enact PBL reforms to give bankrupt individuals more lenient discharge conditions. Second, these policy consequences primarily arise from increased innovation by new or previously inconsequential innovators and can be frustrated by barriers to entry, such as minimum capital requirements. This makes sense because lenders to corporations established by entrants or run by initially small-scale innovators are more apt to require personal assets as collateral, as such firms' corporate assets often are insufficient alone. This is consistent with the harsh treatment of bankrupt individuals itself serving as a barrier to entry. Upstart innovators and radical innovations can disrupt established firms dependent on legacy technology, so established firms might be expected to oppose more debtor-friendly personal bankruptcy laws.

All the reforms in our data make PBL more debtor-friendly, and our results associate these reforms with more intense and accurately focused innovation. The social cost of more lenient PBL is lenders charging higher interest rates to compensate for larger bad loan write-offs. Presumably, an optimal leniency exists, beyond which the downsides of increased leniency to bankrupt individuals exceed the upsides. The recent trend in solely debtor-friendly reforms may reflect historical roots of bankruptcy law in an age when wealthy creditors held greater sway (Efrat, 2002) and before the large positive externalities of innovation (Jones and Summers, 2020) became salient.

Nonetheless, institutional momentum alone fails to explain the reluctance of post-socialist transition economies to offer bankruptcy protection to individuals. Under communism, all property belongs to the state, and no bankruptcy law exists. This condition persisted in many transition economies, especially as regards personal bankruptcy law. Absent personal bankruptcy law, debtors are in breach of contract until their debts are fully repaid, and extrajudicial (often criminal) actors arise to force debtors to repay their debts or to force creditors to declare unrepaid debts repaid (e.g. Austin and Lin, 2021, p. 83 94; Kilborn, 2016, p. 688). The Russian Federation lacked any PBL until 2015, repeated attempts having been defeated, neutralized, or deferred (Kilborn, 2016). China, despite much discussion, still had no national-level personal bankruptcy law in 2025, though Taizhou, Wenzhou, and Shenzhen enacted city-level personal bankruptcy laws in 2019, 2019, and 2021, respectively (Austin and Lin, 2021).

China's Supreme People's Court also publicly lists bankrupt individuals under the categories of "Dishonest Persons Subject to Enforcement Proceedings" and "Persons Subject to Restrictions on High Consumption", which limit their travel, spending, and general prospects. McMorrow, Ding, and Liu (2025), noting that some eighty percent of Chinese venture capital financing providers, many of which are state-owned enterprises, require entrepreneurs' personal debt guarantees, describe initially unlucky high-tech entrepreneurs lingering on these lists and unable to try again, as ultimately successful U.S. entrepreneurs frequently do (Baird and Morrison, 2005; Stam, Audretsch, and Meijaard, 2008; Lee et al., 2011; Fossen, 2014; Jia, 2015). Wei (2025) warns that "tens of thousands of entrepreneurs may face over 100 million yuan in repurchase obligations" and concludes that, with no personal bankruptcy law, entrepreneurship in China is a "game of unlimited liability." McMorrow et al. (2025) describe "harm to the venture ecosystem because if a start-up fails, the founder is essentially facing asset seizures and spending restrictions …They can never recover."

Inattention to personal bankruptcy laws in transition economies aligns with an overarching concern for the stability of existing and former state-owned enterprises rather than entrepreneurial entrants, which proved ultimately more important. On this, McMillan and Woodruff (2003, p. 153) remark, "It is not surprising that those who had spent their lives under central planning did not foresee the impact of entrepreneurship, but few analysts from the West predicted it either." Public policymakers' intent on fostering new sources of growth, jobs, and tax revenues in such economies might consider debtor-friendly personal bankruptcy laws. We welcome further research into these issues.

References

Acharya, V., & Subramanian, K., 2009. Bankruptcy codes and innovation. Review of Financial Studies 22, 4949–4988.

Acs, Z., & Audretsch, D., 1988. Innovation in large and small firms: An empirical analysis. American Economic Review 78 (4), 678–690.

Aghion, P., & Howitt, P., 1992. A model of growth through creative destruction. Econometrica 60 (2), 323–351.

Aghion, P., Antonin, C., & Bunel, S., 2021. The power of creative destruction. In The Power of Creative Destruction. Harvard University Press.

Aghion, P., Akcigit, U., & Howitt, P., 2015. The Schumpeterian growth paradigm. Annual review of economics, 7(1), 557–575.

Alder, B., Polak, B., & Schwartz, A., 2000. Regulating consumer bankruptcy: A theoretical inquiry. Journal of Legal Studies 29 (2), 585–613.

Armour, J., & Cumming, D., 2008. Bankruptcy law and entrepreneurship. American Law and Economics Review 10 (2), 303–350.

Audretsch, D., 1995. Innovation and Industry Evolution, Cambridge, MA. MIT Press.

Austin, D. A., & Lin, C. T., 2021. Personal bankruptcy in the middle kingdom: China's local pilot programs & half of bankruptcy system. American Bankruptcy Law Journal 95 (1), 81–126.

Avery, R., Bostic, R., & Samolyk, K., 1998. The role of personal wealth in small business finance. Journal of Banking & Finance 22, 1019–1061.

Ayotte, K., 2007. Bankruptcy and entrepreneurship: The value of a fresh start. Journal of Law, Economics, and Organization 23, 161–185.

Baird, D., & Morrison, E., 2005. Serial entrepreneurs and small business bankruptcies. Columbia Law Review 105, 2310–2368.

Balsmeier, B., Fleming, L., & Manso, G., 2017. Independent boards and innovation. Journal of Financial Economics 123 (3), 536–557.

Belenzon, S., & Berkovitz, T., 2010. Innovation in business groups. Management Science 56 (3), 519–535.

Barrier, M., 2007. The Animated Man: A Life of Walt Disney. UCLA Press.

Beck, T. & Levine, R., 2005. Legal institutions and financial development. Handbook of New Institutional Economics. Springer, Boston, 251–278.

Bekaert, G., Harvey, C., & Lundblad, C., 2005. Does financial liberalization spur growth? Journal of Financial Economics 77, 3–55.

Bena, J., & Li, K., 2014. Corporate innovations and mergers and acquisitions. Journal of Finance 69, 1923–1960.

Berkowitz, J., & White, M., 2004. Bankruptcy and small firms' access to credit. RAND Journal of Economics

35, 69–84.
Bertrand, M., & Mullainathan, S., 2003. Enjoying the quiet life? Corporate governance and managerial preferences. Journal of Political Economy 111, 1043–1075.
Bhidé, A., 2024. Uncertainty and Enterprise. Oxford University Press.
Bloom, N., Schankerman, M., & Van Reenen, J., 2013. Identifying technology spillovers and product market rivalry. Econometrica 81 (4), 1347–1393.
Brijs, S., Jacmain, S., De Smet, K., & Van Hoe, A., 2018. Het nieuwe faillissementsrecht (The New Bankruptcy Law). R.D.C.-T.B.H., 2018 (3), 255–265.
Brown, J., Martinsson, G., & Petersen, B., 2013. Law, stock markets, and innovation. Journal of Finance 68, 1517–1549.
Cerqueiro, G., & Penas, M., 2017. How does personal bankruptcy law affect startups? Review of Financial Studies 30 (7), 2523–2554.
Cohen, W., Nelson, R., & Walsh, J., 1996. Appropriability conditions and why firms patent and why they do not in the American manufacturing sector. Paper presented at the OECD Conference on New Indicators for the Knowledge-Based Economy.
Cohn, J., Liu, Z., & Wardlaw, M., 2022. Count (and count-like) data in finance. Journal of Financial Economics, 146 (2), 529–551.
Coleman S., & Robb, A., 2009. A comparison of new firm financing by gender: Evidence from the Kauffman Firm Survey. Small Business Economics, 33, 397–411.
Cosh, A., Cumming, D., & Hughes, A., 2009. Outside entrepreneurial capital. Economic Journal 119, 1494–1533.
Cumming, D., & Zhang, M., 2023. Bankruptcy law and angel investors around the world. Journal of International Business Studies 54, 1256–1277.
Dal Bó, E., 2006. Regulatory Capture: A Review. Reviews how firms influence regulatory outcomes. Oxford Review of Economic Policy, 22(2), 203–225.
Di Martino, P., 2008. The historical evolution of bankruptcy law in England, the US and Italy up to 1939: Determinants of institutional change and structural differences. Södertörns Bögskola Working Paper. https://www.diva-portal.org/smash/get/diva2:213033/FULLTEXT01.pdf
Djankov, S., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. 2002. The regulation of entry. Quarterly Journal of Economics 117 (1), 1–37.
Ederer, F., & Manso, G., 2011. Incentives for innovation: Bankruptcy, corporate governance, and compensation system. In R. E. Litan (Ed.), Handbook on Law, Innovation and Growth. Edward Elgar.
Ederer, F., & Manso, G., 2013. Is pay-for-performance detrimental to innovation? Management Science 59 (7), 1496–1513.
Efrat, R., 1999. The Fresh-Start Policy in Bankruptcy in Modern Day Israel. American Bankruptcy Institute Law Review, 7 (2).
Efrat, R., 2000. The Transformation of the Israeli Bankruptcy System as a Reflection of Societal Changes. Florida State University Journal of Transnational Law & Policy, 10(1), Article 2.
Efrat, R., 2002. Global trends in personal bankruptcy. American Bankruptcy Law Journal 76 (1), 81–110.
Enkel, E., & Gassmann, O. 2010. Creative imitation: Exploring the case of cross-industry innovation. R&D Management 40 (3), 256–270.

Faccio, M., & McConnell. J. J., 2020. Impediments to the Schumpeterian process in the replacement of large firms. NBER Working Paper No. 27871.

Fan, W., & White, M., 2003. Personal bankruptcy and the level of entrepreneurial activity. Journal of Law and Economics 46, 543–568.

Feenstra, R., Romalis, J., & Schott, P., 2002. US imports, exports, and tariff data, 1989-2001, NBER Working Paper No. 9387.

Fogel, K., Morck, R., & Yeung, B., 2008. Big business stability and economic growth: Is what's good for General Motors good for America? Journal of Financial Economics 89 (1), 83–108.

Forni, M., & Paba, S. 2002. Spillovers and the growth of local industries. Journal of Industrial Economics 50(2), 151–171.

Fossen, F., 2014. Personal bankruptcy law, wealth, and entrepreneurship—Evidence from the introduction of a "fresh start" policy. American Law and Economics Review 16 (1), 269–312.

Frouté, P., 2007. Theoretical foundation for a debtor friendly bankruptcy law in favour of creditors. European Journal of Law and Economics 24, 201–214.

Gala, V., Kirshner, J., & Volpin, P., 2013. The political economy of personal bankruptcy law. Working Paper. Available at SSRN: https://ssrn.com/abstract=2359591.

Garcia-Macia, D., Hsieh, C., & Klenow, P., 2019. How destructive is innovation? Econometrica 87 (5), 1507–1541.

Georgakopoulos, N., 2002. Bankruptcy law for productivity. Wake Forest Law Review 37, 51–95.

Griffith, R., & Macartney, G., 2014. Employment protection legislation, multinational firms, and innovation. Review of Economics and Statistics 96, 135–150.

Hall, B., Jaffe, A., & Trajtenberg, M., 2001. The NBER patent citation data file: Lessons, insights and methodological tools. NBER Working Paper No. w8498.

Heuer, J., 2014. Rules and Norms of Consumer Insolvency and Debt Relief: A Comparison and Classification of Personal Bankruptcy Systems in 15 Economically Advanced Countries. PhD Dissertation, University of Bremen.

Hill, M., Kelly, G., Lockhart, G., & Van Ness, R., 2013. Determinants and Effects of Corporate Lobbying. Empirical evidence on firm political influence. Financial Management, 42(4), 931-957.

Hirabayashi, J., 2003. Revisiting the USPTO concordance between the U.S. patent classification and the Standard Industrial Classification Systems. Working Paper (USPTO).

Hirshleifer, D., Low, A., & Teoh, S., 2012. Are overconfident CEOs better innovators? Journal of Finance 67, 1457–1498.

Hsu, P., Tian, X., & Xu, Y., 2014. Financial development and innovation: Cross-country evidence. Journal of Financial Economics 112 (1), 116–135.

Jackson, T., 1985. The fresh-start policy in bankruptcy law. Harvard Law Review 98, 1393–1448.

Jia, Y. G., 2015. The impact of personal bankruptcy law on entrepreneurship. Canadian Journal of Economics 48, 464–493.

Jones, B., & Summers, L., 2020. A Calculation of the Social Returns to Innovation. NBER Chapters, in: Innovation and Public Policy, pages 13-59, National Bureau of Economic Research, Inc.

Karpoff, J., & Wittry, M., 2018. Institutional and legal context in natural experiments: The case of state antitakeover laws. Journal of Finance 73(2):657-714.

Kautonen, T., Down, S., & Welter, F., 2011. Involuntary entrepreneurship. World Encyclopedia of Entrepreneurship. Edward Elgar Publishing.

Kilborn, J., 2016. Treating the new European disease of consumer debt in a post-communist state: The groundbreaking new Russian Personal Insolvency Law. Brooklyn Journal of International Law 41 (2), 656-719.

King, R., & Levine, R., 1993. Finance and growth: Schumpeter might be right. Quarterly Journal of Economics 108 (3), 717–737.

Kiranyaz, S., Avci, O., Abdeljaber, O., Ince, T., Gabbouj, M., & Inman, D., 2021. 1D convolutional neural networks and applications: A survey. Mechanical systems and signal processing 1, 151:107398.

Klenow, P., & Rodriquez-Clare, A., 1997. Economic growth: A review essay. Journal of Monetary Economics 40, 597–617.

Knott, A., & Vieregger, C., 2020. Reconciling the firm size and innovation puzzle. Organization Science 31 (2), 245–534.

Koellinger, P., Minniti, M., & Schade, C., 2007. I think I can, I think I can: Overconfidence and entrepreneurial behavior. Journal of economic psychology 28(4):502-27.

La Porta, R., Lopez-de-Silanes, F., & Shleifer, A., 2008. The economic consequences of legal origins. Journal of Economic Literature 46 (2), 285–332.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R., 1998. Law and finance. Journal of Political Economy 106 (6), 1113–1155.

Landier, A., & Thesmar, D., 2008. Financial contracting with optimistic entrepreneurs. Review of Financial Studies 22(1):117-50.

Landier, A., 2005. Entrepreneurship and the Stigma of Failure. Available at SSRN: https://ssrn.com/abstract=850446.

Lee, S., Yamakawa, Y., Peng, M., & Barney, J., 2011. How do bankruptcy laws affect entrepreneurship development around the world? Journal of Business Venturing 26 (5), 505–520.

Liang, J., 2018. The Demographics of Innovation, Wiley.

Mann, R., 1998. Comment on Avery, Bostic & Samolyk. Journal of Banking & Finance, 22,1062-1066.

McMillan, J., & Woodruff, C., 2003. The central role of entrepreneurs in transition economies. Journal of economic Perspectives 16 (3), 153-70.

McMorrow, R., Ding, W., & Liu, N., 2025. Chinese venture capitalists force failed founders on to debtor blacklist. Financial Times, January 5, 2025.

Mills, K., 2018. Fintech, small business and the American dream: How technology is transforming lending and shaping a new era of small business opportunity, 1st ed. Palgrave Macmillan.

Moon, J., 2009. Small business finance and personal assets. Community Investments 21 (3), 1.

Moshirian, F., Tian, X., Zhang, B., & Zhang, W., 2021. Stock market liberalization and innovation. Journal of Financial Economics, 139 (3), 985–1014.

Nica, M., 2019. The relationship between self-employment and economic development. Southwestern Economic Review 46, 59–85.

Nicita, A., & Olarreaga, M., 2006. Trade, production and protection: 1976–2004. World Bank Economic Review 21 (1), 165–171.

Niemeijer, E., 2000. Problematische schuldsituaties: van faillissement naar schuldsanering van natuurlijke

personen. Justitiële Verkenningen, 2, 31–44.
Rajan, R., & Zingales, L., 1998. Financial dependence and growth. American Economic Review 88, 559–586.
Robb, A., & Robinson, D., 2014. The capital structure decisions of new firms. Review of Financial Studies, 27 (1), 153–179
Rosokha, Y., & Younge, K., 2020. Motivating innovation: The effect of loss aversion on the willingness to persist. Review of Economics and Statistics 102(3):569-82.
Shiller, R., 2000. Irrational Exuberance. Princeton University Press.
Schumpeter, J., 1911. Theorie der wirtschaftlichen Entwicklung. Duncker & Humblot.
Schumpeter, J., 1942. Capitalism, socialism, and democracy. Routledge.
Silva, J., & Tenreyro, S., 2010. On the existence of the maximum likelihood estimates in Poisson regression. Economics Letters, 107 (2), 310–312.
Silva, J., & Tenreyro, S., 2011. Poisson: Some convergence issues. The Stata Journal, 11 (2), 207–212.
Small Business Credit Survey. 2019. Report on Employer Firms. Federal Reserve.
Small Business Credit Survey. 2019. Report on Non-employer Firms. Federal Reserve.
Stam, E., Audretsch, D., & Meijaard, J., 2008. Renascent entrepreneurship: Entrepreneurial preferences subsequent to firm exit. Journal of Evolutionary Economics 18 (3), 493–507.
Stiglitz, J., & Weiss, A., 1981. Credit rationing in markets with imperfect information. The American Economic Review, 71(3), 393–410.
Svirydzenka, K., 2016. Introducing a new broad-based index of financial development. IMF Working Paper No. 1605.
Tan, L., 2001. The Bankruptcy Act 1995 and the Bankruptcy Rules 1995: A New Regime in Singapore Insolvency Law.
Tham, W., Baslandze, S., Sojli, E., & Liu, L., 2026. Foundational processes and growth. Journal of Financial Economics, 180, 104276. https://doi.org/10.1016/j.jfineco.2026.104276.
Tobin, J., 1984. On the efficiency of the financial system. Lloyds Bank Annual Review, (153), 1–15.
Wei, Z., 2025. Venture capital - private equity fund repurchase and exit analysis report. Lifeng Partners Law Firm, Shanghai.
Wessels, B., 2000. Kan een niet te goeder trouw zijnde debiteur tot de wettelijke schuldsanering worden toegelaten? Nederlands Juristenblad, 36, 1778–1784.
White, M., 2005. A general model of personal bankruptcy: Insurance, work effort, and opportunism. Working Paper presented at 2005 ALEA Meeting.
Wilson, C., 2021. The Story of Lulu Lemon, 2nd ed. Time Is Tight Books.
Winter, S., 1984. Schumpeterian competition in alternative technological regimes. Journal of Economic Behavior & Organization, 5(3–4), 287–320.
Wurgler, J., 2000. Financial markets and the allocation of capital. Journal of Financial Economics 58 (1–2), 187–214.
Xie, F., Zhang, B., & Zhang, W., 2021. Trust, incomplete contracting, and corporate innovation. Management Science 68 (5), 3419–3443.

Appendix A. Data description

Table A1. Variable definitions

Variable	Definition
Explained variables: Innovation intensity measures	
$patents_{i,c,t}$	Number of successful (i.e., later granted) new patent applications filed at USPTO in industry i in country c in year t. New filings by firms initially holding over 500 patents are excluded.
$cites_{i,c,t}$	Number citations in all subsequent (through to 2016) USPTO patent filing of successful new patent applications filed at USPTO in industry i in country c in year t. Citations of new filings by firms initially holding over 500 patents are excluded.
$débuts_{i,c,t}$	Number of successful patent applications at USPTO by firms in industry i in country c in year t that filed no patents in any previous year.
Variables of interest: PBL reform indicators and industry innovation potential	
$\delta_{c,t}^{XPBL}$	PBL post-reform indicator. Set to one for country c with PBL reform in year t_c in years $t \geq t_c$ and to zero otherwise. Zero throughout for countries without PBL reforms.
$\delta_{c,t}^{TPBL}$	PBL transition period reform indicator. Set to one for country c with PBL reform in year t_c in years $t_c - 2$ and $t_c - 1$ and to zero otherwise. Zero throughout for countries without PBL reforms.
$pot_{i,t}$	Industry innovation potential. Natural log of U.S. firms' mean industry i year t patent count
Control variables	
$CRI_{c,t}$	Creditor rights index change. Measures the change in strength of creditor rights in corporate bankruptcy law in country c in year t. From Acharya and Subramanian (2009).
$exports_{i,c,t}$	Industry export intensity. Value of exports to the U.S. by industry i in country c in year t over total value exports to U.S. by all industries in that country that year.
$imports_{i,c,t}$	Industry import intensity Value of imports from the U.S. by industry i in country c in year t over value of total imports to U.S. by all industries in that country that year.
$value\text{-}added_{i,c,t}$	Industry value added. Value-added, sales revenue minus costs of inputs excluding capital, of industry i in country c in year t over value-added of all industries in that country that year.
$\ln(pop_{c,t})$	Country size. Natural log of population of country c in yea t.
$\ln(pcGDP_{c,t})$	Country prosperity. Natural log of GDP per capita of country c in year t.

Table A2. Detailed information about personal bankruptcy law reforms

Panel A of this table summarizes detailed information and references about personal bankruptcy law reforms from 1990 to 2002 for all the 18 event economies in our sample. If the personal bankruptcy law came into effect in the 1st half of the calendar year, we code the reform year as the current calendar year; if the law came into effect in the 2nd half of the calendar year, we code the reform year as the next calendar year, following Cumming and Zhang (2023). Panel B groups event economies by reform intensity.

Panel A. Personal bankruptcy law (PBL) Reform remarks and reference

Economy	Year	Description of reform and sources
Argentina	1996	Enacted in August 1995, Law 24,522 (Ley de Concursos y Quiebras) replaced the previous Law 19,551. While it aimed to modernize the system, it included several provisions that were notably more "debtor-friendly" than the previous regime, particularly for individuals (personas físicas). This law replaced older bankruptcy legislation and unified procedures for both commercial and individual debtors. It came into force on 1 January 1996, according to its final provisions, which gave courts and creditors time to adjust to the new regime. For individual debtors, Law 24.522 allows a discharge (quiebra del deudor) only after the completion of the bankruptcy process. The law does not specify a fixed “automatic discharge period” In practice, the duration until discharge depends on the complexity of the debtor’s estate, the number of creditors and the judicial delays. Typical cases for individual bankruptcy lasted 3–5 years, but this was case-by-case, not statutory. See https://ally-law.com/restructuring-and-insolvency-guide-argentina/ and https://servicios.infoleg.gob.ar/infolegInternet/anexos/25000-29999/25379/texact.htm for more details.
Australia	1997	The Bankruptcy Legislation Amendment Act 1996 (No. 44, 1996) is one of the most significant pieces of legislation in Australian insolvency history. It officially shifted the legal focus from punishing "bankrupts" to facilitating a "fresh start" for debtors. The majority of the Act, including the landmark Part IX Debt Agreement provisions and Schedule 1 (which contained most of the substantive amendments), came into force on December 16, 1996. The 1996 Act was the legislative realization of the "Harmer Report" (ALRC Report 45), which argued that the bankruptcy system should be more humane and economically productive. The 1996 amendment was a key milestone in introducing a more flexible and debtor-oriented component into Australia’s personal insolvency law. The standard automatic discharge period for formal bankruptcy remained 3 years and one day. Debtor-friendliness came from avoiding bankruptcy altogether, not from faster discharge. See Federal Register of Legislation (https://www.legislation.gov.au/), Heuer (2014), and https://www.aph.gov.au/-/media/Committees/Senate/committee/scrutiny/alerts/1999-1982/Digests_1996.pdf for more details.
Austria	1995	The 1993 amendment to the insolvency / bankruptcy law explicitly introduced a judicial debt-adjustment procedure for private persons. This amendment entered into force on 1 January 1995. Before 1995, Austrian insolvency law (originally based on earlier bankruptcy statutes) did not explicitly provide a formal judicial route for many private individuals (consumers) to obtain a discharge of debts (i.e. “fresh-start” bankruptcy). The 1995 reform was motivated by the need to give indebted private persons a realistic legal path to debt relief and a second chance - previously, many people remained burdened by lifelong debts. 1995 marks a major milestone: for the first time, Austrian law formally allowed private persons (not only companies) to go through judicial insolvency and - if conditions were met - emerge with a debt discharge. Under the 1995 reform of personal bankruptcy (consumer insolvency) in Austria, the standard discharge period (i.e. the length of time over which a debtor must follow the repayment / income-attachment plan before getting a discharge of residual debt) was up to 7 years. See Heuer (2014), https://www.schoenherr.eu/content/austria-major-changes-in-personal-bankruptcy-law and https://www.brennecke-rechtsanwaelte.de/Insolvenzrecht-und-Restschuldbefreiung-in-Europa-Teil-11-Oesterreich-Teil-1_177425 for more details.
Belgium	1999	The key reform is Law of 5 July 1998 on collective debt settlement and the possibility of sale by agreement of seized real estate. This law responds to the problem of “over-indebtedness” for private individuals in Belgium - people who cannot meet their financial obligations and are unable to repay their debts in a sustainable way. Its purpose is to provide a legal framework so that such persons can reorganise their debts and (potentially) obtain debt relief, while preserving a dignified standard of living. The law entered into force on 1 January 1999 (six months after publication) for new applications.

		The 1998 reform provided a debt-relief option for “ordinary” people (employees, retirees, those without ongoing business), not businesses. Under the 1998 Belgian personal-bankruptcy / collective-debt-settlement reform, the discharge period corresponds to the length of the judicial repayment plan. A judicial debt-settlement plan must last at least 3 years and it cannot exceed 5 years. After successful completion of this 3–5-year plan, the court may grant a partial remission of remaining debts, meaning the debtor receives debt discharge (with some exceptions, such as alimony). See Belgian Federal Public Service Social Security website, Heuer (2014), Brijs et al. (2018) and https://www.famipedia.be/fr/regulations/administrative-instructions/information-notes/1999_03_00.html for more details.
Canada	1993	The reform came through Bill C-22, which amended the Bankruptcy and Insolvency Act (BIA). It received Royal Assent in 1992 and came into force on 15 December 1992, but in Canadian practice it is widely referred to as the 1993 bankruptcy reform, because that is when its effects were first fully felt. The 1993 reform was one of the most significant modernizations of Canadian consumer insolvency law. It transformed the system from being mainly business-oriented to one that also addressed consumer over-indebtedness in a structured and humane way. Key objectives of the reform were: to better balance rights of creditors and debtors; allow reorganizations instead of immediate bankruptcies; and make the law simpler, more efficient and more accessible. The “1993 reform” (i.e. 1992 amendments coming in force) is widely regarded as a turning point for Canadian personal insolvency law, making it more modern and debtor-friendly. Under the Bankruptcy and Insolvency Act (BIA) — including after the 1993-era reform (via Bill C-22) - the discharge period for a personal bankruptcy in Canada depends on a few factors (first-time vs repeat bankruptcy, whether there is “surplus income,” and whether anyone objects). It ranges from 9 months to 24 months. See the Bankruptcy and Insolvency Act in Canada, https://sencanada.ca/content/sen/committee/372/bank/rep/bankruptcy-e.pdf and https://laws-lois.justice.gc.ca/eng/acts/b-3/page-26.html for more details.
Finland	1993	In 1993 Finland adopted a new statute for private debt-adjustment: Act on the Adjustment of the Debts of a Private Individual, which entered into force on 8 February 1993. The 1993 DAA established for the first time a formal, court-based legal pathway for private individuals with unsustainable debts (not companies) to restructure and, under certain conditions, be released from remaining debts. The DAA gave private individuals - not just businesses - a formal, judicial debt-restructuring and discharge mechanism. Before 1993, there was no modern, unified legal framework for personal insolvency in Finland. Under Finland’s 1993 law, debt discharge - for those who complete the scheme - typically comes after 3 to 5 years of repayment under court-approved plan, possibly longer if the debtor keeps their home or has private-creditor debts with extended payment period. See https://e-justice.europa.eu/topics/money-monetary-claims/insolvency-bankruptcy/fi_en, Heuer (2014), and https://www.oikeuspalveluvirasto.fi/app/uploads/sites/2/2025/03/Yksityishenk_velkajarjestely_A4_EN_PRINT.pdf for more details.
France	1999	The Law on the Fight Against Social Exclusion (Loi d'orientation relative à la lutte contre les exclusions) of 29 July 1998 is considered the most radical "debtor-friendly" shift: for the first time, it allowed for the partial write-off (effacement partiel) of debts if the debtor's situation was so dire that they could not repay the full principal even with a 10-year extension. It introduced a mandatory two-year stay of execution (moratoire). A commission could freeze all debt repayments and interest for up to two years to give the debtor time to find a job or improve their situation, without being evicted or harassed by bailiffs. The law did not set a fixed statutory “discharge period” in the same sense that modern personal bankruptcy laws (e.g., U.S. Chapter 7/13 discharge periods) do; instead it set a maximum moratorium duration of three years during which debt enforcement could be suspended. After that moratorium, if insolvency persisted, the commission could recommend partial or full debt write-off, which is functionally similar to discharge, but the law did not require debtors to wait beyond that three-year suspension before relief could be granted. See https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000000206894, Heuer (2014), and https://www.banque-france.fr/en/publications-and-statistics/statistiques/france-30-years-fighting-overindebtedness for more details.
Germany	1999	Personal Bankruptcy Reform of 1999 was implemented through amendments to the Insolvenzordnung (InsO, Insolvency Code), which originally came into force on 1 January 1999. It consolidated and modernized insolvency law for both businesses and private individuals. Prior to this, Germany had limited consumer insolvency options; individuals often had to file through civil bankruptcy (Privatkonkurs), which was cumbersome and inconsistent. The main goals were to provide a “fresh start” for over-indebted individuals, simplify and standardize insolvency procedures for private

		persons, integrate consumer insolvency into the general insolvency framework rather than maintaining a separate, restrictive civil bankruptcy system and align Germany with European trends in consumer insolvency law. The InsO aimed to balance two goals: fair, collective satisfaction of creditors (creditors get their share, proportionally), and at the same time offer over-indebted individuals a second chance via discharge — to avoid indefinite debt slavery and social exclusion. Under the 1999 German reform, discharge of unsecured debts occurs after a 6-year good-conduct period, with limited possibilities for early discharge (typically 5 years). See https://e-justice.europa.eu/topics/money-monetary-claims/insolvency-bankruptcy/de_en, Heuer (2014), and https://aei.pitt.edu/11336/1/1887.pdf for more details.
Hong Kong	1998	Bankruptcy (Amendment) Ordinance 1996 (which came into force in Hong Kong on 1 April 1998) counts as a major reform affecting personal bankruptcy. The Amendment modernized and simplified bankruptcy law, making it more accessible, less punitive, and more structured for both individuals and small debtors. Under the new regime, a first-time bankrupt in Hong Kong will be automatically discharged after 4 years from the date of the bankruptcy order, unless a trustee or creditor lodges a valid objection. If an objection is raised (and upheld by court/trustee), the discharge period can be extended, the maximum total bankruptcy period is 8 years. This is a major shift from the prior regime: before the reform, a bankrupt might remain bankrupt for life - discharge was not automatic and depended on a successful court application, which was rare. See Legislative Council of Hong Kong, https://www.legco.gov.hk/yr98-99/english/counmtg/hansard/980930fe.htm and https://www.legco.gov.hk/yr97-98/english/hc/papers/h2301820.htm for more details.
Israel	1996	The 1996 reform is widely regarded as the first ideological shift in Israel's insolvency law: it opened access and lowered thresholds, and marked a recognition that personal insolvency and "fresh start" deserve a place in law and practice, a landmark change that shifted the legal framework toward a more debtor-friendly system. The Bankruptcy Law (Amendment), 1996 introduced several important changes for personal bankruptcy: Fresh-Start Policy, Streamlined Filing and Discharge Process, Debtor-Friendly Procedures, Voluntary Arrangements / Restructuring and Legal Recognition of Low-Asset Debtors. Under the 1996 Israeli personal bankruptcy reform, the discharge period for eligible individuals was significantly shortened compared to the prior system. The minimum discharge period was six months, making the 1996 law much more debtor-friendly and aligned with a "fresh-start" philosophy. The reform introduced a more structured and time-bound framework for personal bankruptcy. Key changes included: Defined procedural steps for debtors and creditors. Court-supervised repayment plans became more formalized. Time-bound discharge for first-time, honest bankrupts was introduced: Typical duration for discharge: 3 - 5 years, depending on the debtor's cooperation and repayment capacity. Repeat bankrupts or those found guilty of misconduct could face longer periods or denial. Clearer criteria for assessing debtor conduct and eligibility for discharge.See Efrat (1999, 2000) and the Bankruptcy Ordinance 1996 for more details.
Japan	2001	In 1999, Japan abolished the old Wagi Law (an outdated voluntary composition procedure that offered limited options for struggling debtors and did little to facilitate true debt restructuring) and instead adopted the Civil Rehabilitation Law (Minji Saisei Ho). Alongside the Civil Rehabilitation Law, the Diet enacted special provisions specifically for individual debtors - often referred to as small-scale civil rehabilitation and salary earner rehabilitation procedures. The Individual Rehabilitation (Kojin Saisei) procedures within the Civil Rehabilitation Act (CRA), which became effective in April 2001. It gave individual debtors (including those with steady income) access to restructuring plans that could reduce overall debt and set more manageable payment schedules - as an alternative to straight bankruptcy. It helped introduce debtor-in-possession (DIP) concepts similar to U.S. systems (allowing debtors more control during restructuring), which was a significant shift from prior procedures that favored liquidation. Under Japan's Civil Rehabilitation Law (1999) for individuals, the typical discharge period depended on the court-approved repayment plan and the debtor's cooperation: Court-supervised repayment plan: Usually 3 to 5 years. The debtor made payments based on a realistic budget of income and expenses over this period.See Hara, (1995, 2000), https://www.courts.go.jp/english/judicial_sys/qa_on_Civil_Procedure/index.html and https://www.daiichi.gr.jp/publication/makieya/p-2001s/p-01 for more details.
Mexico	2000	The Ley de Concursos Mercantiles was enacted on 12 May 2000, replacing older bankruptcy rules and providing a new commercial insolvency regime largely focused on businesses (including merchant individuals). The 2000 reform was a major, modernizing, and debtor-oriented law, providing structured pathways for conciliation, debt restructuring, and potential business rescue. The most significant change was the move in legal philosophy from a creditor-driven liquidation model to a debtor-friendly rehabilitation model. Under Mexico's Ley de Concursos Mercantiles (2000), there is no fixed "discharge

		period" for debts in the way modern consumer bankruptcy laws provide. It depends on the terms of the repayment plan agreed upon between the debtor and creditors and approved by the court. The court can adjust the plan duration based on debtor circumstances and creditor input, but it usually falls within the 3–5 year range. See https://globalrestructuringreview.com/review/restructuring-review-of-the-americas-archived/2020/article/mexico and https://www.financierworldwide.com/basic-overview-of-in-court-reorganisation-in-mexico#:~:text=The%20conciliation%20phase%20(and%2C%20indeed,is%20approved%20by%20the%20Court for more details.
New Zealand	2001	The Insolvency Act 2000 in New Zealand (effective 2000) represents a major, debtor-friendly personal bankruptcy reform in the 1990–2002 period. It reduced discharge time, simplified procedures, and introduced mechanisms like personal insolvency agreements to help debtors regain financial stability more quickly. The Bankruptcy Amendment Act 2000 in New Zealand came into force on 1 July 2000. The amendments made bankruptcy less punitive, allowed debtors to recover more quickly, and clarified their rights, marking an incremental but meaningful shift toward a more debtor-friendly system. This three-year automatic discharge was considered more debtor-friendly compared to the previous regime under the 1967 Bankruptcy Act, which could involve longer periods (typically five years) and less predictable outcomes. See Legislation New Zealand, Ministry of Justice of New Zealand and https://www.parliament.nz/en/pb/bills-and-laws/bills-proposed-laws/document/BILL_4236_bankruptcy-amendment-bill-1996 for more details.
Netherlands	1999	As of 1 December 1998, the WSNP came into force, added as a new third main procedure under the Faillissementswet (Bankruptcy Act) for natural persons. WSNP was designed specifically to give individuals (consumers, sole proprietors, small-business owners) a realistic path to restructure their debts - under court supervision - and eventually be released from remaining debts, rather than being stuck indefinitely or facing harsh asset liquidation. For the first time the Dutch law recognized that ordinary individuals (not just businesses) might need a socially just, legally regulated "fresh start". WSNP formalised that idea. Under the original WSNP regime, the typical payment and good-conduct plan for debtors lasted 3 years. At the end of those three years, remaining debts could be discharged. See Niemeijer (2000), Wessels (2000), https://business.gov.nl/regulations/debt-restructuring/ and https://boutadvocaten.nl/en/areas-of-law/debt-restructuring/ for more details.
Norway	1993	Norway introduced a special debt-relief regime for individuals by enacting the Debt Settlement Act in 1992, which entered into force in January 1993. This law created a formal judicial pathway for over-indebted natural persons to reorganise and reduce their debts and is widely recognised in comparative studies as one of the early consumer insolvency/debt relief laws in Europe. This Act was a direct response to the severe economic and debt crisis Norway experienced in the late 1980s and early 1990s following the deregulation of credit markets. It fundamentally changed the legal landscape by giving individuals a mechanism for a "fresh start" outside of the traditional, punitive bankruptcy system. Under Norway's Debt Settlement Act (gjeldsordningsloven), the standard debt settlement / repayment plan period — after which the remaining unsecured debts may be discharged — is typically five years. During this period the debtor makes payments according to a court-approved plan, and if the arrangement is successfully completed, any remaining eligible debt is cancelled. See https://www.imf.org/external/pubs/ft/scr/2012/cr12214.pdf, Heuer (2014), and https://www.brreg.no/en/searching-our-registers/announcements/about-announcements/announcements-from-the-register-of-mortgaged-moveable-property/opening-of-debt-settlement-proceedings-and-debt-settlements/ for more details.
Singapore	1996	The Bankruptcy Act 1995, which came into force on July 15, 1995, was the major reform that made Singapore's personal insolvency law substantially more debtor-friendly by introducing the concept of an administrative discharge and setting a more reasonable minimum debt threshold. The Act did not provide an automatic, fixed discharge period for bankrupt individuals. Discharge was granted at the court's discretion. Typically, a bankrupt individual could apply for discharge after 3 years, but the court could extend the period up to 15 years if the bankrupt was non-compliant or had engaged in misconduct. See Tan (2001), Singapore Statutes Online: Bankruptcy Act (Cap. 20) & Bankruptcy and Insolvency (Amendment) Act 2000 and https://sso.agc.gov.sg/ for more details.
Sweden	1995	The Debt Adjustment Act (Skuldsaneringslagen) came into force on 1 July 1994, introducing a statutory three-stage debt adjustment procedure for over-indebted individuals, including creditor negotiations, administrative plan formulation, and court involvement when needed - a clear move toward structured debtor relief. Under Sweden's debt restructuring system in place from 1994 onward, most individuals obtain discharge after about five years of following a court-approved plan, reflecting a structured and

		rehabilitative approach to personal insolvency. See https://e-justice.europa.eu/topics/money-monetary-claims/insolvency-bankruptcy/se_en, Heuer (2014), https://kronofogden.se/other-languages/the-enforcement-authority---english/debt-restructuring-debtor/after-decision-on-debt-restructuring and https://archive.riksbank.se/Upload/Rapporter/2011/RUTH/RUTH_chapter2.pdf for more details.
Switzerland	1999	Switzerland adopted a notable personal bankruptcy reform of the 1997 revision of the Swiss Debt Enforcement and Bankruptcy Law (DEBA, Schuldbetreibungs- und Konkursgesetz, SchKG), which became effective 1 January 1999. This 1997/1999 DEBA reform was a major personal bankruptcy law reform that favored debtors, introducing: structured repayment plans, a clear path to discharge, and a rehabilitative framework balancing creditor and debtor interests. This reform modernized restructuring procedures (e.g., Nachlassverfahren), improved composition agreements and enhanced procedural efficiency. But they did not introduce a consumer "good conduct period" and did not create automatic residual debt discharge after 3–7 years. Loss certificates remained central to post-bankruptcy enforcement. See https://schulden.ch/positionen/restschuldbefreiung/, Heuer (2014), and https://www.fedlex.admin.ch/eli/fga/2025/356/de for more details.

Panel B. Reform intensity ranking

Economy	Reform year	Intensity group	Pre-reform TTD	Post-reform TTD	Changes in TTD
Argentina	1996	1	43	4	-39
Australia	1997	0	3	3	0
Austria	1995	1	46	7	-39
Belgium	1999	1	47	4	-43
Canada	1993	0	1.375	1.375	0
Finland	1993	1	45	4	-41
France	1999	0	NA	NA	NA
Germany	1999	1	47	5.5	-41.5
Hong Kong	1998	1	50	6	-44
Israel	1996	1	47	4	-43
Japan	2001	0	4	4	0
Mexico	2000	0	42	42	0
New Zealand	2001	1	5	3	-2
Netherlands	1999	1	48	3	-45
Norway	1993	1	47	5	-42
Singapore	1996	1	46	3	-43
Sweden	1995	1	49	5	-44
Switzerland	1999	0	49	49	0

Figure 1. Attention to personal bankruptcy rises one year pre- reform

Mentions of each country's PBL reform in Google n-grams searches from four years before to four years after the year of the reform (year 0), divided by the average mentions per year through all nine years. Searches are for the name of the reform and in the country's main language, if include in Google n-grams. Searches for other countries are in English. If this returns no data, a secondary English language search of the form "Swedish bankruptcy" is substituted. This yields usable results in all cases except Finland, which is dropped. Table 1 Panel B lists PBL reform countries and years. Details are in Online Appendix Table OA14.

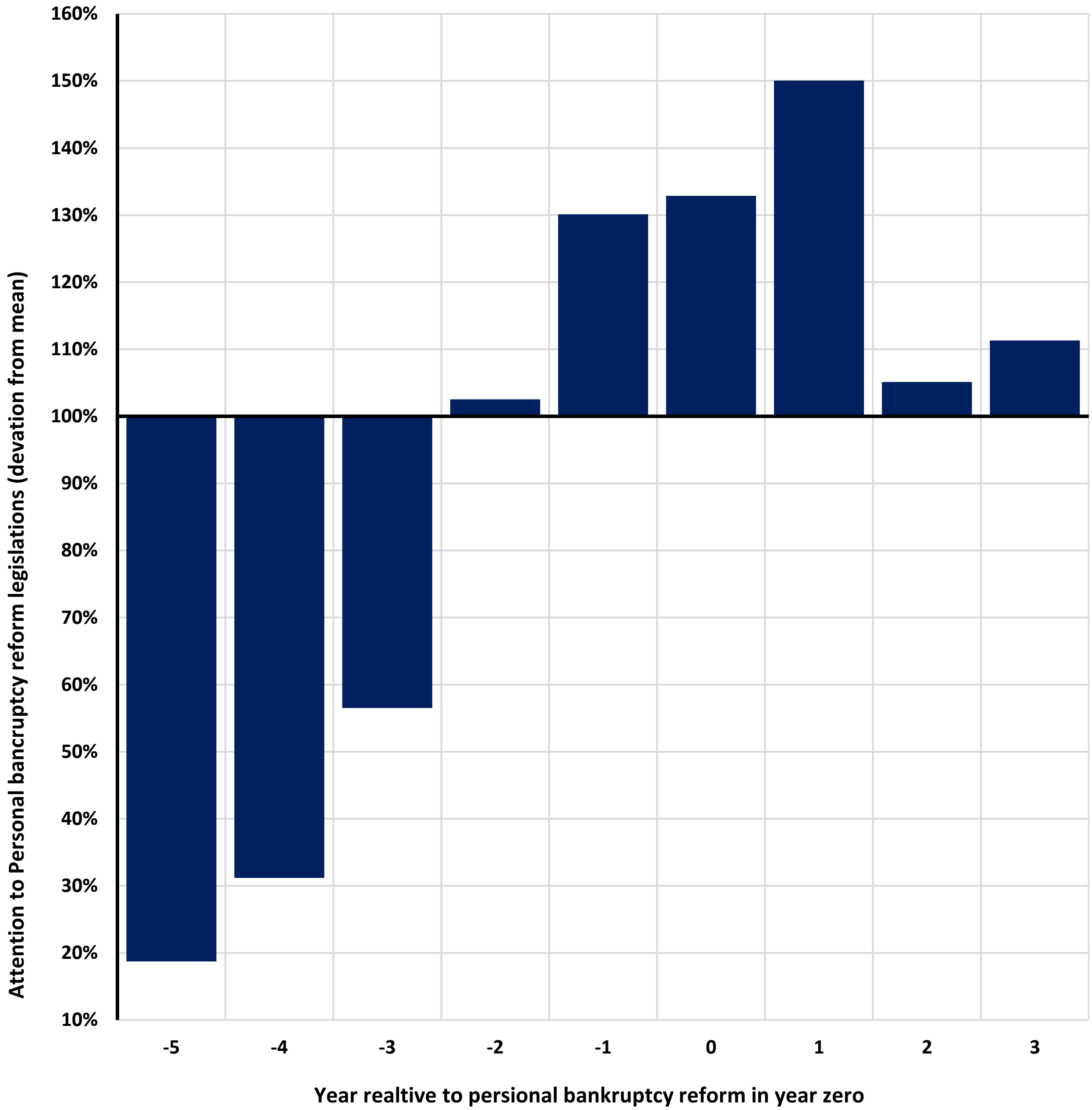
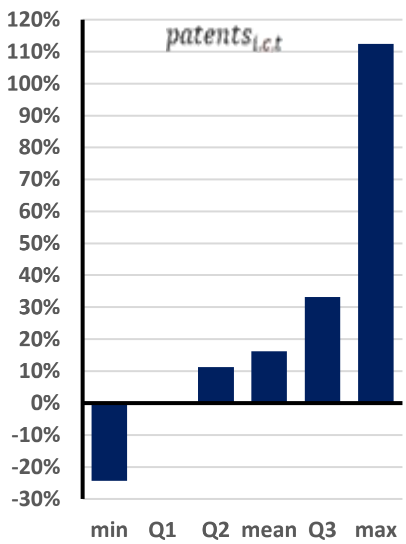


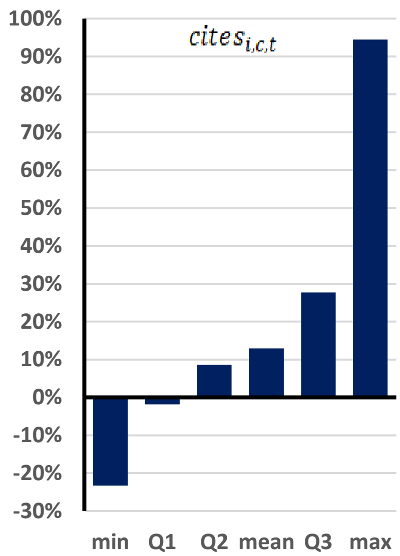
Figure 2. Realignment of innovation across industries by innovation potential

This figure graphs the economic significance of the PBL reform (from Table 3 Panel B) across the distribution of industry innovation potential (pot_i). The vertical axes measure percentage changes in each innovation measure – new patents, subsequent citations to those new patents, and new patenter debuts – which are nonlinear transformations is $e^{\lambda_0+\mu_0\, pot_{i,t}} - 1$ of the Poisson main and interaction regression coefficients, λ_0 and μ_0, respectively in [4] at each innovation potential. A, B, and C report changes in each innovation measure for industries with innovative potential at its minimum (zero), first quartile, median, mean, third quartile, and maximum. Panel D compares each innovation measure before (t-5 to t-3) and after (t to t+2) the PBL reforms for low (Q1) and high (Q4) innovation potential industries.

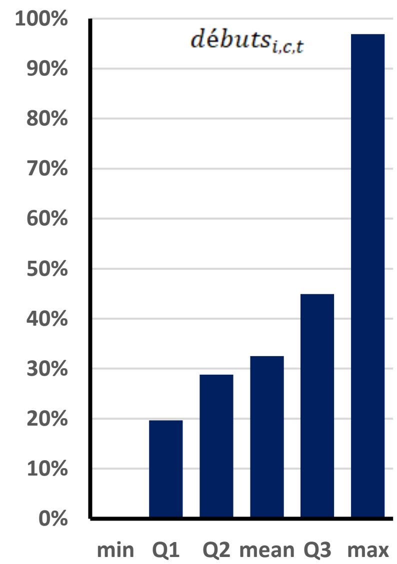
Panel A. Patent count



Panel B. Citation count



Panel C. New patenter count



Panel D. Dynamic shifts

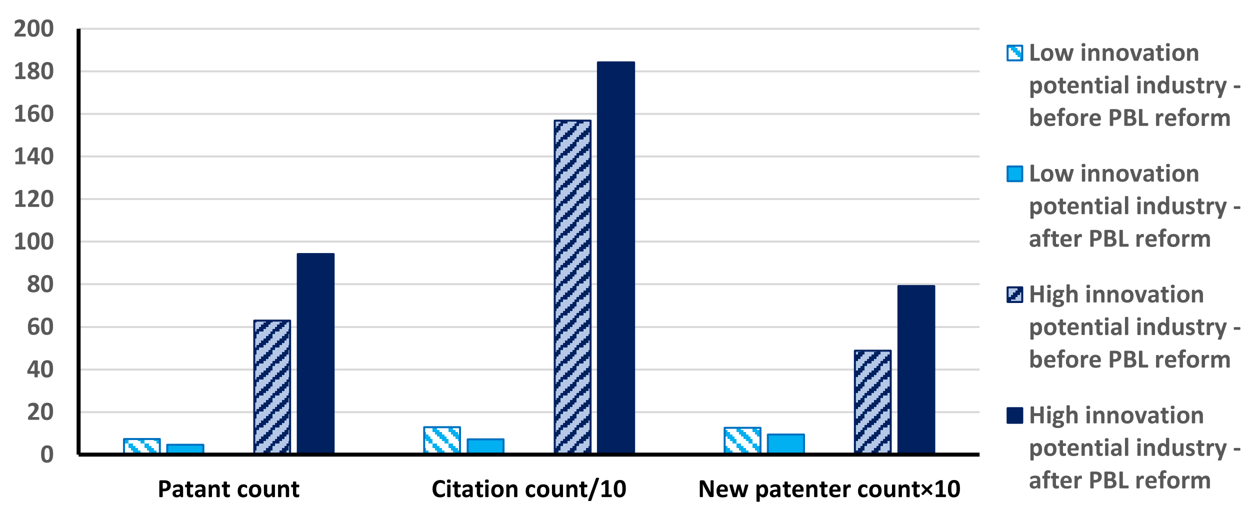
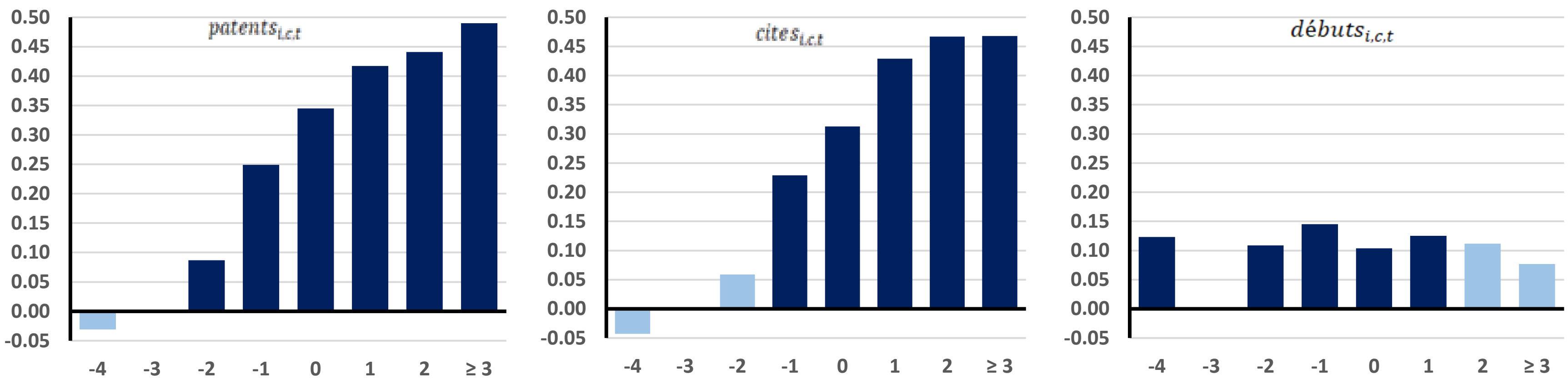


Figure 3. Dynamics of patenting around PBL reform

This figure presents the dynamic effects of PBL reform on innovation across industries with different innovation intensity, estimated as in Table 7. Panel A presents the average effects; each marker represents the estimated coefficients on event year dummies. Panel B presents the interaction effects; each marker represents the estimated coefficients on the interaction terms of patent density and event year dummies. t = 0 represents the PBL reform year. Dark colored bars indicate statistically significant ($p \leq 10\%$) differences from the baseline omitted category $t = -3$.

Panel A. Main effect of PBL reform



Panel B. Interaction of PBL reform with $pot_{i,t}$ (Industry innovation potential)

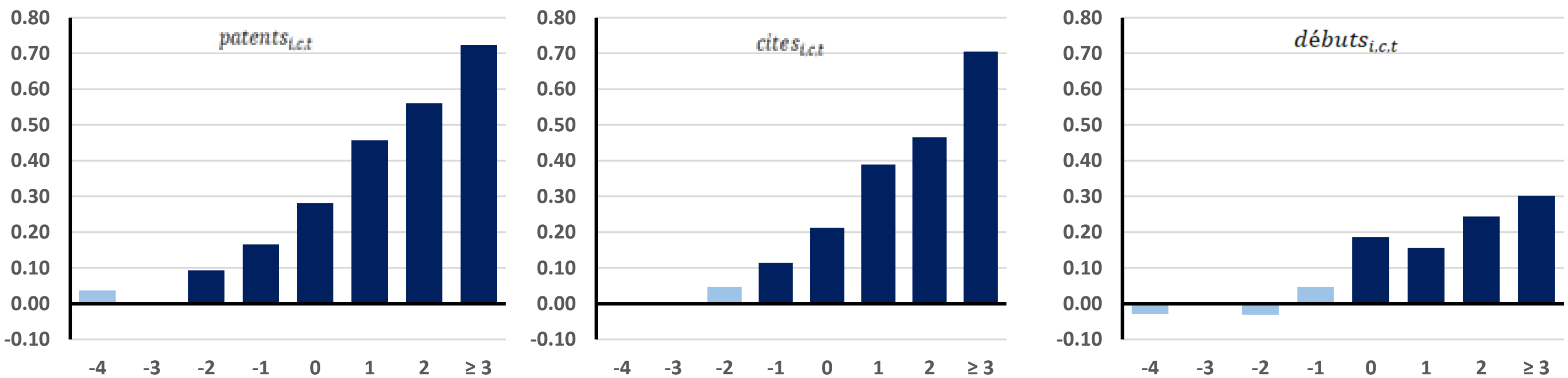
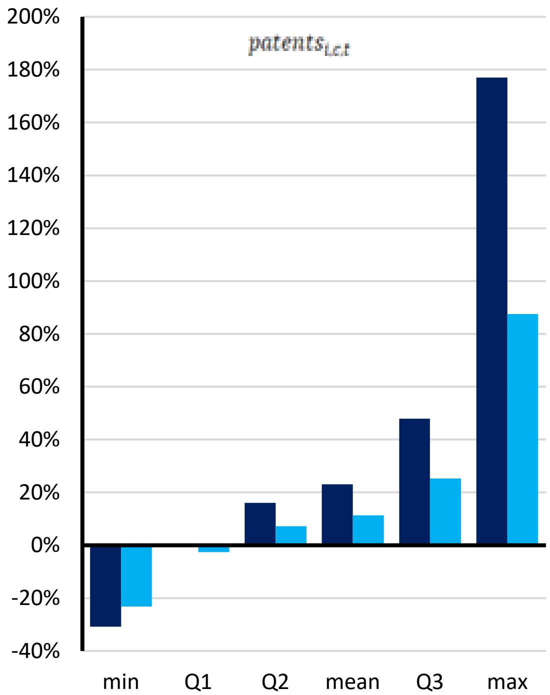


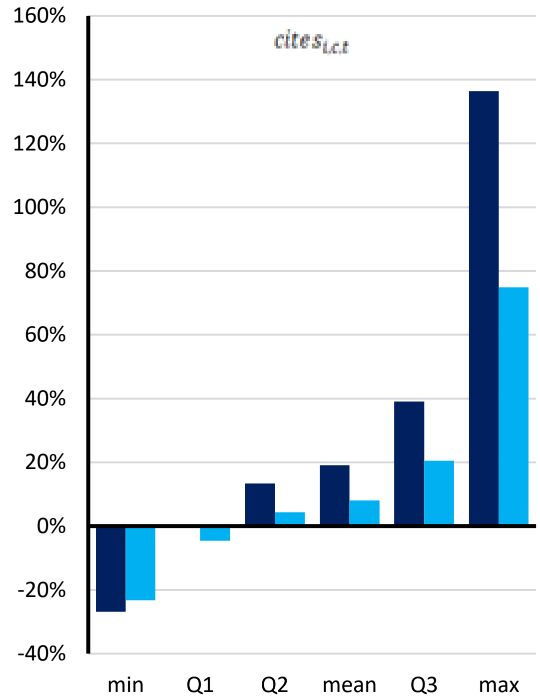
Figure 4. Realignment of innovation across industries by PBL reform intensity

This figure graphs the economic significance of high-intensity (dark bars) versus low-intensity (light bars) PBL reforms (from Table 11 Panel B) across the distribution of industry innovation potential (pot_i). The vertical axes measure percentage changes in each innovation measure – patent count, citation count, and new patenter count – which are nonlinear transformations of the Poisson estimation coefficients in the table as in Figure 2. Panels A, B, and C report changes in each innovation measure for industries with innovation potential at its minimum (zero), first quartile, median, mean, third quartile, and maximum.

Panel A. Patent count



Panel B. Citations count



Panel C. New patenter count

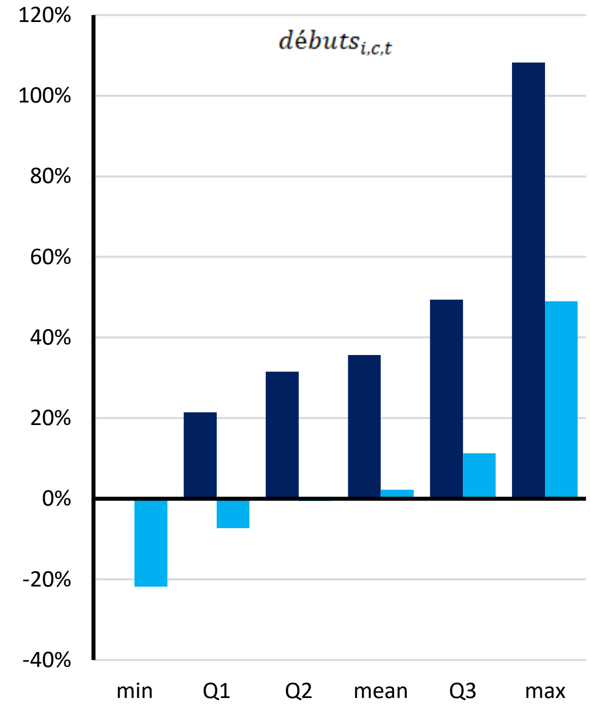
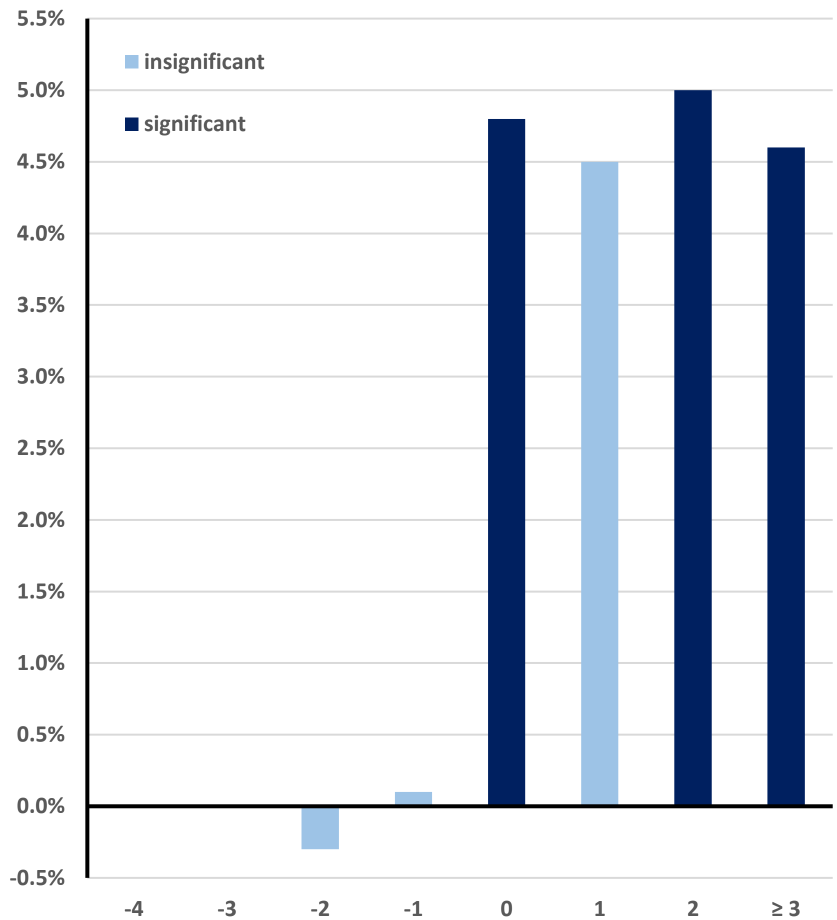


Figure 5. Functional efficiency measures around personal bankruptcy reforms

These graphs present the dynamic effects of PBL reform on two alternative measures of functional efficiency, constructed along the lines of Wurgler (2000), to measure the propensity of capital flowing to sectors with greater value-added, estimated as Panel B of Table 12. $t = 0$ represents the PBL reform year. Dark colored bars indicate statistically significant ($p \leq 10\%$) differences from the baseline omitted category $t = -3$.

Panel A. Correlation of log of value-added with log of investment



Panel B. Rank correlation of value-added with investment

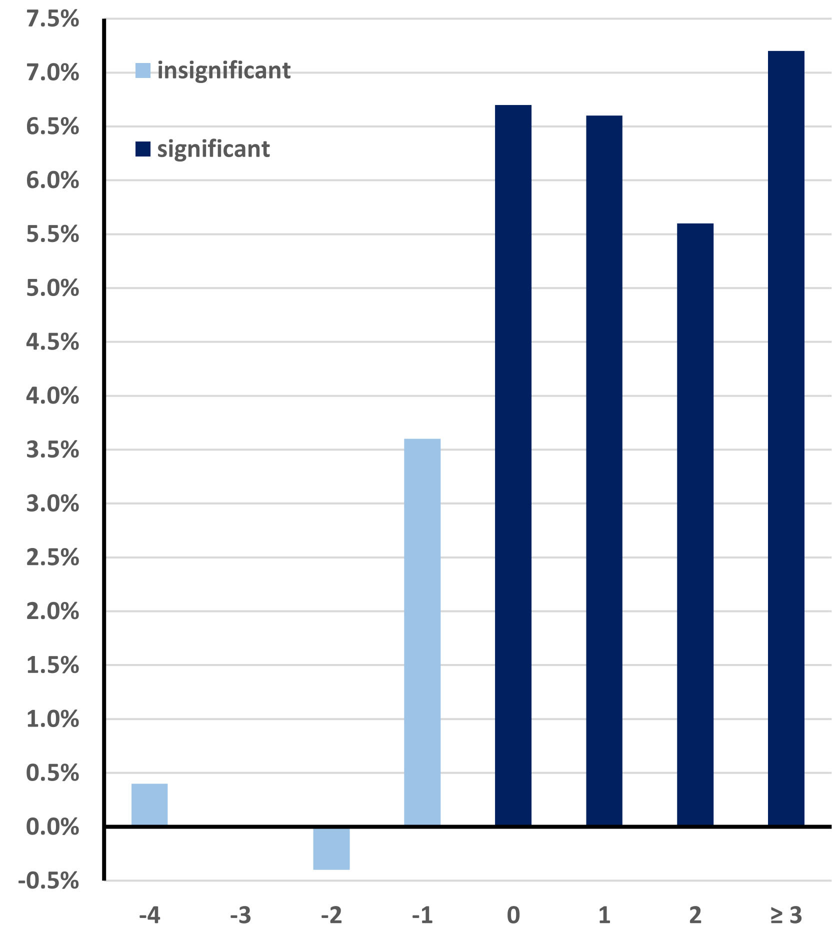


Figure 6. Dynamics of TFP around PBL reform

This figure presents the dynamic effects of PBL reform on TFP across countries, estimated as in regression 13.3 of Table 13. Each marker represents the estimated coefficients on the event year dummies. t = 0 represents the PBL reform year. Dark colored bars indicate statistically significant ($p \leq 10\%$) differences from the baseline omitted category $t = -3$.

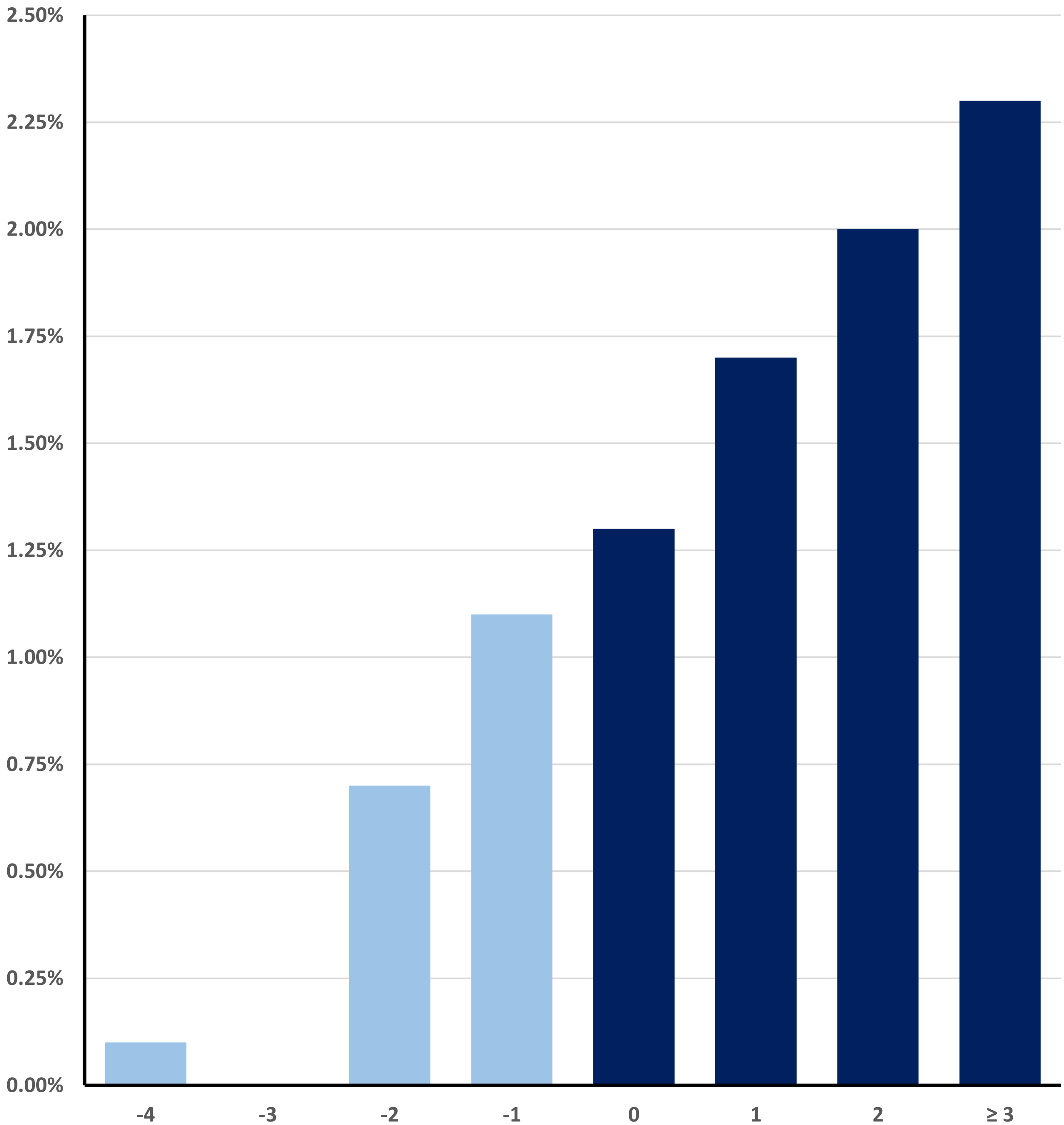


Table 1. Summary statistics

This table presents summary statistics of main variables. For details, see Section 3 and Appendix Table A1.

Panel A. Summary statistics for industry-country-year-level variables

Variables	Count	Mean	S.D.	Min.	P25	Median	P75	Max.
<u>*Explained variables*</u>								
$patents_{i,c,t}$	17807	25.4	123.9	0.000	0.000	1.000	9.000	4806
$cites_{i,c,t}$	17807	510.4	2639.0	0.000	0.000	11.000	149.000	86403
$débuts_{i,c,t}$	17807	2.94	8.83	0.000	0.000	0.000	2.000	151
<u>*Variables of interest*</u>								
$\delta_{c,t}^{XPBL}$ (PBL post-reform indicator)	17807	0.247	0.432	0.000	0.000	0.000	0.000	1.000
$\delta_{c,t}^{TPBL}$ (PBL trans-reform indicator)	17807	0.085	0.279	0.000	0.000	0.000	0.000	1.000
$pot_{i,t}$ (Industry innovation potential)	17807	0.802	0.407	0.000	0.511	0.723	1.057	1.930
<u>*Control variables*</u>								
$exports_{i,c,t}$ (Ind. Exports to US/total)	17807	0.024	0.064	0.000	0.001	0.005	0.019	0.848
$imports_{i,c,t}$ (Ind. imports from US/total)	17807	0.024	0.040	0.000	0.004	0.010	0.024	0.762
$value\text{-}added_{i,c,t}$ (Ind. value-added/total)	17807	0.018	0.041	0.000	0.002	0.007	0.015	0.539
ln($pcGDP$) (Country prosperity)	17807	0.798	0.637	-1.672	0.384	1.017	1.201	2.028
ln($pop_{c,t}$) (Country size)	17807	3.045	1.341	1.078	1.908	2.884	4.046	6.977
$CRI_{c,t}$ (Creditor rights change in CBL)	17807	0.089	0.309	0.000	0.000	0.000	0.000	2.000

Panel B. Industry-year observations, patenting variables, and PBL reform years t_c

Economy	N	$patents_t$	$cites_t$	$débuts_t$	t_c	Economy	N	$patents_t$	$cites_t$	$débuts_t$	t_c
Argentina	546	94	1441	61	1996	Israel	546	5295	218311	1764	1996
Australia	546	5165	147101	1957	1997	Italy	546	15098	210631	3079	
Austria	542	3418	50701	658	1995	Japan	546	166243	3145159	8868	2001
Belgium	546	3230	53170	489	1999	Mexico	546	282	4728	122	2000
Brazil	545	621	8299	196		Netherlands	546	14435	290854	1591	1999
Britain	546	24920	595871	4988		New Zealand	546	708	17397	312	2001
Bulgaria	501	31	240	14		Norway	545	2122	45347	689	1993
Canada	546	21687	706982	5371	1993	Poland	538	37	671	26	
Denmark	546	4135	96299	814		Russia	419	250	3355	198	
Finland	544	8919	234123	1013	1993	Singapore	546	1460	41916	239	1996
France	546	33909	619687	3846	1999	S Africa	542	607	10811	310	
Germany	546	72130	1178135	8262	1999	S Korea	546	31210	584732	1574	
Greece	546	49	913	34		Spain	546	1483	18958	556	
Hong Kong	545	1276	32258	502	1998	Sweden	546	15407	396848	2099	1995
Hungary	536	386	3868	94		Switzerland	546	16767	323064	2091	1999
India	542	416	5362	150		Venezuela	546	233	3642	20	
Ireland	542	918	37206	388		Total	17807				

Table 2. The effect of PBL reform on innovation

This table summarizes difference-in-difference country-industry-year panel Poisson regressions testing the average effect of PBL reform on innovation. Appendix Table A1 provides variable definitions. Control variables are lagged one year. Numbers in parentheses are t-test p-levels, two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Regression	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9
Explained variable		$patents_{i,c,t}$ (# successful patent filings)			$cites_{i,c,t}$ (# subsequent citations)			$débuts_{i,c,t}$ (# first-time patent filers)	
PBL post-reform indicator $\boldsymbol{\delta_{c,t}^{XPBL}}$	0.098 (0.233)	0.322** (0.047)	0.311** (0.010)	0.140 (0.154)	0.320*** (0.001)	0.295*** (0.002)	0.027 (0.801)	0.163* (0.077)	0.149* (0.088)
PBL trans-reform indicator $\boldsymbol{\delta_{c,t}^{TPBL}}$	-0.078* (0.086)	0.109 (0.107)	0.118** (0.024)	-0.108* (0.088)	0.060 (0.370)	0.072 (0.221)	-0.027 (0.698)	0.112** (0.024)	0.122** (0.012)
Industry innovation potential $pot_{i,t}$	0.995*** (0.000)	0.837*** (0.000)	0.831*** (0.000)	1.252*** (0.000)	1.065*** (0.000)	1.050*** (0.000)	0.432** (0.046)	0.369* (0.059)	0.366* (0.058)
Creditor rights index change $CRI_{c,t}$			-0.150** (0.013)			-0.199*** (0.000)			-0.119** (0.027)
Industry export intensity $exports_{i,c,t}$		0.702 (0.272)	0.701 (0.281)		1.149*** (0.001)	1.093*** (0.006)		0.522** (0.033)	0.581** (0.015)
Industry import intensity $imports_{i,c,t}$		1.500** (0.045)	1.462* (0.052)		1.565*** (0.007)	1.476*** (0.009)		1.469* (0.065)	1.410* (0.072)
Industry value added $value\text{-}added_{i,c,t}$		0.549 (0.130)	0.573* (0.078)		0.214 (0.589)	0.224 (0.543)		0.307* (0.054)	0.329** (0.023)
Country prosperity $\ln(pcGDP_{c,t})$		1.736*** (0.001)	1.796*** (0.000)		1.451** (0.014)	1.563*** (0.006)		2.281*** (0.000)	2.340*** (0.000)
Country size $\ln(pop_{c,t})$		2.690*** (0.000)	2.320*** (0.000)		3.492*** (0.000)	2.939*** (0.000)		2.169*** (0.000)	1.868*** (0.003)
Observations	14862	14862	14862	14748	14748	14748	13941	13941	13941
Pseudo R^2	0.957	0.960	0.960	0.970	0.972	0.972	0.789	0.792	0.793
Country-industry & year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3. Different effects of PBL reform on innovation across industries

This table summarizes difference-in-difference country-industry-year panel Poisson regressions testing the varying effect of PBL reform on innovation in industries with different innovation potential. All regressions in Panel A include year and country-industry fixed effects. Numbers in parentheses are t-test p-levels, with two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively. Panel B summarized the economic effects of PBL reform (nonlinear transformations of the Panel A coefficients) on each innovation measure across the distribution of industry innovation potential from Table 1.

Panel A. Poisson regressions

	3.1	3.2	3.3
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
PBL post-reform alignment	0.535***	0.482***	0.351***
$\delta^{XPBL}_{c,t} \times pot_{i,t}$	(0.000)	(0.000)	(0.002)
PBL trans-reform alignment	0.172***	0.119***	0.119
$\delta^{TPBL}_{c,t} \times pot_{i,t}$	(0.000)	(0.005)	(0.259)
PBL post-reform indicator	-0.279***	-0.265***	-0.188
$\delta^{XPBL}_{c,t}$	(0.006)	(0.008)	(0.124)
PBL trans-reform indicator	-0.065	-0.056	0.014
$\delta^{XPBL}_{c,t}$	(0.153)	(0.360)	(0.900)
Industry innovation potential	0.621***	0.802***	0.194
$pot_{i,t}$	(0.000)	(0.000)	(0.168)
Creditor rights index change	-0.148***	-0.171***	-0.124***
$CRI_{c,t}$	(0.005)	(0.005)	(0.002)
Industry export intensity	1.020***	1.322***	0.537**
$exports_{i,c,t}$	(0.000)	(0.000)	(0.028)
Industry import intensity	0.641	0.948**	0.713
$imports_{i,c,t}$	(0.180)	(0.015)	(0.264)
Industry value added	0.785*	0.455	0.366**
$value\text{-}added_{i,c,t}$	(0.077)	(0.314)	(0.035)
Country prosperity	1.899***	1.638***	2.396***
$\ln(pcGDP_{c,t})$	(0.000)	(0.003)	(0.000)
Country size	2.249***	2.777***	1.680**
$\ln(pop_{c,t})$	(0.001)	(0.001)	(0.013)
Observations	14862	14748	13941
Pseudo R^2	0.962	0.974	0.793

Panel B. Implied post-PBL reform change in innovation measures across industries

	Poisson coefficient on		Point in distribution of Industry innovation potential pot_i					
			Min.	Q1	Median	Mean	Q3	Max.
Explained variable	Interaction $\delta^{XPBL}_{c,t} \times pot_{i,t}$	Main effect $\delta^{XPBL}_{c,t}$	0.00	0.511	0.723	1.057	0.802	1.930
$patents_{i,c,t}$	0.535	-0.279	-24.3%	-0.6%	11.3%	33.2%	16.2%	112.5%
$cites_{i,c,t}$	0.482	-0.265	-23.3%	-1.9%	8.6%	27.7%	12.9%	94.5%
$débuts_{i,c,t}$	0.351	insignificant	0.0%	19.6%	28.8%	44.9%	32.5%	96.9%

Table 4. PBL reform and innovation across industries, more interactions

This table reruns the regressions in Table 3 by including the interaction terms between control variables and innovation potential. All regressions include year and country-industry fixed effects. Numbers in parentheses are t-test p-levels, with two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Regression	4.1	4.2	4.3
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
PBL post-reform alignment	0.467***	0.406***	0.233***
$\delta_{c,t}^{XPBL} \times pot_{i,t}$	(0.000)	(0.000)	(0.010)
PBL trans-reform alignment	0.157***	0.121***	0.074
$\delta_{c,t}^{TPBL} \times pot_{i,t}$	(0.000)	(0.009)	(0.417)
PBL post-reform indicator	-0.203**	-0.176**	-0.079
$\delta_{c,t}^{XPBL}$	(0.045)	(0.047)	(0.465)
PBL trans-reform indicator	-0.049	-0.062	0.049
$\delta_{c,t}^{XPBL}$	(0.274)	(0.360)	(0.607)
Industry innovation potential	0.068	0.963*	-1.180***
$pot_{i,t}$	(0.896)	(0.066)	(0.003)
Creditor rights index change	0.191*	0.379**	-0.008
$CRI_{c,t}$	(0.055)	(0.018)	(0.866)
Industry export intensity	1.069	-0.092	-0.471
$exports_{i,c,t}$	(0.164)	(0.921)	(0.473)
Industry import intensity	0.132	-2.550	-1.252
$imports_{i,c,t}$	(0.925)	(0.245)	(0.237)
Industry value added	-0.151	0.538	1.334***
$value\text{-}added_{i,c,t}$	(0.758)	(0.675)	(0.000)
Country prosperity	1.461*	1.483*	1.688**
$\ln(pcGDP_{c,t})$	(0.055)	(0.080)	(0.022)
Country size	2.156***	2.764***	1.767***
$\ln(pop_{c,t})$	(0.002)	(0.000)	(0.006)
$CRI_{c,t} \times pot_{i,t}$	-0.350***	-0.491***	-0.147**
	(0.000)	(0.000)	(0.011)
$exports_{i,c,t} \times pot_{i,t}$	-0.226	0.693	0.494
	(0.627)	(0.126)	(0.194)
$imports_{i,c,t} \times pot_{i,t}$	0.244	1.957	1.229**
	(0.752)	(0.120)	(0.036)
$value\text{-}added_{i,c,t} \times pot_{i,t}$	1.211	-0.211	-1.634***
	(0.232)	(0.919)	(0.003)
$\ln(pcGDP_{c,t}) \times pot_{i,t}$	0.453	0.086	0.758***
	(0.188)	(0.802)	(0.000)
$\ln(pop_{c,t}) \times pot_{i,t}$	0.011	-0.094	0.137
	(0.907)	(0.359)	(0.119)
Observations	14862	14748	13941
Pseudo R^2	0.962	0.974	0.794

Table 5. PBL reform and innovation across industries, added controls

This table reruns the regressions of Table 4 including additional control variables associated with financial and institutional development (a measure of financial development, three legal origin dummies, and one of institutional development) and their interactions with innovation potential. Numbers in parentheses are t-test p-levels, with two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Regression	5.1	5.2	5.3
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$d\acute{e}buts_{i,c,t}$
Post-reform alignment to potential	0.474***	0.423***	0.177*
$\delta_{c,t}^{XPBL} \times pot_{i,t}$	(0.000)	(0.000)	(0.053)
Trans-reform alignment to potential	0.186***	0.170***	0.062
$\delta_{c,t}^{TPBL} \times pot_{i,t}$	(0.000)	(0.001)	(0.508)
Post-reform indicator	-0.203	-0.167	-0.030
$\delta_{c,t}^{XPBL}$	(0.123)	(0.223)	(0.777)
Trans-reform indicator	-0.075	-0.094	0.059
$\delta_{c,t}^{TPBL}$	(0.158)	(0.178)	(0.470)
Innovation potential	-0.412	0.475	-0.829
$pot_{i,t}$	(0.460)	(0.420)	(0.162)
Financial development index	-0.564	-0.519	-0.955*
$findev_{c,t}$	(0.243)	(0.453)	(0.097)
Institutional development index	-0.023**	-0.039***	-0.010
$instdev_{c,t}$	(0.039)	(0.001)	(0.282)
Financial development interaction	0.266	0.375	1.010**
$findev_{c,t} \times pot_{i,t}$	(0.607)	(0.609)	(0.028)
Institutional development interaction	0.030*	0.043**	0.015
$instdev_{c,t} \times pot_{i,t}$	(0.075)	(0.011)	(0.211)
English legal origin dummy interaction	-0.012	0.083	-0.510
$\delta_{English\ legal\ origin} \times pot_{i,t}$	(0.969)	(0.792)	(0.141)
French legal origin dummy interaction	-0.190	-0.452	-0.060
$\delta_{French\ legal\ origin} \times pot_{i,t}$	(0.663)	(0.296)	(0.858)
German legal origin dummy interaction	-0.275	-0.153	-0.106
$\delta_{German\ legal\ origin} \times pot_{i,t}$	(0.503)	(0.752)	(0.772)
Observations	14446	14345	13564
Pseudo R^2	0.962	0.975	0.796
Other Table 4 controls	Yes	Yes	Yes
Other Table 4 interaction terms	Yes	Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes

Table 6. PBL reform and innovation across industries, policy shocks

This table reruns the regressions of Table 3 by including country-year fixed effects, which subsume time varying country-level controls (creditor rights index change, log per capita GDP and log population). Numbers in parentheses are t-test p-levels, with two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Regression	6.1	6.2	6.3
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
Post-reform alignment to potential	0.517***	0.465***	0.388***
$\delta_{c,t}^{XPBL} \times pot_{i,t}$	(0.000)	(0.000)	(0.000)
Trans-reform alignment to potential	0.158***	0.106*	0.144*
$\delta_{c,t}^{TPBL} \times pot_{i,t}$	(0.000)	(0.050)	(0.084)
Industry innovation potential	0.588***	0.753***	0.206
$pot_{i,t}$	(0.000)	(0.000)	(0.119)
Industry export intensity	0.277	0.519	0.947***
$exports_{i,c,t}$	(0.569)	(0.314)	(0.000)
Industry import intensity	1.338***	1.022**	0.079
$imports_{i,c,t}$	(0.000)	(0.015)	(0.889)
Industry value added	0.232***	0.110	0.039
$value\text{-}added_{i,c,t}$	(0.003)	(0.385)	(0.878)
Observations	14796	14672	13801
Pseudo R^2	0.965	0.978	0.799
Country-year FEs	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes

Table 7. PBL reform and innovation across industries, dynamics

This table summarizes industry-country-year panel Poisson regressions explaining changes innovation after PBL reforms to estimates the dynamic effect of PBL reform on innovation across industries with different innovation potential. Panel A presents the average effects and panel B presents the interaction effects. Numbers in parentheses are t-test p-levels, with two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Main effects

Regression	Years after	7A.1	7A.2	7A.3
Explained variable	reform	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
Level $\delta_{-4,c,t}$	-4	-0.031 (0.253)	-0.043 (0.164)	0.123* (0.053)
Level $\delta_{-2,c,t}$	-2	0.087** (0.013)	0.059 (0.292)	0.109*** (0.003)
Level $\delta_{-1,c,t}$	-1	0.249*** (0.000)	0.229*** (0.001)	0.145*** (0.002)
Level $\delta_{0,c,t}$	0	0.345*** (0.000)	0.313*** (0.000)	0.104** (0.043)
Level $\delta_{1,c,t}$	1	0.417*** (0.000)	0.429*** (0.000)	0.125* (0.055)
Level $\delta_{2,c,t}$	2	0.441*** (0.004)	0.467*** (0.003)	0.112 (0.157)
Level $\delta_{3+,c,t}$	≥ 3	0.490*** (0.004)	0.577*** (0.002)	0.077 (0.449)
Observations		11443	11331	10584
Pseudo R^2		0.962	0.973	0.795
Controls		Yes	Yes	Yes
Country-industry & year FEs		Yes	Yes	Yes

Panel B. Interaction effects

Regression Explained variable	Years after reform	7B.1 $patents_{i,c,t}$	7B.2 $cites_{i,c,t}$	7B.3 $débuts_{i,c,t}$
Alignment with potential $\delta_{-4,c,t} \times pot_{i,t}$	-4	0.037 (0.623)	-0.002 (0.983)	-0.029 (0.718)
Alignment with potential $\delta_{-2,c,t} \times pot_{i,t}$	-2	0.093*** (0.002)	0.047 (0.179)	-0.031 (0.651)
Alignment with potential $\delta_{-1,c,t} \times pot_{i,t}$	-1	0.166*** (0.000)	0.114*** (0.001)	0.047 (0.575)
Alignment with potential $\delta_{0,c,t} \times pot_{i,t}$	0	0.282*** (0.000)	0.212*** (0.000)	0.186** (0.043)
Alignment with potential $\delta_{1,c,t} \times pot_{i,t}$	1	0.457*** (0.000)	0.389*** (0.000)	0.156** (0.046)
Alignment with potential $\delta_{2,c,t} \times pot_{i,t}$	2	0.561*** (0.000)	0.465*** (0.000)	0.244*** (0.009)
Alignment with potential $\delta_{3+,c,t} \times pot_{i,t}$	≥ 3	0.723*** (0.000)	0.705*** (0.000)	0.302*** (0.000)
Level $\delta_{-4,c,t}$	-4	-0.074 (0.305)	-0.052 (0.542)	0.147 (0.100)
Level $\delta_{-2,c,t}$	-2	-0.021 (0.665)	-0.005 (0.938)	0.135* (0.085)
Level $\delta_{-1,c,t}$	-1	0.056 (0.280)	0.090* (0.082)	0.100 (0.247)
Level $\delta_{0,c,t}$	0	0.027 (0.763)	0.061 (0.468)	-0.078 (0.448)
Level $\delta_{1,c,t}$	1	-0.112 (0.352)	-0.047 (0.651)	-0.027 (0.771)
Level $\delta_{2,c,t}$	2	-0.189 (0.101)	-0.088 (0.491)	-0.125 (0.327)
Level $\delta_{3+,c,t}$	≥ 3	-0.339* (0.053)	-0.310* (0.097)	-0.221** (0.046)
Observations		11443	11331	10584
Pseudo R^2		0.964	0.975	0.796
Controls		Yes	Yes	Yes
Country-industry & year FEs		Yes	Yes	Yes

Table 8. Event study

This table summarizes industry-country-year panel Poisson regressions explaining changes innovation after PBL reforms in an event study using data from year *t*-4 to year *t*+2 (*t* represents the PBL reform year) fore each country with a PBL reform. Numbers in parentheses are t-test p-levels, with two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Regression	8.1	8.2	8.3
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
Post-reform alignment to potential	0.351***	0.279***	0.232***
$\delta_{c,t}^{XPBL} \times pot_{i,t}$	(0.000)	(0.000)	(0.005)
Trans-reform alignment to potential	0.110***	0.054	0.059
$\delta_{c,t}^{TPBL} \times pot_{i,t}$	(0.006)	(0.225)	(0.456)
Post-reform indicator	-0.130	-0.058	-0.141
$\delta_{c,t}^{XPBL}$	(0.197)	(0.638)	(0.152)
Trans-reform indicator	-0.050	0.003	-0.030
$\delta_{c,t}^{TPBL}$	(0.353)	(0.969)	(0.572)
Industry innovation potential	0.325***	0.405*	-0.017
$pot_{i,t}$	(0.004)	(0.064)	(0.907)
Observations	4271	4252	3982
Pseudo R^2	0.974	0.982	0.811
Controls	Yes	Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes

Table 9. Alternative definitions of large legacy patenters

This table summarizes industry-country-year panel Poisson regressions explaining changes in innovation after PBL reforms for large legacy patenter (L) firms and all other (NL) firms using different thresholds for defining L firms. Only the coefficient on $\delta_{c,t}^{XPBL} \times pot_{i,t}$ and its significance are reported. Numbers in parentheses are t-test p-levels, two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Firm type	NL firms		L firms	
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$patents^L_{i,c,t}$	$cites^L_{i,c,t}$
In 1990, L firms have >=				
1 patent	0.800***	0.657***	0.148**	0.034
	(0.000)	(0.000)	(0.033)	(0.649)
5 patents	0.765***	0.661***	0.138**	0.030
	(0.000)	(0.000)	(0.014)	(0.642)
25 patents	0.722***	0.626***	0.096**	-0.009
	(0.000)	(0.000)	(0.016)	(0.895)
50 patents	0.667***	0.600***	0.091**	-0.024
	(0.000)	(0.000)	(0.010)	(0.732)
75 patents	0.647***	0.578***	0.080**	-0.047
	(0.000)	(0.000)	(0.012)	(0.460)
100 patents	0.618***	0.564***	0.085**	-0.055
	(0.000)	(0.000)	(0.040)	(0.415)
200 patents	0.550***	0.509***	0.078**	-0.082*
	(0.000)	(0.000)	(0.026)	(0.083)
300 patents	0.538***	0.488***	0.072	-0.066
	(0.000)	(0.000)	(0.201)	(0.219)
400 patents	0.550***	0.497***	0.005	-0.140**
	(0.000)	(0.000)	(0.951)	(0.010)
500 patents (baseline)	**0.535*** **	**0.482*** **	**-0.013**	**-0.151** **
	(0.000)	**(0.000)**	**(0.886)**	**(0.015)**
600 patents	0.514***	0.453***	-0.028	-0.155**
	(0.000)	(0.000)	(0.740)	(0.011)
700 patents	0.511***	0.452***	-0.038	-0.170**
	(0.000)	(0.000)	(0.684)	(0.025)
800 patents	0.499***	0.444***	-0.046	-0.174***
	(0.000)	(0.000)	(0.538)	(0.004)
900 patents	0.491***	0.439***	-0.061	-0.186***
	(0.000)	(0.000)	(0.351)	(0.002)
1000 patents	0.485***	0.438***	-0.071	-0.203**
	(0.000)	(0.000)	(0.360)	(0.016)
Controls	Yes	Yes	Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes	Yes

Table 10. Minimum capital requirements and the PBL effect on innovation

This table summarizes industry-country-year panel Poisson regressions explaining changes innovation after PBL reforms separately for countries with and without minimum capital requirements (MCR). Numbers in parentheses are t-test p-levels, two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Regression	10.1	10.2	10.3	10.4	10.5	10.6
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
Post-reform alignment if MCR	0.502^{***}	0.412^{***}	0.374^{***}			
$\delta_c^{MCR} \times \delta_{c,t}^{XPBL} \times pot_{i,t}$	(0.000)	(0.000)	(0.000)			
Post-reform alignment if no MCR	0.904^{***}	0.826^{***}	0.484^{***}	0.407^{***}	0.413^{**}	0.127^{*}
$\delta_c^{NO\ MCR} \times \delta_{c,t}^{XPBL} \times pot_{i,t}$	(0.000)	(0.000)	(0.000)	(0.000)	(0.019)	(0.072)
Post-reform alignment				0.503^{***}	0.414^{***}	0.348^{***}
$\delta_{c,t}^{XPBL} \times pot_{i,t}$				(0.000)	(0.000)	(0.001)
Post-reform if MCR	-0.248^{***}	-0.179^{**}	-0.220^{**}			
$\delta_c^{MCR} \times \delta_{c,t}^{XPBL}$	(0.009)	(0.030)	(0.041)			
Post-reform if no MCR	-0.777^{***}	-0.770^{***}	-0.446^{***}	-0.520^{***}	-0.577^{***}	-0.234^{***}
$\delta_c^{NO\ MCR} \times \delta_{c,t}^{XPBL}$	(0.000)	(0.000)	(0.002)	(0.000)	(0.002)	(0.001)
Post-reform				-0.232^{***}	-0.163^{**}	-0.173
$\delta_{c,t}^{XPBL}$				(0.008)	(0.025)	(0.100)
Alignment to potential if MCR	0.576^{***}	0.676^{***}	0.119			
$\delta_c^{MCR} \times pot_{i,t}$	(0.000)	(0.000)	(0.287)			
Alignment to potential if no MCR	0.754^{***}	1.139^{***}	-0.457^{*}	0.212	0.494^{*}	-0.699^{***}
$\delta_c^{NO\ MCR} \times pot_{i,t}$	(0.005)	(0.000)	(0.054)	(0.441)	(0.088)	(0.003)
Alignment to potential				0.585^{***}	0.709^{***}	0.293^{*}
$pot_{i,t}$				(0.000)	(0.000)	(0.052)
Trans-reform align. to potential	0.178^{***}	0.133^{**}	0.152	0.181^{***}	0.134^{***}	0.136
$\delta_{c,t}^{TPBL} \times pot_{i,t}$	(0.000)	(0.021)	(0.129)	(0.000)	(0.003)	(0.179)
Trans-reform indicator	-0.079	-0.075	-0.046	-0.072^{*}	-0.065	-0.017
$\delta_{c,t}^{TPBL}$	(0.110)	(0.302)	(0.622)	(0.097)	(0.270)	(0.858)
Observations	14862	14748	13941	14862	14748	13941
Pseudo R^2	0.962	0.974	0.793	0.962	0.974	0.794
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Country-industry and year FEs	Yes	Yes	Yes	Yes	Yes	Yes

Table 11. PBL reform intensity and the PBL effect on innovation

This table summarizes industry-country-year panel Poisson regressions explaining changes in innovation after low- and high-intensity PBL reform. Numbers in parentheses are t-test p-levels, two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Poisson regressions

	11.1	11.2	11.3
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
Post-reform alignment if low	0.462***	0.427***	0.334***
$\delta_c^{low\_int} \times \delta_{c,t}^{XPBL} \times pot_{i,t}$	(0.000)	(0.000)	(0.005)
Post-reform alignment if high	0.719***	0.608***	0.380***
$\delta_c^{high\_int} \times \delta_{c,t}^{XPBL} \times pot_{i,t}$	(0.000)	(0.000)	(0.000)
Post-reform if low	-0.263**	-0.265**	-0.246*
$\delta_c^{low\_int} \times \delta_{c,t}^{XPBL}$	(0.045)	(0.029)	(0.058)
Post-reform if high	-0.369***	-0.313**	-0.142
$\delta_c^{high\_int} \times \delta_{c,t}^{XPBL}$	(0.000)	(0.019)	(0.167)
Alignment to potential if low	0.670***	0.838***	0.189
$\delta_c^{high\_int} \times pot_{i,t}$	(0.000)	(0.000)	(0.220)
Alignment to potential if high	0.398**	0.663***	0.184
$\delta_c^{low\_int} \times pot_{i,t}$	(0.032)	(0.010)	(0.320)
Trans-reform align. to potential	0.177***	0.123***	0.124
$\delta_{c,t}^{TPBL} \times pot_{i,t}$	(0.000)	(0.004)	(0.207)
Trans-reform indicator	-0.070	-0.062	0.002
$\delta_{c,t}^{TPBL}$	(0.178)	(0.290)	(0.981)
Observations	14862	14748	13941
Pseudo R^2	0.962	0.974	0.794
Other controls	Yes	Yes	Yes
Country-industry and year FEs	Yes	Yes	Yes

Panel B. Implied post-PBL reform change in innovation measures across industries

		Poisson coefficient on		Point in distribution of Industry innovation potential pot_i					
PBL reform intensity	Innovation measure	Interaction $\delta_{c,t}^{XPBL} \times pot_{i,t}$	Main effect $\delta_{c,t}^{XPBL}$	Min. 0.00	Q1 0.511	Median 0.723	Mean 0.802	Q3 1.057	Max. 1.93
high	$patents_{i,c,t}$	0.719	-0.369	-30.9%	-0.2%	16.1%	23.1%	47.8%	177.0%
	$cites_{i,c,t}$	0.608	-0.313	-26.9%	-0.2%	13.4%	19.1%	39.0%	136.4%
	$débuts_{i,c,t}$	0.380	Insignificant	0.0%	21.4%	31.5%	35.6%	49.4%	108.2%
low	$patents_{i,c,t}$	0.462	-0.263	-23.1%	-2.7%	7.3%	11.4%	25.3%	87.5%
	$cites_{i,c,t}$	0.427	-0.265	-23.3%	-4.6%	4.4%	8.1%	20.5%	74.9%
	$débuts_{i,c,t}$	0.334	-0.246	-21.8%	-7.3%	-0.5%	2.2%	11.3%	49.0%

Table 12. PBL reform and investment efficiency

This table estimates effects of PBL reform on two measures of investment efficiency at the country level. The explained variable $\rho_{(\ln VA_{c,t}\,,\ \ln I_{c,t})}$ is the correlation between the log values of value-added over output and investment. $\rho^{rank}_{(VA_{c,t}\,,\ I_{c,t})}$ is the correlation between the rankings of value-added and investment. OLS specifications are used. Panel A presents the summary statistics of the country-year-level variables used in these tests. Panel B presents the regression results. Numbers in parentheses are robust t-test p-levels, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Summary statistics

Variables	Count	Mean	S.D.	Min.	P25	Median	P75	Max.
Explained variables								
$\rho_{(\ln VA_{c,t}\,,\ \ln I_{c,t})}$	294	0.881	0.112	0.304	0.872	0.915	0.943	0.985
$\rho^{rank}_{(VA_{c,t}\,,\ I_{c,t})}$	311	0.857	0.138	0.212	0.829	0.904	0.936	0.981
Variables of interest								
$\delta^{XPBL}_{c,t}$ (Post-reform indicator)	311	0.289	0.454	0.000	0.000	0.000	1.000	1.000
$\delta^{TPBL}_{c,t}$ (Trans-reform indicator)	311	0.080	0.272	0.000	0.000	0.000	0.000	1.000
Control variables								
$CRI_{c,t}$ (Creditor rights index change)	311	0.093	0.323	0.000	0.000	0.000	0.000	2.000
ln($pcGDP_{c,t}$) (Country prosperity)	311	2.308	0.069	2.020	2.288	2.330	2.345	2.419
ln($pop_{c,t}$) (Country size)	311	3.005	1.372	1.078	1.767	2.768	4.046	6.977

Panel B. Estimation results

Regression	12B.1	12B.2
Explained variable	$\rho_{(\ln VA_{c,t},\ln I_{c,t})}$	$\rho^{rank}_{(VA_{c,t}\,,\ I_{c,t})}$
Post-reform indicator $\delta^{XPBL}_{c,t}$	0.043***	0.043**
	(0.004)	(0.015)
Trans-reform indicator $\delta^{TPBL}_{c,t}$	-0.005	-0.006
	(0.751)	(0.737)
Creditor rights index change $CRI_{c,t}$	0.001	0.005
	(0.935)	(0.623)
Country prosperity $\ln(pcGDP_{c,t})$	0.268	0.019
	(0.500)	(0.975)
Country size $\ln(pop_{c,t})$	-0.248***	-0.451***
	(0.003)	(0.000)
Observations	294	311
Adjusted R^2	0.849	0.826
Country and year FEs	Yes	Yes

Regression		12B.3	12B.4
Explained variable		$\rho_{(\ln VA_{c,t},\ln I_{c,t})}$	$\rho^{rank}_{(VA_{c,t}\,,\ I_{c,t})}$
Level $\delta_{-4,c,t}$	-4	0.000	0.004
		(0.988)	(0.908)
Level $\delta_{-2,c,t}$	-2	-0.003	-0.004
		(0.925)	(0.893)
Level $\delta_{-1,c,t}$	-1	0.001	0.036
		(0.968)	(0.222)
Level $\delta_{0,c,t}$	0	**0.048****	**0.067****
		(0.038)	**(0.016)**
Level $\delta_{1,c,t}$	1	0.045	**0.066****
		(0.179)	**(0.049)**
Level $\delta_{2,c,t}$	2	**0.050****	**0.056***
		(0.048)	**(0.085)**
Level $\delta_{3+,c,t}$	≥ 3	**0.046***	**0.072****
		(0.072)	**(0.022)**
12B.1 & 12B.2 controls		Yes	Yes
Observations		232	247
Adjusted R^2		0.816	0.813
Country and year FEs		Yes	Yes

Table 13. PBL reform and total factor productivity

This table estimates effects of PBL reforms on total factor productivity (TFP) at the country level. Explained variable is TFP. Regressions are OLS models. Regressions 13.1 and 13.2 summarize regressions with and without *CRI*. Regression 13.3 is a dynamic average effect regression. Numbers in parentheses are t-test p-levels, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Regression	13.1	13.2			13.3
Explained variable	TFP	TFP			TFP
Post-reform indicator	0.025***	0.020***	Level	-4	0.001
$\delta_{c,t}^{XPBL}$	(0.000)	(0.000)	$\delta_{-4,c,t}$		(0.962)
Trans-reform indicator	0.009	0.012**	Level	-2	0.007
$\delta_{c,t}^{TPBL}$	(0.123)	(0.022)	$\delta_{-2,c,t}$		(0.378)
Creditor rights index		-0.028***	Level	-1	0.011
change $CRI_{c,t}$		(0.000)	$\delta_{-1,c,t}$		(0.153)
Country prosperity	0.473***	0.478***	Level	0	**0.013***
$\ln(pcGDP_{c,t})$	(0.000)	(0.000)	$\delta_{0,c,t}$		**(0.084)**
Country size	-0.399***	-0.414***	Level	1	**0.017****
$\ln(pop_{c,t})$	(0.000)	(0.000)	$\delta_{1,c,t}$		**(0.026)**
			Level	2	**0.020****
			$\delta_{2,c,t}$		**(0.026)**
			Level	≥ 3	**0.023****
			$\delta_{3+,c,t}$		**(0.030)**
			13.2 controls		Yes
Observations	424	424			336
Adjusted R^2	0.926	0.930			0.947
Country and year FEs	Yes	Yes			Yes

Figure OA1. Alternative definitions of large legacy patenters

The sample drops large legacy patentholders unlikely to require personal debt guarantees by their principals, and thus unlikely to be directly affected by PBL reforms. Large legacy patenters are defined as firms with over 500 patents in 1990, the first year of our data. This graph shows the consequences of redefining large legacy patenters as firms with at least 1, 5, 25, 50, 75, 100, 200, 300, 400, 500, 600, 700, 800, 900, and 1,000 patents in 1990 as in Table 9. Blue bars graph coefficients on the interaction variable $\delta_{c,t}^{XPBL} \times pot_{i,t}$ in regressions explaining patent counts and subsequent citations to those patents for each alternative sample. Red bars graph analogous coefficients from regressions using large legacy patenters dropped in constructing each alternative sample. Pale colour indicates statistically insignificant coefficients.

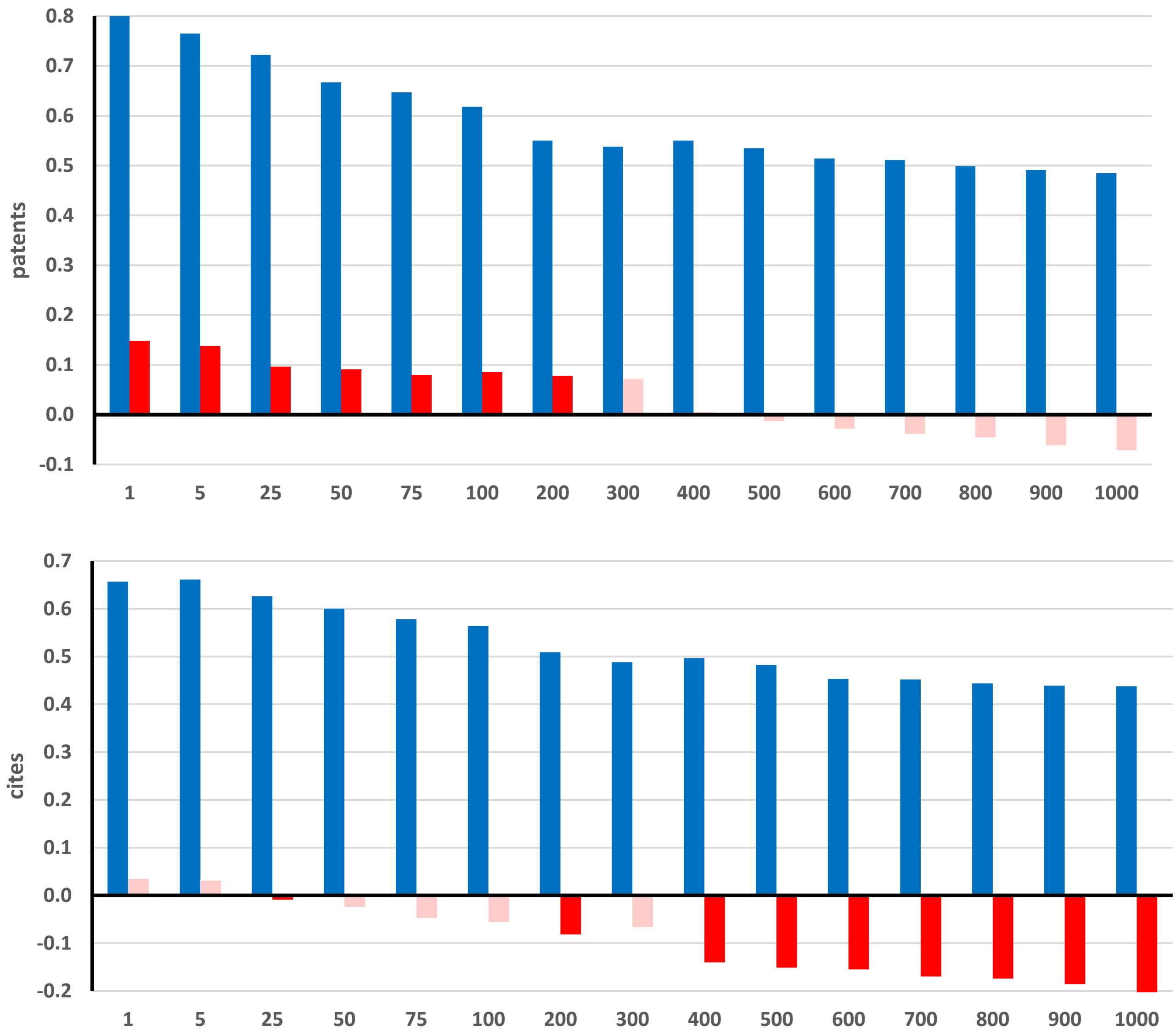


Table OA1. Effect of PBL reform on innovation, ex. countries with IPP change

This table estimates the effect of PBL reform on innovation by excluding four countries with IPP change in the examination period. The variables are defined in Appendix Table A1. Numbers in parentheses are t-test p-levels, two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Main effects

Regression	OA1A.1	OA1A.2	OA1A.3	OA1A.4	OA1A.5	OA1A.6	OA1A.7	OA1A.8	OA1A.9
Explained variable	$patents_{i,c,t}$ (# successful patent filings)			$cites_{i,c,t}$ (# subsequent citations)			$débuts_{i,c,t}$ (# first-time patent filers)		
Post-reform indicator $\delta_{c,t}^{XPBL}$	0.100	0.341*	0.330**	0.135	0.340*	0.316*	-0.004	0.173**	0.161*
	(0.239)	(0.060)	(0.022)	(0.191)	(0.092)	(0.072)	(0.969)	(0.040)	(0.065)
Trans-reform indicator $\delta_{c,t}^{TPBL}$	-0.080*	0.116	0.126**	-0.111*	0.069	0.085	-0.041	0.124**	0.136**
	(0.092)	(0.122)	(0.035)	(0.093)	(0.505)	(0.368)	(0.572)	(0.024)	(0.011)
Industry innovation potential $pot_{i,t}$	0.987***	0.829***	0.823***	1.229***	1.042***	1.026***	0.355*	0.321*	0.321*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.057)	(0.071)	(0.077)
Creditor rights index change $CRI_{c,t}$			-0.164*			-0.223***			-0.113**
			(0.054)			(0.000)			(0.037)
Observations	13034	13034	13034	12930	12930	12930	12204	12204	12204
Pseudo R^2	0.959	0.961	0.961	0.971	0.973	0.973	0.796	0.799	0.799
Other controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Country-industry & year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. Interaction effects

Regression	OA1B.1	OA1B.2	OA1B.3
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
Post-reform alignment $\delta_{c,t}^{XPBL} \times pot_{i,t}$	0.535***	0.483***	0.342***
	(0.000)	(0.000)	(0.002)
Trans-reform alignment $\delta_{c,t}^{TPBL} \times pot_{i,t}$	0.176***	0.126**	0.120
	(0.000)	(0.013)	(0.291)
Post-reform indicator $\delta_{c,t}^{XPBL}$	-0.262***	-0.245**	-0.165
	(0.008)	(0.015)	(0.207)
Trans-reform indicator $\delta_{c,t}^{XPBL}$	-0.061	-0.052	0.028
	(0.217)	(0.507)	(0.808)
Industry innovation potential $pot_{i,t}$	0.615***	0.783***	0.162
	(0.000)	(0.000)	(0.250)
Observations	13034	12930	12204
Pseudo R^2	0.963	0.975	0.800
Controls	Yes	Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes

Table OA2. The effect of PBL reform on innovation, technology class level

This table estimates the effect of PBL reform on innovation redefining industries as USPTO technology classes. The variables are otherwise as in Appendix Table A1. Numbers in parentheses are t-test p-levels, two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Summary statistics

Variables	Count	Mean	S.D.	Min.	P25	Median	P75	Max.
Explained variables:								
$patents^*_{i,c,t}$	16350	27.7	74.3	1.000	2.000	6.000	22.000	1544
$cites^*_{i,c,t}$	16350	555.9	1534.5	0.000	29.000	113.000	433.000	26894
$débuts^*_{i,c,t}$	16350	3.3	5.3	0.000	1.000	1.000	4.000	94
Variable of interests:								
PBL post-reform indicator $\delta^{XPBL}_{c,t}$	16350	0.323	0.468	0.000	0.000	0.000	1.000	1.000
PBL trans-reform indicator $\delta^{TPBL}_{c,t}$	16350	0.103	0.304	0.000	0.000	0.000	0.000	1.000
Industry innovation potential $pot^*_{i,t}$	16350	2.432	1.101	1.145	1.635	2.005	2.904	8.638
Control variables:								
Creditor rights index change $CRI_{c,t}$	16350	0.114	0.347	0.000	0.000	0.000	0.000	2.000
Country prosperity $\ln(pcGDP_{c,t})$	16350	1.046	0.455	-1.672	0.938	1.133	1.244	2.028
Country size $\ln(pop_{c,t})$	16350	3.006	1.218	1.078	1.898	2.873	4.049	6.977

Panel B. Main effects

Regression	OA2B.1	OA2B.2	OA2B.3	OA2B.4	OA2B.5	OA2B.6	OA2B.7	OA2B.8	OA2B.9
Explained variable		$patents^*_{i,c,t}$			$cites^*_{i,c,t}$			$débuts^*_{i,c,t}$	
Post-reform indicator $\delta^{XPBL}_{c,t}$	0.104	0.324***	0.314***	0.138	0.313***	0.287***	0.039	0.169**	0.153**
	(0.272)	(0.000)	(0.000)	(0.233)	(0.000)	(0.002)	(0.709)	(0.019)	(0.033)
Trans-reform indicator $\delta^{TPBL}_{c,t}$	-0.067	0.114**	0.122**	-0.097	0.065	0.077	-0.017	0.105**	0.115**
	(0.230)	(0.029)	(0.013)	(0.165)	(0.322)	(0.207)	(0.806)	(0.049)	(0.027)
Industry innovation potential $pot^*_{i,t}$	0.292***	0.268***	0.265***	0.309***	0.283***	0.275***	0.151***	0.139***	0.138***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Creditor rights index change $CRI_{c,t}$			-0.141***			-0.208***			-0.131***
			(0.007)			(0.005)			(0.004)
Country prosperity $\ln(pcGDP_{c,t})$		1.947***	2.004***		1.730***	1.832***		2.036***	2.099***
		(0.000)	(0.000)		(0.009)	(0.006)		(0.009)	(0.007)
Country size $\ln(pop_{c,t})$		1.883***	1.516**		2.784***	2.194**		1.239**	0.885
		(0.001)	(0.010)		(0.001)	(0.011)		(0.026)	(0.109)
Observations	16177	16177	16177	16177	16177	16177	16013	16013	16013
Pseudo R^2	0.913	0.916	0.916	0.935	0.938	0.938	0.564	0.567	0.567
Country-tech class & year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel C. Interaction effects

Explained variable	OA2C.1 $patents^{*}_{i,c,t}$	OA2C.2 $cites^{*}_{i,c,t}$	OA2C.3 $débuts^{*}_{i,c,t}$
Post-reform alignment to potential $\delta^{XPBL}_{c,t} \times pot^{*}_{i,t}$	0.160^{***} (0.000)	0.146^{***} (0.000)	0.106^{***} (0.000)
Trans-reform alignment to potential $\delta^{TPBL}_{c,t} \times pot^{*}_{i,t}$	0.057^{***} (0.000)	0.045^{**} (0.031)	0.030 (0.252)
Post-reform indicator $\delta^{XPBL}_{c,t}$	-0.125 (0.134)	-0.127 (0.243)	-0.111 (0.180)
Trans-reform indicator $\delta^{TPBL}_{c,t}$	-0.030 (0.529)	-0.039 (0.636)	0.046 (0.554)
Industry innovation potential $pot^{*}_{i,t}$	0.214^{***} (0.000)	0.215^{***} (0.000)	0.083^{**} (0.029)
Observations	16177	16177	16013
Pseudo R^2	0.917	0.939	0.568
Controls	Yes	Yes	Yes
Country-tech class & year FEs	Yes	Yes	Yes

Table OA3. Japanese patent counts as innovation potential proxy

This table estimates the effect of PBL reform on innovation by using Japanese firms' average patent counts in an industry to measure the industry's patent potential. The variables are defined in Appendix Table A1. Numbers in parentheses are t-test p-levels, two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Main effects

Regression	OA3A.1	OA3A.2	OA3A.3	OA3A.4	OA3A.5	OA3A.6	OA3A.7	OA3A.8	OA3A.9
Explained variable		$patents_{i,c,t}$			$cites_{i,c,t}$			$débuts_{i,c,t}$	
Post-reform indicator $\delta_{c,t}^{XPBL}$	0.090 (0.298)	0.325* (0.055)	0.313** (0.017)	0.129 (0.210)	0.314*** (0.001)	0.289*** (0.002)	0.027 (0.795)	0.162** (0.039)	0.149* (0.088)
Trans-reform indicator $\delta_{c,t}^{TPBL}$	-0.084* (0.076)	0.110 (0.129)	0.120* (0.050)	-0.116* (0.076)	0.057 (0.381)	0.069 (0.248)	-0.027 (0.696)	0.112** (0.029)	0.122** (0.012)
Industry innovation potential $pot_{i,t}$	0.877*** (0.001)	0.714*** (0.003)	0.706*** (0.002)	1.212*** (0.000)	1.033*** (0.000)	1.014*** (0.000)	0.398** (0.015)	0.336** (0.020)	0.333** (0.021)
Creditor rights index change $CRI_{c,t}$			-0.155** (0.012)			-0.199*** (0.001)			-0.118** (0.034)
Observations	14824	14824	14824	14710	14710	14710	13910	13910	13910
Pseudo R^2	0.956	0.959	0.959	0.969	0.972	0.972	0.789	0.792	0.792
Other controls		Yes	Yes		Yes	Yes		Yes	Yes
Country-industry & year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. Interaction effects

Regression	OA3B.1	OA3B.2	OA3B.3
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
Post-reform alignment to potential $\delta_{c,t}^{XPBL} \times pot_{i,t}$	0.368*** (0.000)	0.318*** (0.000)	0.194*** (0.001)
Trans-reform alignment to potential $\delta_{c,t}^{TPBL} \times pot_{i,t}$	0.131*** (0.000)	0.079*** (0.006)	0.067 (0.217)
Post-reform indicator $\delta_{c,t}^{XPBL}$	-0.292*** (0.000)	-0.278*** (0.003)	-0.132 (0.269)
Trans-reform indicator $\delta_{c,t}^{XPBL}$	-0.089** (0.048)	-0.064 (0.290)	0.031 (0.738)
Industry innovation potential $pot_{i,t}$	0.455*** (0.008)	0.792*** (0.000)	0.194* (0.061)
Observations	14824	14710	13910
Pseudo R^2	0.962	0.974	0.793
Controls	Yes	Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes

Table OA4. Effect of PBL reform on innovation, ex. four CRI reform countries

This table estimates the effect of the PBL reform on innovation by excluding four event countries with CRI change. The variables are defined in Appendix Table A1. Numbers in parentheses are t-test p-levels, clustering by country and industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Main effects

Regression	OA4A.1	OA4A.2	OA4A.3	OA4A.4	OA4A.5	OA4A.6	OA4A.7	OA4A.8	OA4A.9
Explained variable		$patents_{i,c,t}$			$cites_{i,c,t}$			$débuts_{i,c,t}$	
Post-reform indicator $\delta^{XPBL}_{c,t}$	0.085 (0.401)	0.343*** (0.004)	0.344*** (0.003)	0.087 (0.521)	0.317** (0.010)	0.318** (0.010)	-0.086 (0.523)	0.043 (0.654)	0.045 (0.636)
Trans-reform indicator $\delta^{TPBL}_{c,t}$	-0.056 (0.329)	0.154*** (0.004)	0.156*** (0.004)	-0.083 (0.310)	0.115* (0.065)	0.116* (0.061)	-0.085 (0.305)	0.058 (0.280)	0.060 (0.266)
Industry innovation potential $pot_{i,t}$	0.884*** (0.000)	0.717*** (0.000)	0.718*** (0.000)	1.001*** (0.000)	0.807*** (0.000)	0.807*** (0.000)	0.379** (0.029)	0.342** (0.031)	0.342** (0.030)
Creditor rights index change $CRI_{c,t}$			-0.493 (0.180)			-0.517 (0.207)			-0.172 (0.295)
Observations	12756	12756	12756	12642	12642	12642	11835	11835	11835
Pseudo R^2	0.962	0.965	0.965	0.973	0.976	0.976	0.794	0.798	0.798
Other controls		Yes	Yes		Yes	Yes		Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. Interaction effects

Regression	OA4B.1	OA4B.2	OA4B.3
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
Post-reform alignment to potential $\delta^{XPBL}_{c,t} \times pot_{i,t}$	0.494*** (0.000)	0.382*** (0.000)	0.351*** (0.000)
Trans-reform alignment to potential $\delta^{TPBL}_{c,t} \times pot_{i,t}$	0.191*** (0.000)	0.157*** (0.000)	0.159 (0.163)
Post-reform indicator $\delta^{XPBL}_{c,t}$	-0.215*** (0.003)	-0.139** (0.027)	-0.297*** (0.005)
Trans-reform indicator $\delta^{XPBL}_{c,t}$	-0.061* (0.076)	-0.070 (0.194)	-0.092 (0.370)
Industry innovation potential $pot_{i,t}$	0.557*** (0.000)	0.646*** (0.000)	0.215* (0.084)
Observations	12756	12642	11835
Pseudo R^2	0.966	0.977	0.799
Controls	Yes	Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes

Table OA5. Effect of PBL reform on innovation, different reform period definition

This table estimates the effect of PBL reform on innovation by defining the trans- and post-reform period differently. The variables are defined in Appendix Table A1. Numbers in parentheses are t-test p-levels, two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Main effects

Regression	OA5A.1	OA5A.2	OA5A.3	OA5A.4	OA5A.5	OA5A.6	OA5A.7	OA5A.8	OA5A.9
Explained variable		$patents_{i,c,t}$			$cites_{i,c,t}$			$débuts_{i,c,t}$	
Post-reform indicator $\delta_{c,t}^{XPBL}$	0.187* (0.078)	0.348* (0.069)	0.327** (0.034)	0.287** (0.012)	0.406*** (0.000)	0.368*** (0.001)	0.069 (0.495)	0.148 (0.104)	0.129 (0.152)
Trans-reform indicator $\delta_{c,t}^{TPBL}$	0.050 (0.258)	0.220*** (0.009)	0.214*** (0.003)	0.048 (0.397)	0.198*** (0.005)	0.185*** (0.003)	0.009 (0.901)	0.132** (0.018)	0.125** (0.029)
Industry innovation potential $pot_{i,t}$	0.997*** (0.000)	0.830*** (0.000)	0.826*** (0.000)	1.247*** (0.000)	1.048*** (0.000)	1.038*** (0.000)	0.429** (0.047)	0.369* (0.058)	0.367* (0.057)
Creditor rights index change $CRI_{c,t}$			-0.124 (0.124)			-0.164** (0.014)			-0.088 (0.128)
Observations	14862	14862	14862	14748	14748	14748	13941	13941	13941
Pseudo R^2	0.957	0.960	0.960	0.970	0.972	0.972	0.789	0.793	0.793
Other controls		Yes	Yes		Yes	Yes		Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. Interaction effects

Regression	OA5B.1	OA5B.2	OA5B.3
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
Post-reform alignment to potential $\delta_{c,t}^{XPBL} \times pot_{i,t}$	0.614*** (0.000)	0.577*** (0.000)	0.357*** (0.000)
Trans-reform alignment to potential $\delta_{c,t}^{TPBL} \times pot_{i,t}$	0.254*** (0.000)	0.199*** (0.000)	0.204* (0.094)
Post-reform indicator $\delta_{c,t}^{XPBL}$	-0.351*** (0.000)	-0.311*** (0.001)	-0.215** (0.049)
Trans-reform indicator $\delta_{c,t}^{XPBL}$	-0.058 (0.224)	-0.033 (0.445)	-0.066 (0.595)
Industry innovation potential $pot_{i,t}$	0.635*** (0.000)	0.793*** (0.000)	0.204 (0.163)
Observations	14862	14748	13941
Pseudo R^2	0.962	0.974	0.793
Controls	Yes	Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes

Table OA6. The effect of PBL reform on innovation, at the extensive margin

This table estimates the effect of the PBL reform on innovation at the extensive margin. The variables are defined in Appendix Table A1. Numbers in parentheses are t-test p-levels, clustering by country and industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Main effects

Regression	OA6A.1	OA6A.2	OA6A.3	OA6A.4	OA6A.5	OA6A.6	OA6A.7	OA6A.8	OA6A.9
Explained variable	$\delta_{patents_{i,c,t}>0}$ (Patent dummy)			$\delta_{cites_{i,c,t}>0}$ (Citation dummy)			$\delta_{débuts_{i,c,t}>0}$ (new patenter dummy)		
Post-reform indicator $\boldsymbol{\delta_{c,t}^{XPBL}}$	0.000 (0.993)	-0.011 (0.589)	-0.011 (0.588)	0.002 (0.930)	-0.008 (0.668)	-0.009 (0.648)	0.029 (0.160)	0.023 (0.194)	0.020 (0.258)
Trans-reform indicator $\boldsymbol{\delta_{c,t}^{TPBL}}$	-0.006 (0.688)	-0.011 (0.384)	-0.011 (0.380)	-0.006 (0.703)	-0.011 (0.418)	-0.010 (0.431)	0.004 (0.764)	0.002 (0.889)	0.004 (0.730)
Industry innovation potential $pot_{i,t}$	0.002 (0.912)	-0.001 (0.975)	-0.001 (0.975)	0.010 (0.655)	0.007 (0.748)	0.007 (0.749)	0.009 (0.736)	0.004 (0.867)	0.004 (0.868)
Creditor rights index change $CRI_{c,t}$			-0.001 (0.931)			-0.004 (0.697)			-0.021 (0.155)
Observations	17807	17807	17807	17807	17807	17807	17807	17807	17807
Adjusted R^2	0.666	0.664	0.667	0.667	0.565	0.567	0.567	0.567	0.567
Other controls		Yes	Yes		Yes	Yes		Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. Interaction effects

Regression	OA6B.1	OA6B.2	OA6B.3
Explained variable	$\delta_{patents_{i,c,t}>0}$	$\delta_{cites_{i,c,t}>0}$	$\delta_{débuts_{i,c,t}>0}$
Post-reform alignment to Potential $\delta_{c,t}^{XPBL} \times pot_{i,t}$	0.020 (0.159)	0.020 (0.130)	0.023 (0.203)
Trans-reform alignment to potential $\delta_{c,t}^{TPBL} \times pot_{i,t}$	0.047** (0.042)	0.042* (0.087)	0.027 (0.145)
Post-reform indicator $\delta_{c,t}^{XPBL}$	-0.027 (0.153)	-0.025 (0.153)	0.001 (0.967)
Trans-reform indicator $\delta_{c,t}^{XPBL}$	-0.048** (0.025)	-0.044* (0.055)	-0.017 (0.294)
Industry innovation potential $pot_{i,t}$	-0.009 (0.676)	-0.000 (0.991)	-0.003 (0.929)
Observations	17807	17807	17807
Adjusted R^2	0.666	0.667	0.567
Controls	Yes	Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes

Table OA7. The effect of PBL reform on innovation, alternative measures

This table estimates the effect of the PBL reform on innovation by using two different innovation measures. The variables are defined in Appendix Table A1. Numbers in parentheses are t-test p-levels, clustering by country and industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Main effects

Regression	OA7A.1	OA7A.2	OA7A.3	OA7A.4	OA7A.5	OA7A.6
Explained variable		$ncites_{c,t}$			$cites\_14y_{c,t}$	
Post-reform indicator	0.072	0.280**	0.262**	0.154*	0.281***	0.248***
$\delta_{c,t}^{XPBL}$	(0.445)	(0.031)	(0.011)	(0.060)	(0.001)	(0.003)
Trans-reform indicator	-0.114**	0.069	0.080	-0.113**	0.030	0.041
$\delta_{c,t}^{TPBL}$	(0.046)	(0.332)	(0.169)	(0.047)	(0.629)	(0.411)
Industry innovation potential	1.073***	0.909***	0.897***	1.092***	0.929***	0.910***
$pot_{i,t}$	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Creditor rights index change			-0.197***			-0.223***
$CRI_{c,t}$			(0.000)			(0.008)
Observations	14748	14748	14748	10070	10070	10070
Pseudo R^2	0.945	0.948	0.948	0.967	0.970	0.970
Other controls		Yes	Yes		Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. Interaction effects

Regression	OA7B.1	OA7B.2
Explained variable	$ncites_{c,t}$	$cites\_14y_{c,t}$
Post-reform alignment to potential	0.517***	0.453***
$\delta_{c,t}^{XPBL} \times pot_{i,t}$	(0.000)	(0.000)
Trans-reform alignment to potential	0.175***	0.112**
$\delta_{c,t}^{TPBL} \times pot_{i,t}$	(0.000)	(0.026)
Post-reform indicator	-0.311***	-0.274**
$\delta_{c,t}^{XPBL}$	(0.003)	(0.014)
Trans-reform indicator	-0.104**	-0.080
$\delta_{c,t}^{XPBL}$	(0.042)	(0.186)
Industry innovation potential	0.669***	0.675***
$pot_{i,t}$	(0.000)	(0.000)
Observations	14748	10070
Pseudo R^2	0.950	0.972
Controls	Yes	Yes
Country-industry & year FEs	Yes	Yes

Table OA8. Effect of PBL reform on radical innovation

This table estimates the effect of the PBL reform on radical innovation by using two different measures. The variables are defined in Appendix Table A1. Numbers in parentheses are t-test p-levels, two-way clustering by country and industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Main effects

Regression	OA8A.1	OA8A.2	OA8A.3	OA8A.4	OA8A.5	OA8A.6
Explained variable		$radical\_1_{i,c,t}$			$radical\_2_{i,c,t}$	
Post-reform indicator	0.031	0.253***	0.229***	0.150	0.333***	0.316***
$\delta_{c,t}^{XPBL}$	(0.785)	(0.004)	(0.008)	(0.116)	(0.001)	(0.001)
Trans-reform indicator	-0.145**	0.049	0.062	-0.080	0.088	0.105**
$\delta_{c,t}^{TPBL}$	(0.030)	(0.429)	(0.256)	(0.146)	(0.134)	(0.041)
Industry innovation potential	0.935***	0.748***	0.730***	0.987***	0.883***	0.869***
$pot_{i,t}$	(0.004)	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)
Creditor rights index change			-0.236***			-0.273**
$CRI_{c,t}$			(0.002)			(0.016)
Observations	9664	9664	9664	12563	12563	12563
Pseudo R^2	0.807	0.810	0.811	0.921	0.923	0.923
Other controls		Yes	Yes		Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. Interaction effects

Regression	OA8B.1	OA8B.2
Explained variable	$radical\_1_{i,c,t}$	$radical\_2_{i,c,t}$
Post-reform alignment to potential	0.493***	0.357***
$\delta_{c,t}^{XPBL} \times pot_{i,t}$	(0.000)	(0.000)
Trans-reform alignment to potential	0.117*	0.081
$\delta_{c,t}^{TPBL} \times pot_{i,t}$	(0.083)	(0.101)
Post-reform indicator	-0.324***	-0.117
$\delta_{c,t}^{XPBL}$	(0.006)	(0.361)
Trans-reform indicator	-0.059	0.012
$\delta_{c,t}^{XPBL}$	(0.513)	(0.876)
Industry innovation potential	0.512***	0.740***
$pot_{i,t}$	(0.003)	(0.000)
Observations	9664	12563
Pseudo R^2	0.812	0.924
Controls	Yes	Yes
Country-industry & year FEs	Yes	Yes

Table OA9. Effect of PBL reform on innovative entrepreneurship, other measure

This table estimates the effect of the PBL reform on innovative entrepreneurship by using another measure. The variables are defined in Appendix Table A1. Numbers in parentheses are t-test p-levels, two-way clustering by country and industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Main effects

Regression	OA9A.1	OA9A.2	OA9A.3
Explained variable		$d\acute{e}but\_1_{i,c,t}$	
Post-reform indicator	0.028	0.156*	0.142
$\delta_{c,t}^{XPBL}$	(0.808)	(0.051)	(0.103)
Trans-reform indicator	-0.050	0.085*	0.096*
$\delta_{c,t}^{TPBL}$	(0.498)	(0.089)	(0.086)
Industry innovation potential	0.546***	0.485***	0.484***
$pot_{i,t}$	(0.005)	(0.003)	(0.003)
Creditor rights index change			-0.123***
$CRI_{c,t}$			(0.000)
Observations	10579	10579	10579
Pseudo R^2	0.585	0.588	0.588
Other controls		Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes

Panel B. Interaction effects

Regression	OA9B.1
Explained variable	$d\acute{e}but\_1_{i,c,t}$
Post-reform alignment to potential	0.209***
$\delta_{c,t}^{XPBL} \times pot_{i,t}$	(0.010)
Trans-reform alignment to potential	0.045
$\delta_{c,t}^{TPBL} \times pot_{i,t}$	(0.528)
Post-reform indicator	-0.055
$\delta_{c,t}^{XPBL}$	(0.624)
Trans-reform indicator	0.032
$\delta_{c,t}^{XPBL}$	(0.727)
Industry innovation potential	0.524***
$pot_{i,t}$	(0.000)
Observations	9677
Pseudo R^2	0.896
Controls	Yes
Country-industry & year FEs	Yes

Table OA10. Leave-one-country-out robustness

Panels A and B of this table summarize difference-in-differences Poisson regressions testing the average and the interaction effect of PBL reform on innovation by dropping two major patenting countries one at a time. In panel A, for all regressions, only the coefficient on the PBL post-reform indicator $\boldsymbol{\delta_{c,t}^{XPBL}}$ and its significance are reported. In panel B, only the coefficient on $\delta_{c,t}^{XPBL} \times pot_{i,t}$ and its significance are reported. Standard errors are estimated, two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
Panel A. Main effects			
Dropping Germany	0.307^{***}	0.291^{***}	0.083
Dropping Japan	0.285^{**}	0.269^{**}	0.143
Panel B. Interaction effects			
Dropping Germany	0.525^{***}	0.502^{***}	0.340^{***}
Dropping Japan	0.620^{***}	0.544^{***}	0.349^{***}
Controls	Yes	Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes

Table OA11. Leave-one-year-out robustness

Panels A and B of this table summarize difference-in-differences Poisson regressions testing the average and the interaction effect of PBL reform on innovation by dropping one year at a time, respectively. In panel A, for all regressions, only the coefficient on the PBL post-reform indicator $\boldsymbol{\delta_{c,t}^{XPBL}}$ and its significance are reported. In panel B, only the coefficient on $\delta_{c,t}^{XPBL} \times pot_{i,t}$ and its significance are reported. Standard errors are estimated, two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Main effects

Dropped year	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
1990	0.305**	0.289***	0.147*
1991	0.309**	0.290***	0.149*
1992	0.310***	0.295***	0.146*
1993	0.321***	0.313***	0.160**
1994	0.316**	0.305***	0.146
1995	0.316***	0.299***	0.145*
1996	0.311***	0.296***	0.149
1997	0.317***	0.304***	0.164*
1998	0.298**	0.275***	0.149*
1999	0.333**	0.338***	0.141
2000	0.334***	0.306***	0.129
2001	0.287***	0.271***	0.148*
2002	0.278***	0.257***	0.158**
Panel B. Interaction effects			
1990	0.507***	0.439***	0.336***
1991	0.512***	0.453***	0.321***
1992	0.519***	0.453***	0.348***
1993	0.530***	0.472***	0.354***
1994	0.540***	0.500***	0.357***
1995	0.557***	0.506***	0.373***
1996	0.533***	0.481***	0.359***
1997	0.532***	0.470***	0.368***
1998	0.536***	0.485***	0.364***
1999	0.561***	0.508***	0.344***
2000	0.520***	0.463***	0.339***
2001	0.593***	0.554***	0.344***
2002	0.516***	0.493***	0.354**
Controls	Yes	Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes

Table OA12. Event study, robustness checks

In this table, panel A adopts an event study among event countries from year *t*-5 to year *t*+3 (*t* represents the PBL reform year). Panel B adopts an event study among event countries within year *t*-4 to year *t*+2, by including *CRI*. Numbers in parentheses are t-test p-levels, two-way clustering by country and industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Panel A. Event study, t-5 to t+3

Regression	OA12A.1	OA12A.2	OA12A.3
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
Post-reform alignment to potential	0.379***	0.311***	0.280***
$\delta_{c,t}^{XPBL} \times pot_{i,t}$	(0.000)	(0.000)	(0.001)
Trans-reform alignment to potential	0.099*	0.046	0.084
$\delta_{c,t}^{TPBL} \times pot_{i,t}$	(0.062)	(0.366)	(0.258)
Post-reform indicator	-0.281***	-0.234**	-0.234***
$\delta_{c,t}^{XPBL}$	(0.007)	(0.029)	(0.000)
Trans-reform indicator	-0.085	-0.048	-0.079
$\delta_{c,t}^{TPBL}$	(0.166)	(0.546)	(0.234)
Industry innovation potential	0.432***	0.499**	0.009
$pot_{i,t}$	(0.000)	(0.013)	(0.940)
Observations	5404	5380	5071
Pseudo R^2	0.971	0.979	0.810
Controls	Yes	Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes

Panel B. Event study, t-4 to t+2, including *CRI*

Regression	OA12B.1	OA12B.2	OA12B.3
Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
Post-reform alignment to potential	0.351***	0.279***	0.232***
$\delta_{c,t}^{XPBL} \times pot_{i,t}$	(0.000)	(0.000)	(0.005)
Trans-reform alignment to potential	0.110***	0.054	0.057
$\delta_{c,t}^{TPBL} \times pot_{i,t}$	(0.007)	(0.214)	(0.466)
Post-reform indicator	-0.127	-0.067	-0.179
$\delta_{c,t}^{XPBL}$	(0.230)	(0.529)	(0.109)
Trans-reform indicator	-0.050	0.003	-0.031
$\delta_{c,t}^{TPBL}$	(0.367)	(0.967)	(0.537)
Industry innovation potential	0.325***	0.404*	-0.015
$pot_{i,t}$	(0.005)	(0.084)	(0.923)
Observations	4271	4252	3982
Pseudo R^2	0.974	0.982	0.811
Controls	Yes	Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes

Table OA13. Interaction effect of PBL reform on innovation, robustness

This table estimates the interaction effect of PBL reform on innovation by using a time-invariant measure of innovation potential. Instead of using a time-varying $pot_{i,t}$, we construct a pre-reform, time-invariant indicator $pot\_pre_{c,i}$, defined as $pot_{i,t}$ in industry *i* in the year right before the PBL reform of country *c*. Panel A reruns the baseline regressions using the full sample. Panel B restricts the sample to a balanced event window for each event country (from t−5 to t+4). Panel C generates a normalized measure $n\_pot\_pre_{c,i}$ by ranking $pot\_pre_{c,i}$ within each country. Numbers in parentheses are t-test p-levels, two-way clustering by country and by industry, with one, two, or three asterisks indicating significance at 10%, 5%, or 1%, respectively.

Explained variable	$patents_{i,c,t}$	$cites_{i,c,t}$	$débuts_{i,c,t}$
Panel A. Full sample			
Post-reform alignment	0.547^{***}	0.507^{***}	0.401^{***}
$\delta_{c,t}^{XPBL} \times pot\_pre_{c,i}$	(0.000)	(0.000)	(0.001)
Observations	14862	14748	13941
Pseudo R^2	0.961	0.972	0.793
Panel B. Balanced event window			
Post-reform alignment	0.407^{***}	0.350^{***}	0.239^{**}
$\delta_{c,t}^{XPBL} \times pot\_pre_{c,i}$	(0.000)	(0.000)	(0.011)
Observations	11033	10923	10167
Pseudo R^2	0.963	0.974	0.796
Panel C. Normalized measure			
Post-reform alignment	0.916^{***}	0.879^{***}	0.687^{***}
$\delta_{c,t}^{XPBL} \times n\_pot\_pre_{c,i}$	(0.002)	(0.001)	(0.000)
Observations	14862	14748	13941
Pseudo R^2	0.960	0.971	0.793
Controls	Yes	Yes	Yes
Country-industry & year FEs	Yes	Yes	Yes

Table OA14. Google n-grams used in Figure 1

Google n-grams searches count the number of times a phrase occurs in all publications in a given language as a fraction of all phrases of similar word count each year. Variation over time in this fraction can be interpreted as variation in attention to the concept it represents. Case-insensitive searches conducted from four years before to four years after each reform, using the name of the legislation as the search term with the language set to the business language of the country. If the country's main language is not included in the Google n-grams or if the country is multilingual, English data are searched. Publications are grouped by language, not by country of publication (ex. U.S. and British English are separate categories), and not all languages are covered. If this procedure shows no attention, a second search is done using the name of the nationality and the term bankruptcy – e.g. "Swedish bankruptcy" in the country's business language, and then in English. This can confound attention to corporate bankruptcy with attention to personal bankruptcy news. Searches along the lines of "Swedish personal bankruptcy" return blank results. This procedure yields n-grams for all cases except Finland's reform, which is therefore dropped. Google n-grams data are as of April 23, 2026.

country	search term	t - 5	reform	t + 5	lang.	-4	-3	-2	-1	0	1	2	3	4
Argentina	bancarrota personal	1992	1996	2000	Spa.	0.00	0.46	1.34	1.36	0.85	2.78	1.16	0.37	0.35
Australia	Bankruptcy Legislation Amendment Act	1993	1997	2001	Eng.	0.00	0.00	0.93	2.15	2.43	1.62	1.30	1.34	1.07
Austria	Österreichisches Insolvenzrecht	1991	1995	1999	Ger.	0.00	0.34	0.53	2.05	1.86	3.20	0.63	0.51	0.19
Belgium	Belgian bankruptcy	1994	1998	2002	Eng.	0.25	0.20	0.20	1.83	1.64	0.32	0.65	2.02	2.10
Canada	Bankruptcy and Insolvency Act	1989	1993	1997	Eng.	0.49	0.10	0.11	0.15	0.87	1.58	2.03	1.81	1.68
France	lutte contre les exclusions	1995	1999	2003	Eng.	0.00	0.00	0.28	1.10	1.41	2.57	2.30	0.85	1.36
Germany	Deutsches Insolvenzrecht	1995	1999	2003	Ger.	0.00	0.56	1.67	3.23	0.00	0.93	1.81	1.28	0.78
Hong Kong	个人破产法	1994	1998	2002	Chi.	0.00	0.45	0.00	0.10	0.27	1.39	2.58	2.41	1.21
Israel	פְּשִׁיטַת רֶגֶל	1991	1995	1999	Heb.	0.93	0.85	0.78	0.96	0.98	0.64	1.03	1.23	1.49
Japan	Civil Rehabilitation Law	1997	2001	2005	Eng.	0.14	0.02	2.56	1.74	1.57	1.26	1.22	0.39	0.87
Mexico	Ley de Concursos Mercantiles	1996	2000	2004	Spa.	0.03	0.00	0.03	0.34	1.28	0.50	1.69	2.04	2.51
Netherlands	Netherlands bankruptcy	1995	1999	2003	Eng.	0.95	1.20	0.73	1.43	0.47	1.07	0.65	1.41	0.77
New Zealand	Insolvency Act 2000	1997	2001	2005	Eng.	0.00	0.00	0.00	0.00	0.66	3.04	2.80	1.14	2.93
Norway	Norwegian bankruptcy	1989	1993	1997	Eng.	0.00	0.00	0.00	0.00	0.00	0.00	3.49	0.00	0.00
Singapore	Bankruptcy Act 1995	1992	1996	2000	Eng.	0.00	0.00	0.28	1.10	1.41	2.57	2.30	0.85	1.36
Sweden	Swedish bankruptcy	1991	1995	1999	Eng.	0.57	1.43	0.22	0.91	0.43	0.44	0.85	1.26	0.71
Switzerland	Debt Enforcement and Bankruptcy Law	1995	1999	2003	Eng.	0.00	0.00	0.53	0.00	7.30	0.00	0.51	0.00	0.64
					Average	0.20	0.33	0.60	1.09	1.38	1.41	1.59	1.11	1.18

Online Appendix B. Machine Learning USPC subclass to primary SICSN link

The USPC subclasses that are linked to multiple SICSNs necessitate judgment calls. Some prior studies do rough matches using only the first (numerically lowest) SICSN; which need not be its most important SICSN. We, therefore, use machine learning to match each patent to one *primary* SICSN. Specifically, we first obtain the text of the title and abstract of each successful patent application from PATSTAT or, failing that, from Google Patents, by publication number. Google's Word2Vec300, a two-layer neural net, then transforms this text into numerical 300-element feature vectors suitable as input for deep-learning neural networks.[12]

We next partition the universe of successful patent applications into 2,284,033, whose USPC subclass corresponds to a single SICSN (Group 1), and 924,822, whose USPC subclass corresponds to multiple SICSNs (Group 2). We randomly draw ten disjoint training subsamples of roughly 200,000 patent applications each from Group 1. The draw is proportional to the population distribution across SICSNs, so the subsample sizes vary slightly. This leaves 283,540 Group 1 patent applications for out-of-sample validation tests.

We then apply logistic, lasso, elastic net, and ridge regressions as well as artificial neural network (ANN), and convolution neural network (CNN) to these training subsamples to use patent applications' feature vectors to ascertain a principal SICSN for each.[13] This yields ten alternative versions of each technique. Each technique is then tested out-of-sample using the 283,540 patent applications excluded from the random draw. The deep-learning neural net approaches stand out as markedly more accurate, with CNN slightly more accurate than ANN. Out-of-sample success rates (average predicted probabilities across the ten versions) are 0.58 for logit regressions, 0.59 for elastic net regressions, 0.58 for lasso regressions, 0.58 for ridge regressions, 0.66 for ANNs, and 0.67 for CNNs. CNNs require more computer time than ANNs, but not prohibitively more in this case.

We therefore use CNNs. A 67% success rate is substantially above the baseline 2.4% probability of a uniform distribution accords each of the 42 SICSNs. Consequently, we deem a CNN "valid" if it assigns a probability higher than 2.4% (better than chance) to the matched SICSN.

Finally, we use the average choices of the ten CNNs trained as above to assign probabilities to each of the multiple SICSNs associated with a Group 2 patent application. Specifically, we declare the primary SICSN of each Group 2 patent application to be that with the highest probability, averaged across valid CNNs. For patent applications with no valid CNN (about 2.75%), we rely on the CNN that accords the

---

[12] See https://code.google.com/archive/p/word2vec/ for details.

[13] CNNs, though developed to analyze images, has advantages in analyzing vectors (Kiranyaz et al. 2021).

highest probability to the patent's SICSNs to make the decision. This approach successfully assigns primary SICSN to 923,422 of the 924,822 patent applications in Group 2. The remaining 1,400 (0.15%) are randomly assigned a primary SICSN from its SICSNs.

We assess this approach by assigning a second false (placebo) SICSN to each one-SICSN patent application in the out-of-sample validation subset of Group 1. Our approach selects the correct SICSN in 97% of cases. Our approach selects the first (lowest) SICSN as primary in only 36% of Group 2 patent applications.

Table OA15 summarizes the resulting industry code concordance of USPC subclasses and primary SICSNs.

Table OA15. SIC-Sequence-Number to SIC-Code concordance table

We carefully match the SIC sequence numbers with the SIC codes. First, for seven SIC codes that cannot be matched to any SIC sequence number, we put a * in the column "SIC Sequence Number" in the Online Appendix. These SIC codes are 21, 23-27 and 31. We record these seven industries in the format of 1*, 2*…7* in a separate column "Industrial Classification." These industries do not have patents recorded with the USPTO. However, we still need to keep these industries for our analysis because firms may enter or exit these industries. Second, when we count the number of unique industries, to avoid double counting, we skip redundant SIC sequence numbers, i.e., those matched with the same SIC codes as other SIC sequence numbers. For example, we skip SIC sequence numbers 3, 4, 5 and 10 because SIC sequence numbers 6, 7, 8, 9, 11, 12 and 13 are matched with the same SIC codes as theirs. After skipping redundant SIC sequence numbers, we renumber the SIC sequence numbers in the column "Industrial Classification." We also skip SIC sequence number 56 and SIC code 39 because they do not refer to any specific industries. This matching process results in 49 unique industries, including 42 industries with patents and 7 industries without patents. The original data source is the 2008 OTAF Concordance Table available at: http://www.uspto.gov/web/offices/ac/ido/oeip/taf/data/sic_conc/2008_diskette/.

SSN Sequence Sequence	Industrial class-ification	Product Field Title	SIC Code
1	1	FOOD AND KINDRED PRODUCTS	20
*	1*	TOBACCO MANUFACTURES	21
2	2	TEXTILE MILL PRODUCTS	22
*	2*	APPAREL AND OTHER TEXTILE PRODUCTS	23
*	3*	LUMBER AND WOOD PRODUCTS	24
*	4*	FURNITURE AND FIXTURES	25
*	5*	PAPER AND ALLIED PRODUCTS	26
*	6*	PRINTING AND PUBLISHING	27
3		CHEMICALS AND ALLIED PRODUCTS	28
4		Chemicals, except drugs and medicines	281,282,284-289
5		Basic industrial inorganic and organic chemistry	281,286
6	3	Industrial inorganic chemistry	281
7	4	Industrial organic chemistry	286
8	5	Plastics materials and synthetic resins	282
9	6	Agricultural chemicals	287
10		All other chemicals	284,285,289
11	7	Soaps, detergents, cleaners, perfumes, cosmetics and toiletries	284
12	8	Paints, varnishes, lacquers, enamels, and allied products	285
13	9	Miscellaneous chemical products	289
14	10	Drugs and medicines	283
15	11	PETROLEUM AND NATURAL GAS EXTRACTION AND REFINING	13,29
16	12	RUBBER AND MISCELLANEOUS PLASTICS PRODUCTS	30
*	7*	LEATHER AND LEATHER PRODUCTS	31
17	13	STONE, CLAY, GLASS AND CONCRETE PRODUCTS	32
18		PRIMARY METALS	33,3462,3463
19	14	Primary ferrous products	331,332,3399,3462
20	15	Primary and secondary non-ferrous metals	333-336, 339(ex.3399),3463
21	16	FABRICATED METAL PRODUCTS	34(except 3462,3463,348)
22		MACHINERY, EXCEPT ELECTRICAL	35

23	17	Engines and turbines	351
24	18	Farm and garden machinery and equipment	352
25	19	Construction, mining and material handling machinery and equipment	353
26	20	Metal working machinery and equipment	354
27	21	Office computing and accounting machines	357
28		Other machinery, except electrical	355,356,358,359
29	22	Special industry machinery, except metal working	355
30	23	General industrial machinery and equipment	356
31	24	Refrigeration and service industry machinery	358
32	25	Miscellaneous machinery, except electrical	359
33		ELECTRICAL AND ELECTRONIC MACHINERY, EQUIPMENT AND SUPPLIES	36,3825
34		Electrical equipment, except communications equipment	361-364,369,3825
35	26	Electrical transmission and distribution equipment	361,3825
36	27	Electrical industrial apparatus	362
37		Other electrical machinery, equipment and supplies	363,364,369
38	28	Household appliances	363
39	29	Electrical lighting and wiring equipment	364
40	30	Miscellaneous electrical machinery, equipment and supplies	369
41		Communications equipment and electronic components	365-367
42	31	Radio and television receiving equipment ex. communication types	365
43	32	Electronic components & accessories & communications equip.	366-367
44		TRANSPORTATION EQUIPMENT	37,348
45		Motor vehicles and other transportation equipment, except aircraft	348,371,373-376,379
46	33	Motor vehicles and other motor vehicle equipment	371
47	34	Guided missiles and space vehicles and parts	376
48		Other transportation equipment	373-375,379(except 3795)
49	35	Ship and boat building and repairing	373
50	36	Railroad equipment	374
51	37	Motorcycles, bicycles, and parts	375
52	38	Miscellaneous transportation equipment	379(except 3795)
53	39	Ordinance except missiles	348,3795
54	40	Aircraft and parts	372
55	41	PROFESSIONAL AND SCIENTIFIC INSTRUMENTS	38(except 3825)
*		MISCELLANEOUS MANUFACTURING INDUSTRIES	39
56	42	ALL OTHER SICs	99