The Informational Value of Patents in Banking Relationships*

Farzad Saidi† University of Cambridge

Alminas Žaldokas‡ HKUST

September 15, 2015

Abstract

Is there a trade-off between patenting and secrecy for innovating firms, and if so, is it influenced by financial relationships? In this paper, we scrutinize the impact of banks' information acquisition on the incentives to disclose innovation through patents by borrower firms. We find that increased lender informedness following the creation of universal banks leads to fewer patents issued by publicly listed U.S. firms, without affecting investment in innovation and its outcomes. To provide further evidence of the value of private information in banking relationships, we exploit the American Inventor's Protection Act of 1999 as a shock to innovation disclosure. We find that firms in industries that experienced a greater change in the publicity of their patent applications were significantly more likely to break up their previous banking relationships to switch lenders, and especially so if the incumbent lender was a universal bank that had greater scope for private-information acquisition.

JEL classification: G20, G21, O31

Keywords: patenting, loan contracting, universal banking, information acquisition, corporate disclosure, innovation

*We thank Laurent Bach, William Mann, Adrien Matray, Ramana Nanda, Marcus Opp, Jaideep Prabhu, Per Strömberg and Stefan Wagner, as well as seminar participants at Stockholm School of Economics for many helpful suggestions. We also thank Nicky Ferguson and especially Thilo Kind for excellent research assistance. Saidi acknowledges generous research support by the Cambridge Endowment for Research in Finance and the Keynes Fund for Applied Economics in Cambridge.

†University of Cambridge, Judge Business School, Trumpington Street, Cambridge CB2 1AG, United Kingdom. E-mail: f.saidi@jbs.cam.ac.uk

‡Hong Kong University of Science and Technology (HKUST) Business School, Department of Finance, Clear Water Bay, Kowloon, Hong Kong. E-mail: alminas@ust.hk

1 Introduction

Firms' information production and their disclosure decisions are inevitably related to their participation in financial markets. Although the literature has extensively looked at how such information is produced in efforts to raise capital in public markets, there has been far less empirical evidence on how firms signal information to private providers of capital, and how such disclosure decisions interrelate with capital providers' learning process about firms.

We consider one particular group of private providers of capital – banks. In lending and other relationships, banks have incentives to produce information about firms, which, in turn, affects firms' own disclosure decisions. Such incentives and ability of banks to produce information are also related to the type of relationship they have with firms. For instance, banks of wide scope, such as universal banks, have more means of generating information about their borrowers, operationalized through cross-selling.

In order to empirically estimate how banks' information production relates to firms' disclosure decisions, we consider firms' patenting behavior. Firms face a decision whether to patent their innovation, in which case they receive intellectual property protection at the cost of rivals learning more about firms' innovation activities, or to keep it secret. Such disclosure about firms' technological progress is also relevant for their financing choices, assuming it provides a credible signal about their innovation process. On the other hand, financiers that are well-informed about their borrowers' activities through other sources might benefit less from additional information stemming from patents.

Our study hinges on two settings. First, we study how firms' disclosure behavior changes after their lenders' informedness increases. To this end, we use the rise of universal banking as a source of variation in bank scope, in particular a deregulation in 1996 that boosted cross-selling by universal banks and relaxed restrictions on bank-scope-increasing mergers between commercial and investment banks. This enables us to scrutinize changes in the disclosure behavior of firms that transacted with a loan-granting commercial bank and also received an underwriting product from an investment bank, both of which have merged – either with

each other (treatment group) or with other banks of complementary scope (control group). We find that when banks can gather more information about their borrowers through both loans and non-loan products, firms patent less, while their level of innovation – as measured by research and development and new-product announcements – is unaffected.

Our evidence suggests that lower levels of information asymmetry between lenders and borrowers change firms' incentives to produce information because of the value of private information in banking relationships. This implies that, due to its value, private-information acquisition should lead to greater stability of banking relationships. To provide evidence for this mechanism, we consider the feedback effect of how changing costs of voluntary information disclosure affect firms' ability, or willingness, to switch lenders. Presumably, when firms are exogenously forced to generate more publicly available information, bank-firm relationships that were formed based on endogenous information production might be broken as the value of private information in bank-firm relationships decreases. In other words, firms face fewer costs to switch to new lenders when they are pressed to increase their disclosure standards.

In order to shed light on how information disclosure affects the stability of banking relationships, we rely on our second setting. Here we exploit the adoption of the American Inventor's Protection Act of 1999 (AIPA) that forced firms to disclose the content of their patent applications within 18 months after the filing date. Prior to this legal change, information about patents became public only after they were granted. Firms could therefore delay revealing the content of their patents without losing prior art protection. We recognize that in the pre-AIPA era, industries differed in the time lag between patent applications and grant dates. Thus, we define the cross-sectional intensity of AIPA's passage based on this delay. We argue that industries with the longest lag between application filing and patent disclosure were most heavily affected by the passage of AIPA, which imposed a maximum delay time of 18 months, even for patents that were not granted eventually. For the validity of our identification strategy, any such pre-AIPA delay measure must not be – and we, in fact, show that it is not – correlated with cross-industry variation in access to finance or

other characteristics that might influence banking relationships.

After controlling for shocks to firm-level demand and bank-level supply of loans, we find that firms in industries that were affected more heavily in their time to innovation disclosure following AIPA were significantly more likely to break up their existing banking relationships to form new ones. This suggests that after the publicity of firms' innovation increases, the value of formerly private information in banking relationships drops, thereby allowing firms to switch lenders who are no longer at an informational disadvantage compared to the incumbent lender. We show that this effect is especially pronounced among relationships with universal banks that had greater means for private-information acquisition, and for firms that issued non-zero patents in the pre-AIPA period.

To the best of our knowledge, this paper constitutes the first comprehensive empirical analysis of the interplay between banks' potential for information acquisition and corporate-innovation disclosure, and how the latter can spill over back into the stability of banking relationships. In doing so, our paper relates to the literature on how banks produce information about firms and, thereby, mitigate informational asymmetries. Banks learn about borrower firms through screening and monitoring activities (Ramakrishnan and Thakor (1984); Diamond (1984); Allen (1990); Winton (1995); Dass and Massa (2011)), and they are likely to learn even more if they provide multiple services to the firm (Boot (2000); Degryse and Van Cayseele (2000); Neuhann and Saidi (2014)).

The empirical literature has focused on relationship lending as one way how banks' information about a firm and its reusability interact with firms' financing decisions (see Houston and James (1996) for evidence on public firms, or Boot (2000) for a more extensive summary). Our paper argues that banks' information acquisition affects the public information that firms release to markets, and in reverse, when such public information is exogenously made more available, it becomes cheaper for firms to break up existing relationships. As we argue that the value of private information between lenders and borrowers governs firms' ability to switch lenders, our paper connects with Rajan (1992), who argues that banks' private information can lead to greater hold-up. By testing this claim, our paper provides

empirical evidence on the stability and duration of banking relationships, as discussed in Ongena and Smith (2001) and Gopalan, Udell, and Yerramilli (2011).

Furthermore, we contribute to the literature on how the development of the financial sector affects firms' patenting decisions (Benfratello, Schiantarelli, and Sembenelli (2008); Amore, Schneider, and Žaldokas (2013); Chava, Oettl, Subramanian, and Subramanian (2013); Cornaggia, Mao, Tian, and Wolfe (2015); see also Kerr and Nanda (2014) for an extensive survey of the literature). These papers have largely focused on how banking development affected firm-level innovation strategies as captured in terms of new patents granted. Some recent papers have highlighted that patents might have an additional role on top of recording firm-level innovation. For instance, Mann (2014) argues that patents can act as collateral for loans. Chava, Nanda, and Xiao (2015) also show that certain facets of patents, namely increased patent protection and creditor rights over collateral, result in cheaper loans. We uncover an additional, reverse channel through which credit affects patenting, building on the idea that patents constitute a credible signal for the quality of otherwise hard-to-observe innovation. Importantly, our results are unlikely to be driven by firm-level changes in actual innovation – measured either as its inputs (research and development expenditures) or outputs (new-product announcements and Tobin's q).

Kerr and Nanda (2014) acknowledge the increasingly important role of bank finance (and debt) for innovation, hinting at the relevance of financial contracting even among mature firms. While the level of asymmetric information is typically assumed to be low between banks and publicly listed firms, such as those under scrutiny in this paper, innovation is among the most uncertain types of investments undertaken by these firms. We show that there is value attached to information acquisition about public firms in lending relationships, which speaks to the monitoring channel of bank finance. In particular, the kind of monitoring mechanism we consider is specific to large universal banks that have the ability to cross-sell loans and non-loan products to firms. In this manner, our paper specifies, and further differentiates, the role of bank finance for innovation, compared with studies on the (typically equity) financing of early-stage firms which do not continuously develop a portfolio

of innovations but, instead, are entirely characterized by a single innovation, namely their product (see, for instance, Bernstein, Giroud, and Townsend (2015)).

Lastly, our paper also relates to studies on voluntary disclosure and proprietary costs in disclosing information. In testing the hypotheses generated by a voluminous theoretical literature (e.g., Darrough (1993); Gigler (1994); Evans and Sridhar (2002); Ganglmair and Oh (2014)), empirical work faces the challenge that most of firms' public disclosure might have limited proprietary costs. We consider a case where such proprietary costs are significant, namely firms' trade-off between patenting their innovation and keeping it secret. Given the unobservability of innovation that remains secret, most of the empirical literature has relied on survey data (Hall, Helmers, Rogers, and Sena (2014)). We exploit a shock to firm-level disclosure of patent information, the American Inventor's Protection Act of 1999 (see Graham and Hegde (2015) and Johnson and Popp (2003) for a detailed description of the event). In this regard, the most closely related paper to our study is that by Dass, Nanda, and Xiao (2015), who analyze firms' stock liquidity as an additional concern that might encourage firms to patent a larger stock of their knowledge. In contrast, we show how firms' relationships with their creditors govern their decision to patent existing innovation.

The remainder of the paper is organized as follows. In Section 2, we discuss our identification strategies, and describe the data. Our results for the impact of banks' information production on firms' patenting behavior, and the effect of AIPA on the stability of banking relationships are in Section 3, and Section 4 concludes.

2 Empirical Strategy and Data

In this paper, we scrutinize the interplay between bank-level information acquisition, corporate disclosure, and the value of information in bank-firm relationships. Our analysis is based on the premise that tighter bank-firm relationships are associated with lower levels of information asymmetry between lenders and borrowers, which, in turn, affects the contracting options between lenders and borrowers.

We attempt to shed light on these dynamics by analyzing two settings. First, we use variation in bank scope as a determinant of bank-level information acquisition to explore the impact of lender informedness on firms' incentives to reveal information about their innovation through patents. Second, we exploit the American Inventor's Protection Act of 1999 (AIPA) as a source of variation in disclosure of patent applications to estimate the effect of innovation disclosure on the stability of lending relationships. If private information about corporate innovation is valuable in existing banking relationships, then AIPA should have led to a deterioration of such value, thereby opening up the possibility for firms to switch lenders.

In the following section, we provide background information on these two empirical settings and our associated identification strategies, namely the rise of universal banking and AIPA. Then, we will describe the data that we use on innovation and banking relationships.

2.1 Bank-level Information Acquisition and Universal Banking

One determinant of the level of information asymmetry between lenders and borrowers could be the scope of bank-firm interactions. In particular, the stepwise repeal of the Glass-Steagall Act in the U.S. allowed commercial banks to become universal banks that could offer a wide array of financial instruments. The Glass-Steagall Act of 1933 originally imposed a separation of commercial banking (deposit taking and lending) and investment banking (especially underwriting of corporate securities). The first major step of the repeal took place in January and September 1989, which is when commercial banks were allowed to generate a certain proportion (10% in 1989) of their revenues through underwriting activities, including underwriting of corporate debt and equity, typically through so-called Section 20 subsidiaries.

However, there were still firewalls in place that separated the two activities to the extent that banks could not actively cross-sell loans and non-loan products to their clients. The respective prudential limits, or firewalls, within bank-holding companies were abolished by the Federal Reserve Board in a second step on August 1, 1996. This enabled universal banks

and firms to interact more frequently and across a wider range of products through cross-selling, which was formerly practically forbidden under the Federal Reserve Act (Sections 23A and B). Simultaneously, the revenue limit on underwriting securities was raised from 10 to 25%, thereby allowing more commercial banks to expand into universal banking by directly merging with an investment bank.

As argued by Drucker and Puri (2005) and Neuhann and Saidi (2014), this deepening of bank-firm relationships improved universal banks' ability to efficiently provide external finance to firms through informational economies of scope. Cross-selling can lead to increased lender informedness through the complementary nature of information acquired by universal banks when contracting on loans and non-loan products. For instance, a firm's downside is important for a credit analyst that is assessing a firm's quality as a borrower, whereas an equity-underwriting analyst tends to concentrate on a firm's upside when trying to justify its stock price for an initial public or seasoned equity offering.

Variation in bank-level information acquisition. In our empirical analysis, we identify the impact of bank-level information acquisition off the variation in mergers between commercial/universal and investment banks, spurred by the 1996 deregulation. To test the general relevance of the 1996 deregulation for the patenting behavior of universal-bank-financed firms, especially when said universal-bank loans were cross-sold, we first estimate the following difference-in-differences specification:

$$\begin{aligned} \ln(1 + Patents_{it}) &= \beta_1 UB\ loan_{ijt} + \beta_2 UB\ loan_{ijt} \times After_t(1996) \\ &\quad + \beta_3 X_{ijt} + \delta_t + \mu_i + \eta_j + \epsilon_{it}, \end{aligned} \tag{1}$$

where $UB\ loan_{ijt}$ is an indicator variable for whether, given any loans received by firm i from (and including) year $t-4$ to (and including) year t, at the time of any loan transaction any one of the lead arrangers j was a universal bank, and $After_t(1996)$ is an indicator for whether the year in question was in 1996 or later. X_{ijt} denotes other control variables measured in year t, namely the log of firm i's sales, the log of its number of employees, the log of the

average ratio of deal size across all loans over the firm's assets from $t-4$ to t, and the proportion of refinancing loans from $t-4$ to t. δ_t, μ_i, η_j denote year, firm, and bank fixed effects, respectively, where bank fixed effects are included for *all* lead arrangers of all loans from year $t-4$ to t that were or eventually become universal banks, whereas all remaining commercial banks are grouped together. Standard errors are clustered at the firm-year level.

The analysis is conducted at the firm-year level, with the relevant event being whether a firm received a universal-bank loan anytime in the past five years. This implies that we estimate effects of universal-bank loans on, among others, patenting behavior that last, or show only in, up to five years.

In our actual identification strategy, we more explicitly make use of bank mergers that led to an increase in scope, i.e., between loan-granting commercial or already existing universal banks and underwriting investment banks, which we know to have spurred after the 1996 deregulation. Similar in spirit to (1), we estimate the following regression specification:

$$\begin{aligned} y_{it} \;=\; & \beta_1 Loan\ from\ UB,\ underwriting\ from\ IB,\ both\ merged_{ijt} \\ & +\beta_2 Loan\ from\ UB\ that\ merged_{ijt} \times Underwriting\ from\ IB\ that\ merged_{ijt} \\ & +\beta_3 Loan\ from\ UB\ that\ merged_{ijt} \\ & +\beta_4 Underwriting\ from\ IB\ that\ merged_{ijt} + \beta_5 X_{ijt} + \delta_t + \mu_i + \eta_j + \epsilon_{it}, \end{aligned} \tag{2}$$

where y_{it} is an outcome variable at the firm-year level, *Loan from UB, underwriting from IB, both merged*$_{ijt}$ indicates whether anytime from $t-10$ to $t-1$, firm i received a loan from a commercial or universal bank, an underwriting product from an investment bank, and both banks merged with each other until year t, *Loan from UB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-10$ to $t-1$, firm i received a loan from a commercial or universal bank that merged with an investment bank thereafter, and *Underwriting from IB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-10$ to $t-1$, firm i received an underwriting product from an investment bank that merged with a commercial or universal bank thereafter. X_{ijt} denotes other control variables measured in year t, namely

the log of firm i's sales, the log of its number of employees, the log of the average ratio of deal size across all loans over the firm's assets from $t-10$ to $t-1$, and the proportion of refinancing loans from $t-10$ to $t-1$. δ_t, μ_i, η_j denote year, firm, and bank fixed effects, respectively, where bank fixed effects comprise both universal-bank and investment-bank fixed effects. Universal-bank (UB) fixed effects are included for *all* lead arrangers of all loans from year $t-10$ to $t-1$ that were or eventually become universal banks, whereas all remaining commercial banks are grouped together. Investment-bank (IB) fixed effects are included for all universal banks that provided firm i with an underwriting product anytime from year $t-10$ to $t-1$, whereas all remaining investment banks are grouped together. Standard errors are clustered at the firm-year level.

We extend the relevant time window to eleven years so as to realistically accommodate the triplet of events (loan transaction, underwriting, and any mergers). Note that our ten-year window for the two transactions (loans and underwriting), for the robustness of which we provide evidence in the Appendix, starts in $t-1$, rather than t (the last possible year that we consider for a potential merger), so as to safeguard that both loan and underwriting transactions took place before any potential merger of the two banks, rather than their being a result of the merger.

The coefficient of interest is β_1, which estimates whether a firm that received a loan from a commercial or universal bank *and* an underwriting product from a separate investment bank changed its behavior after the two respective banks have merged. This can be interpreted as an intention-to-treat effect insofar as said set of firms is likely to continue contracting with the surviving universal bank, which now has more information from previous loan and underwriting transactions.

The main identifying assumption is that firms with previous loan transactions with commercial or universal banks and previous underwriting by investment banks – all of which merged with a bank of different scope (control group), but not necessarily with one another (treatment group) – differ only in the degree of informedness of the resulting universal bank when dealing with the same firm in the future. Furthermore, in Figure 1, we provide evi-

dence of parallel pre-trends in terms of patenting behavior and innovation-related investment activities among our treatment and control groups in the period leading up to the merger(s) of loan-granting commercial/universal and underwriting investment banks.

The underlying rationale for our identifying assumption is that private-information acquisition by commercial/universal and investment banks is complementary, and that a merger between these two types of institutions is necessary for the resulting universal bank to realize informational economies of scope. Furthermore, we implicitly assume that private-information acquisition leads to greater stability of banking relationships. In the following, we design and discuss an empirical test to shed light on this very issue.

2.2 American Inventor's Protection Act of 1999

To pin down the interplay between firms' public-information production and banks' private-information acquisition, we look at how an exogenous shock to firms' public-information disclosure in the form of patent applications alters their relationships with existing lenders. If lenders can benefit from intertemporal information reusability about the firm, and such benefit is passed through to the firm in terms of lower financing costs once the firm is forced to reveal some of this information publicly, an incumbent bank loses the advantage that it had in financing the firm due to its previously undertaken information acquisition. As argued by Rajan (1992), such relationships can also lead to hold-up by banks. We posit that an increase in publicly available information about a firm's innovation leads to a potential break-up of existing bank-firm relationships, as other banks become comparatively more competitive in financing the firm.

As a shock to the proportion of information on firm-level innovation that is public, rather than private, we use the passage of the American Inventor's Protection Act of 1999 (AIPA). Historically, inventing firms were allowed to keep their U.S. patent applications secret until the final patent was granted – in theory, for up to 20 years (Graham and Hegde (2015)) – a practice known as "submarine patenting." Firms could, thus, avoid revealing

the content of their patents publicly without losing intellectual property protection. On the other hand, they could still signal this information privately to banks. AIPA came into effect on November 29, 2000, and harmonized U.S. patent laws with the rest of the world by requiring public disclosure of patent applications 18 months after the filing day, even if the patent is not granted.[1]

Arguably, prior to 1999, firms differed in the secrecy of their patent applications. One particular consideration in whether firms keep innovation secret or make it public is the proprietary cost of rivals obtaining technical knowledge of innovation (Hall, Helmers, Rogers, and Sena (2014)). This is especially true if the patent is not granted eventually, in which case the firm neither receives the intellectual property protection, nor keeps the knowledge in-house. Industry conditions are then likely to determine firms' decision whether to patent or to keep their innovation secret.

We estimate the average time lag between patent applications and their grant dates (when their content was made public) for each SIC2 industry over five years during the pre-AIPA period from 1996 to 2000. The longer the lag, the more likely the industry standard was to keep patent applications secret for a longer period of time. Alternatively, such delays may have been due to non-strategic reasons, such as technical complexities in the patent-review process in a given industry. Either way, public-information disclosure was delayed. Indeed, Graham and Hegde (2015) also report some heterogeneity in terms of inventors' disclosure choices across technology fields. For instance, they show that computers and communication technologies were more likely than drugs and chemicals to use pre-AIPA secrecy for strategic reasons such as cross-licensing, fencing, litigation, and submarine patenting. As displayed in Table 1, the average delay across different industries is 26 months, and none of the industries under consideration has a mean delay below 18 months.

Against this background, we define the cross-sectional intensity of AIPA's passage based on the time lag between patent applications and their grant dates. We argue that indus-

[1] Firms were still able to opt for secrecy by completely foregoing foreign patenting. As shown by Graham and Hegde (2015), only a small proportion – one-digit percentage – of inventors decided to do so. Therefore, AIPA can, at the very least, be considered a shock that reduced the *average* time for patent applications to become public information.

tries with the longest lag were most affected by the passage of the law, which imposed the maximum delay time of 18 months. Importantly, this delay measure is not correlated in any meaningful way with cross-industry variation in access to finance or other characteristics that might influence banking relationships.

To show this, we run regressions at the SIC2 industry level, reporting both cross-sectional estimates (top panel) as well as time-series regressions (bottom panel) in Table 2. In the top panel, the dependent variables in the first four and last four columns are, respectively, the mean and median differences in years between filing and grant dates, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. Similarly, independent variables are measured as their respective aggregate values between 1996 and 2000. In the bottom panel, the dependent variables in the first four and last four columns are, respectively, the mean and median differences in years between filing and grant dates, across all patents granted to publicly listed firms in the respective industry in a given year. Similarly, the independent variables reflect the respective annual values.

The first column reports the correlation between our SIC2-industry delay measure and international trade characteristics of the industry, namely its import as well as export penetration. Arguably, a firm's integration into global trade and openness to foreign competition could affect both its strategic decision to patent innovation as well as its banking relationships (see Manova (2013) and the survey by Foley and Manova (2015)). We measure import penetration as total imports over the total value of shipments plus total imports minus total exports in a given SIC2 industry, and export penetration as total exports over the total value of shipments in a given SIC2 industry. We find no relationship between our delay measure and import as well as export penetration.

Furthermore, we also consider the possibility that our delay measure may be correlated with the number of patents filed in a given SIC2 industry. For instance, one could argue that industries that patent heavily and are, thus, presumably more innovative could have shorter delays, as patent officers learn more about the respective technologies. These industries could also differ in their banking relationships (Amore, Schneider, and Žaldokas (2013); Chava,

Oettl, Subramanian, and Subramanian (2013); Cornaggia, Mao, Tian, and Wolfe (2015)). In the second column, we find no correlation between our delay measures and the number of patents in the industry, suggesting that differences in patenting activity are unlikely to explain industry-level variation in the delay in disclosing patent information.

Additionally, in the third column, we consider the average total factor productivity in a given SIC2 industry, using the semiparametric estimation procedure by Olley and Pakes (1996), as has been done by Imrohoroglu and Tuzel (2014). Industries with long delays in their patent grants are neither more nor less productive, again reassuring us that our measure does not capture a confounding industry characteristic.

Finally, in the fourth column, we use the financial dependence of industries, measured as the median value of financing needs across firms in a given SIC2 industry, as in Rajan and Zingales (1998). For each firm, the financing needs are measured as total capital expenditures minus total operating cash flows, over total capital expenditures. Again, we find no association with the delay measures.

Variation in firm-level innovation disclosure. As we have shown our industry-level delay measure not to be correlated with any industry-level variables that could explain patenting behavior or the stability of banking relationships, we use this delay measure to capture variation in the intensity of treatment under AIPA. In particular, firms operating in industries associated with longer delays from filing to grant dates were affected more heavily by AIPA insofar as their innovations became public information relatively more quickly compared to the pre-AIPA regime.

To estimate the effect of AIPA on the stability of lending relationships, we build a panel of all bank-firm pairs (ij) with at least one loan within the previous five years leading up to AIPA (pre-period from 1996 to 2000) or within the first five years after AIPA (post-period from 2001 to 2005).[2] In this manner, we yield two observations per bank-firm pair. For each observation, we measure either the total loan volume received by firm i from bank j, which

[2] In the Appendix, we also provide robustness checks for three-year and four-year windows around the implementation of AIPA.

serves as our measure of the intensive margin of lending relationships, or a mere indicator for non-zero loan volume, reflecting the extensive margin. This setup allows us to include not just bank-firm fixed effects, but also firm-year fixed effects to capture shifts in firm-level demand for loans *across all banking relationships*, and bank-year fixed effects to capture shifts in bank-level supply *across all firms contracting with the respective bank*. Naturally, our industry-level treatment measure interacted with a post-AIPA dummy is captured by firm-year fixed effects. However, as we are interested in the development of pre-existing banking relationships, we interact our treatment measure, a post-AIPA dummy, and an indicator for whether a bank-firm pair ij already contracted in the pre-AIPA period. This gives us variation at the bank-firm-year level, and we run the following specification:

$$\begin{aligned} y_{ijt} &= \beta_1 Treatment_i \times Initial\ relationship_{ij} \times Post_t \\ &\quad + \beta_2 Initial\ relationship_{ij} \times Post_t + \mu_{it} + \eta_{jt} + \theta_{ij} + \epsilon_{ijt}, \end{aligned} \tag{3}$$

where y_{ijt} is the logged total loan volume or an indicator for non-zero loans at the bank-firm level for each period, $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000, $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period, and $Post_t$ is a dummy variable for the post-period from 2001 to 2005. μ_{it}, η_{jt}, and θ_{ij} denote firm-year, bank-year, and bank-firm fixed effects, respectively, where bank fixed effects are defined for all commercial and universal banks, and standard errors are clustered at the bank level.

The coefficient of interest is β_1, which varies at the ijt level and reflects a firm's propensity to break up an existing relationship, which in the above specification is equivalent to establishing a new banking relationship. To see this, assume that a firm broke up an existing relationship with a bank from which it borrowed \$500m in the pre-AIPA period and \$0 in the post-AIPA period. If the firm did not borrow from any bank in the post-AIPA period – in the extreme case, due to bankruptcy – then the effect should be explained entirely by

firm-level demand and, thus, by the firm-year fixed effects μ_{it}. That is, if a break-up is not accompanied by the establishment of a new relationship, then β_1 should be zero.

In our empirical tests, we also test whether this effect is stronger for firms that entered into relationships with universal banks in the pre-AIPA period. Our rationale for doing so is that universal banks had more means of acquiring firm-specific information, so the value of said private information dropped more significantly in universal-bank relationships.

Theoretically, firms that patented in the pre-AIPA period should be affected more heavily by AIPA, which we test as well. This is especially true if pre-AIPA patenting by firms indicates their propensity to patent in the post-AIPA period. As we argue that AIPA increased the cost of innovation disclosure when patenting, some firms may have reacted to this by patenting less in the post-AIPA period. However, firms without patents in the post-AIPA period are less likely to switch lenders because they should not be treated by the 18-month disclosure. Therefore, our effects for break-ups of banking relationships should be driven by firms that did not cease to patent because of AIPA, and this subsample of firms should be well represented by firms that were actively patenting in the pre-AIPA period.

2.3 Data Description

Our focus in this paper is to examine the effect of firms' patent disclosure. The patent dataset used in our analysis is assembled by the National Bureau of Economic Research (NBER), which contains information on all patents awarded by the U.S. Patent and Trademark Office (USPTO) as well as citations made to these patents (Hall, Jaffe, and Trajtenberg (2001)). We match the NBER patent dataset with Compustat data following the procedures developed in Hall, Jaffe, and Trajtenberg (2001) and Bessen (2009).

As we analyze the possibility that patents are a way to disclose information, we wish to control for actual firm innovation. We measure inputs of the innovation process by firms' research and development (R&D) expenditures as well as selling, general, and administrative (SG&A) expenditures, following the observation in Koh and Reeb (2015) that firms have

discretion over reporting R&D expenses, and also motivated by the fact that not all inputs of the innovation process (e.g., CEO salaries) are recorded as R&D. Similarly, as some of the inputs in the innovation process (e.g., innovators' hardware) are recorded as investment into fixed assets, we also consider firms' capital expenditure.

In terms of outputs of the innovation process, we look at new-product announcements, following Mukherjee, Singh, and Žaldokas (2015). In constructing measures of new-product announcements, we combine textual analysis with event studies conducted on stock-market returns. We first search the LexisNexis news database for company press releases that are tagged under the subject "new products" and the headlines of which contain any keywords, or roots of words, such as "launch," "product," "introduce," "begin," or "unveil." We download all such press releases, and parse out firm ticker symbols and the date of the announcement from the text. We only consider firms listed on NYSE, NASDAQ, or AMEX. Using this criterion, we obtain 98,221 unique press releases.

We next identify material information about new products among these press releases. The underlying idea is that if a press release containing our new-product keywords indeed refers to a major innovation, the stock market should respond to the news. Similar in spirit to Kogan, Papanikolaou, Seru, and Stoffman (2012), who estimate the value of patents by relying on stock-price reactions to patent grants, we calculate firms' stock-price reactions to measure the expected value of the product announcement.

For this purpose, we implement an event-study methodology by fitting a market model over the (-246,-30) period to yield the expected returns on the firm's stock, and then estimating cumulative abnormal returns over the (-1,1) day period around the announcement. After estimating abnormal returns, we are left with 56,797 announcements. To obtain the total number of material new-product announcements over the year, we either (i) count the number of positive cumulative abnormal returns around product announcements made by firms over the year, or (ii) count the number of announcements with cumulative abnormal returns above the 75th percentile in the sample (2.61%). We only consider positive abnormal returns to remove any confounding product announcements that were not associated with

new product introductions.[3] In addition, the second method is designed to distill major new innovations introduced by the firm.

When we consider loans, our sample comprises syndicated loans issued by public firms from the DealScan database. We match the respective borrowers with data on corporate debt and equity underwriting mandates in SDC. We identify universal banks based on the list generated by Neuhann and Saidi (2014), which we provide in Table 3. We also use their methodology to detect loans that were cross-sold with underwriting services by universal banks within a five-year circle. In addition, we have used string matching to generate unique bank identifiers for both commercial and universal banks across these datasets. This, in turn, enables us to use the SDC M&A database, alongside any mergers that we record through LexisNexis news search, to identify mergers between any two banks in our DealScan loan data and SDC underwriting data.

Summary statistics. In Table 1, we present the summary statistics. In general, our sample starts in 1987 and ends in 2010, with the exception of the NBER patent data, which are available only until 2006. In the top panel, we present summary statistics for our universal-banking-related identification of the effect of banks' information acquisition in Tables 4 and 5. In the bottom panel, we present summary statistics for our AIPA-based identification of the effect of innovation disclosure on the stability of banking relationships in Tables 6 to 9.

Note that in the bottom panel, we record two observations per bank-firm pair. We have 8,110 such pairs without and 7,558 pairs with conditioning on the availability of loan-volume data in DealScan.[4] Out of these 8,110 bank-firm relationships, 65.8% – i.e., 5,339 – already existed in the pre-AIPA period. That is, one-third of bank-firm pairs that we observe came into existence only in the post-AIPA period. Out of the 5,339 pre-existing relationships, 17.9% still existed in the post-AIPA period. This also explains the average sum of the loan indicator over both periods, as $0.179 \times 0.658 + 1 = 1.118$ (note that we condition on at least one loan transaction for any bank-firm pair, so the minimum value over both periods is 1 and the maximum is 2).

[3] For instance, these could be "delays in new product introductions" or "new product recalls."
[4] The sample drops to at most 7,511 pairs when merging our data with the NBER patent dataset.

3 Results

We now turn to the estimation results of our two empirical settings. We start by presenting our results for the effect of bank-level information acquisition on firms' patenting and innovation behavior. Consistent with banks' private-information acquisition leading to reduced necessity of firms to use patents as a signal for the quality of their innovation, we find a negative effect of increased lender informedness on firm-level patenting. We find no such negative effects on other measures of innovation activities and related expenditures.

To validate the value of private information about innovation in banking relationships, we use the American Inventor's Protection Act of 1999 (AIPA) as an exogenous variation in the disclosure of patent applications. By estimating the effect of AIPA on the stability of lending relationships, we investigate whether the subsequently (more) public information about firms' innovation led to a decrease in the value of formerly private information between banks and firms. We find that firms in industries with previously longer delays between filing and grant dates (i.e., those that we claim to have been more heavily treated under AIPA) were significantly more likely to switch lenders.

3.1 Effect of Information Acquisition by Universal Banks on Firm-level Patenting and Innovation

In Table 4, we start by providing some baseline evidence that informed lending in the form of (potentially) cross-sold universal-bank loans is associated with weaker incentives for firms to patent. In the first two columns, we estimate specification (1) without and with further controls, and regress the logged number of a publicly listed firm's patents on an indicator for whether anytime from year t to $t-4$, a firm received a loan from a universal bank. The relevant difference-in-differences estimate is the coefficient on $UB\ loan_{ijt} \times After_t(1996)$, which captures to what extent borrowers of universal banks chose to patent more or less compared to borrowers of commercial banks following the 1996 deregulation, which affected only universal banks.

We find that while borrowers of universal banks tended to patent more than those of commercial banks before 1996, they patented 4.2 to 7.6% fewer patents after the 1996 deregulation. To show that this post-1996 treatment effect stems chiefly from universal banks' ability to cross-sell loans and non-loan products after the 1996 deregulation, thereby enabling them to acquire more information about their borrowers, we split up our post-1996 estimate for universal-bank loans into cross-sold and non-cross-sold ones.

In doing so, we define cross-selling as the incidence of concurrent lending and corporate-securities underwriting by universal banks in or after 1996. We define a pair of loans and non-loan products to be cross-sold if they are issued to the same firm by the same universal bank in any order within five years (from year $t-4$ to t).[5] In order not to capture a firm-demand effect, we compare only cross-sold universal-bank loans with non-cross-sold universal-bank loans issued to firms that trusted another bank with an underwriting mandate. In this manner, firms with universal-bank loans that did not receive any underwriting service are captured by the coefficient on $UB\ loan_{ijt} \times After_t(1996)$, whereas the two groups of universal-bank loans that we wish to compare are captured by the two interaction effects of $UB\ loan_{ijt} \times After_t(1996)$ with $\textit{Cross-selling}_{ijt}$ and $\textit{Non-cross-sold underwriting}_{ijt}$. As can be seen in the last two columns of Table 4, the strongest adverse effect on post-1996 patenting is observed among cross-sold universal-bank loans. The effect is significantly different (at the 1% level) from that for non-cross-sold universal-bank loans.

The 1996 deregulation did not just allow universal banks to proactively cross-sell loans and non-loan products, but also relaxed revenue limits on underwriting, which enabled commercial banks of varying sizes to more easily merge with investment banks. We use the variation in mergers between commercial/universal and investment banks to provide more causal evidence that complementary information acquisition from lending and underwriting activities by universal banks reduces firms' incentives to patent their innovation.

To this end, we estimate (2), and present the results for firms' patenting behavior and

[5] Note that our cross-selling definition is censored in 1996, implying that we can only incorporate five full years of potential cross-selling activity activity starting in 2000. Our results are robust to variations of this time window, and are available upon request.

their inputs as well as outputs of the innovation process in Table 5. In the first two columns, we focus on patents. As before, we find a negative effect of more informed relationship banking. In this case, we estimate an intention-to-treat effect for firms that dealt with commercial/universal banks for loans and investment banks for underwriting services, comparing firms' patenting behavior after these banks merged compared to the case where they both merged with different banks of complementary scope. After including other controls in the second column, we find that firms issued 15.2% fewer patents.

In this setting, treatment and control differ only in whether their previous contracting partners – commercial/universal and investment banks – merged with each other, rather than with other banks of complementary scope. The treatment effect is captured by the coefficient on $Loan\ from\ UB$, $underwriting\ from\ IB$, $both\ merged_{ijt}$, and reflects the intention-to-treat effect of informed relationship banking on firms' patenting behavior. In particular, treatment and control firms should not differ in their extent to which they would profit from intellectual property rights or any other benefits of patents, except for the signaling value that patents have for the particular bank-firm relationship under consideration.

To show that treated firms do not patent less because they become less active in terms of their innovation, we consider a battery of measures that should reflect inputs and outputs of the innovation process. In the last three columns of Table 5, we find no effect on the sum of R&D and capital expenditures, the firm's q ratio, or the number of new-product announcements. Furthermore, in Table A.1, we investigate any potential effects on R&D expenditures, the sum of R&D and SG&A expenditures, capital expenditure, and our alternative measure of new-product announcements, for which we count the number of announcements with cumulative abnormal returns above the 75th percentile in the sample.[6] While we find a mildly significant (at the 7% level) and negative treatment effect on R&D, we find no effect on the sum of R&D and SG&A expenditures or new-product announcements. In addition, in the third column of Table A.1, we even find a *positive* effect on capital expenditure.

[6] In untabulated tests, our (non-)findings are robust to replacing our measures of new-product announcements by the sum of all positive cumulative abnormal returns around product announcements made by firms over the year, which is designed to capture the total incremental value of all new product introductions by a firm during the year.

Lastly, in Table A.2, we consider the possibility that firms may be cutting back on low-quality patents. This is, however, not the case, as can be seen in the first column, where we use as dependent variable the total number of forward citations across all patents. Treated firms' patents are associated with 22.5% fewer citations (the effect is significant at the 1% level), so our negative treatment effect pertains also to high-quality patents. In the last three columns of Table A.2, we test whether the negative treatment effect on patents may hold generally for any class of collateralizable assets, because patents may be used as collateral in loan agreements (Mann (2014)). However, we find only *positive*, and no negative, treatment effects on assets as well as property, plant, and equipment.

All of these insights hold up to changing the time window for the triplet of events (loan transaction, underwriting, and a potential merger) from eleven years (as in Tables 5, A.1, and A.2) to nine years (see Tables A.3, A.4, and A.5).

Altogether, we find no consistently negative effects on various measures of innovation in the presence of our negative treatment effect on patenting, speaking to our channel that the firm's incentives for signaling the quality of its otherwise hard-to-observe innovation decreases after a positive shock to the quality of the bank's information about the firm.

3.2 Effect of AIPA on the Stability of Lending Relationships

We next turn to our results for the effect of AIPA on the stability of lending relationships. First, we visualize our main result, namely the break-up of lending relationships for firms in industries that were affected more heavily by AIPA. For this purpose, in Figure 2, we plot the total loan volume across *all* banking relationships. For the post-AIPA period starting in 2001, we split up these banking relationships into loans from new and pre-existing relationships. In the top panel, we plot these graphs for firms in the top quintile of the distribution of the mean (pre-AIPA) difference between the filing date and the grant date, which should have been affected more heavily by AIPA. In the bottom panel, we plot the same graphs for firms in the bottom quintile of said distribution, i.e., for firms that should not have been affected

as much by AIPA because their patents had previously been disclosed more quickly.

While in general, firms borrowed more from new relationships after AIPA, they did so relatively more often in the treatment group than in the control group. Visually speaking, the two dotted lines are closer in the bottom panel than in the top panel. In fact, total loan volume generated from new relationships exceeds that generated from pre-existing relationships by 71%, 227%, 265%, 282%, and 745% in the years 2001 to 2005, respectively, for the treatment group compared to 21%, 153%, 192%, 185%, and 340% for the control group.

Furthermore, as seen in Table 2, firms in treatment and control industries are similar along relevant observables, which can also be drawn from the fact that the general evolution of total loan volume is similar – in terms of levels and slopes – across both panels in Figure 2. To provide further evidence that the break-up of lending relationships is driven by a deterioration of the value of private information in bank-firm relationships, we consider two comparative statics. First, we scrutinize whether the effect is stronger for firms that were in relationships with universal banks that had more means of acquiring private information about their borrowers. Second, we test whether the effect is more pronounced for firms that issued non-zero patents in the pre-AIPA period. As can be seen in Figures 3 and 4, the effect is stronger for these two subgroups, especially so for patenting firms.

We now discuss our econometric estimates for the graphs that we have just discussed. As described in Section 2.2, we yield two observations for each bank-firm pair (ij). We record all bank-firm pairs with at least one loan within the previous five years leading up to AIPA (pre-period from 1996 to 2000) or within the first five years after AIPA (post-period from 2001 to 2005). Our continuous treatment variable is the mean delay from filing to patent grant in years, which varies at the SIC2-industry level. After controlling for bank-firm, bank-year, and firm-year fixed effects, our estimated treatment effect is the triple interaction between our delay measure, an indicator for whether firm i transacted with bank j in the pre-AIPA period, and an indicator for the post-AIPA period.

In Table 6, we run specification (3), where as dependent variable we use the log of the total volume of all loan transactions per period between firm i and bank j, which reflects the

intensive margin of lending relationships. The treatment effect in the first column is given by the coefficient on $Treatment_i \times Initial\ relationship_{ij} \times Post_t$. In the second and third columns, we test whether the treatment effect is stronger for firms that were in universal-bank relationships and for firms that patented in the pre-AIPA period, respectively. All three effects are negative and significant at the 1% level, thereby indicating significantly more break-ups of lending relationships among treated firms.

By including bank-firm pairs with non-zero loans in the pre-AIPA period, the post-AIPA period, or both, the triple interaction $Treatment_i \times Initial\ relationship_{ij} \times Post_t$ – after controlling for firm-year fixed effects – allows us to estimate a negative treatment effect for firms with pre-existing relationships, which in this setting is equivalent to firms switching lenders, rather than firms reducing their demand for loans. This is because any shocks to firm-level demand for loans *across all banking relationships* would be captured by firm-year fixed effects.

A potential reason for why the coefficients are large in absolute size is that the effect operates also at the extensive margin, and the logarithm is not a good approximation for the growth rate when total loan volume drops to zero in the post-AIPA period. Therefore, we re-run the specifications from Table 6, and use as dependent variable an indicator for the occurrence of *any* loan transaction between firm i and bank j in a given period. The results are in Table 7, and all three coefficients of interest across the three columns are negative and significant at the 1% level. Using a standard deviation of 0.223 for $Treatment_i$ (see Table 1), the first column indicates that one standard deviation is associated with $0.089 \times 0.223 = 2.0\%$ more break-ups. In the second column, this effect is magnified for firms in universal-bank relationships to $(0.292 - 0.153) \times 0.223 = 3.1\%$ more break-ups per one-standard-deviation increase. The strongest effect is observed among patenting firms in the third column, for which a one-standard-deviation increase in delay is associated with $(0.406 - 0.015) \times 0.223 = 8.7\%$ more break-ups.

As argued in Section 2.2, firms that patented in the pre-AIPA period should be – and, as we have just shown, have in fact been – affected more heavily by AIPA, because we

expect that firms which did not patent in the pre-AIPA period due to secrecy concerns are less likely to start patenting after AIPA. We further investigate whether firms with particularly valuable patents, as measured by the average number of forward citations per patent across all patents issued by a given firm in the pre-AIPA period, were more likely to break up banking relationships. In Table A.6, we show that the treatment effect on both the intensive and extensive margin of lending relationships is indeed driven by particularly valuable patents. We also add interactions with the total number of patents issued in the pre-AIPA period, and find that the negative treatment effect for highly cited patents is not explained by firms patenting more. Insofar as highly cited patents may reflect generally valuable innovation activities on the firm side, and assuming that firms that produced highly valuable innovation in the pre-AIPA period continued to do so in the post-AIPA period, our estimates in Table A.6 could be interpreted as evidence that firms in treated industries were particularly likely to switch lenders when AIPA led to the disclosure of highly valuable innovation-related information.

We provide a battery of robustness checks. First, for the sake of our identification – especially the ability to include firm-year fixed effects – the sample is limited to bank-firm pairs with at least one period in the pre- or post-AIPA period, so that the effect is identified off the variation for firms in treated industries with pre-existing banking relationships, allowing us to identify firms that switched lenders while controlling for any shocks to firm-level demand for loans. However, observed bank-firm pairs may be subject to a selection effect that might bias our estimates. To test whether such selection affects our estimates in any meaningful way, we enrich our sample by all theoretically possible bank-firm pairs, i.e., including those with zero transactions throughout. We re-run the respective regressions from Tables 6 and 7 in Tables A.7 and A.8, where our results are robust.

Second, our results are robust to using the *median*, rather than the *mean*, SIC2-level delay from filing to grant date as our continuous treatment variable, as can be seen in Tables A.9 and A.10. Third, we vary the length of the time window around AIPA from five (as in our baseline regressions in Tables 6 and 7) to three and four years in Tables A.11 to A.14.

Our results are generally robust, but statistical significance is at times reduced because of the drop in sample size, which is due to the fact that there are fewer bank-firm pairs with non-zero loans in the pre- or post-AIPA period if the length of the period is shortened.

Fourth, in Tables A.15 and A.16, we drop firms that were delisted for bankruptcy-related reasons anytime before the end of the estimation period in order to filter out break-ups of lending relationships due to corporate default. The estimates are virtually unaltered compared to our baseline estimates in Tables 6 and 7. As bankruptcy-related reasons for observed break-ups of banking relationships are equivalent to a negative shock to firm-level demand, this further attests to the validity of our identification strategy, in that firm-year fixed effects fully capture such shocks.

Most importantly, in Tables 8 and 9, we conduct placebo tests by shifting the first year of the post-AIPA period forward by three years, namely from 2001 to 1998, which reduces the sample size somewhat for the same reason given above. In the first two columns, the treatment effects are much weaker than in Tables 6 and 7, and never statistically significant. In the third column, the treatment effect for patenting firms is even reversed.

4 Conclusion

Previous research has documented how corporate disclosure interacts with information production in public markets. Much less evidence exists on how firms signal information to private providers of capital, and how this affects capital providers' learning process about the firm. This paper bridges this gap in the literature by looking at one particular group of private providers of capital – banks – and shows that their information acquisition shapes corporate disclosure, while the latter feeds back to the stability of banking relationships.

More specifically, we consider information about firms' innovation, the disclosure of which is associated with significant costs due to rivals obtaining technical knowledge. On the other hand, if banks can privately acquire information about firms' innovation, the level of information asymmetry about firms' technological potential is reduced. As a result, firms

are more likely to choose secrecy over innovation disclosure, e.g., patenting.

We provide empirical evidence that lends support to such relationship between banks' information acquisition and corporate disclosure. We first use an exogenous shock that facilitates cross-selling and information acquisition by banks of wide scope, namely universal banks established through mergers of commercial and investment banks. We show that after universal banks are able to draw inference from loans and non-loan products, firms that had prior exposure to the merging banks issue fewer patents. That is, deeper relationships allow banks to rely more on soft information, so they require less hard information such as patents. Importantly, firms' investment in R&D activities, capital expenditure, and Tobin's q are not affected by the same shock.

We then consider the opposite side of the relationship. Following the passage of the American Inventor's Protection Act, firms were forced to release their patent information earlier. Firms that were particularly affected by this shock – i.e., those that had the longest delays between filing and grant dates during the pre-AIPA regime – were significantly more likely to break up their existing banking relationships after the shock. We argue that this can be explained by an increase in publicly available information about firms' innovation, thereby equalizing banks' competitive positions in terms of borrower-level information.

Taken in combination, these two tests attest to close linkages between bank-level information acquisition and corporate disclosure of innovation. Our findings have implications for the literatures on relationship banking, corporate finance, and innovation economics. On the banking side, we empirically establish that firms' decision to disclose information is influenced by banks' information acquisition. On the corporate side, we provide evidence that the choice between patenting and keeping innovation secret is influenced by their financing decisions. Finally, we highlight the role of patents as a source of information and a signaling device in banking relationships, in addition to their primary use as intellectual property rights. This, in turn, warrants that empirical studies using patents as a measure of innovation should also consider firms' discretion to selectively disclose only some of their innovation by patenting it.

References

Allen, F. (1990): "The Market for Information and the Origin of Financial Intermediation," *Journal of Financial Intermediation*, 1(1), 3–30.

Amore, M. D., C. Schneider, and A. Žaldokas (2013): "Credit Supply and Corporate Innovation," *Journal of Financial Economics*, 109(3), 835–855.

Benfratello, L., F. Schiantarelli, and A. Sembenelli (2008): "Banks and Innovation: Microeconometric Evidence on Italian Firms," *Journal of Financial Economics*, 90(2), 197–217.

Bernstein, S., X. Giroud, and R. Townsend (2015): "The Impact of Venture Capital Monitoring," *Journal of Finance*.

Bessen, J. (2009): *NBER PDP Project User Documentation*.

Boot, A. W. (2000): "Relationship Banking: What Do We Know?," *Journal of Financial Intermediation*, 9(1), 7 – 25.

Chava, S., V. K. Nanda, and S. C. Xiao (2015): "Intellectual Property Protection and Financial Markets: Patenting vs. Secrecy," *Lending to Innovative Firms*.

Chava, S., A. Oettl, A. Subramanian, and K. V. Subramanian (2013): "Banking Deregulation and Innovation," *Journal of Financial Economics*, 109(3), 759–774.

Cornaggia, J., Y. Mao, X. Tian, and B. Wolfe (2015): "Does Banking Competition Affect Innovation?," *Journal of Financial Economics*, 115(1), 189–209.

Darrough, M. N. (1993): "Disclosure Policy and Competition: Cournot vs. Bertrand," *The Accounting Review*, 68(3), 534–561.

Dass, N., and M. Massa (2011): "The Impact of a Strong Bank-Firm Relationship on the Borrowing Firm," *Review of Financial Studies*, 24(4), 1204–1260.

Dass, N., V. K. Nanda, and S. C. Xiao (2015): "Intellectual Property Protection and Financial Markets: Patenting vs. Secrecy," *UT Dallas Working Paper*.

Degryse, H., and P. Van Cayseele (2000): "Relationship Lending within a Bank-Based System: Evidence from European Small Business Data," *Journal of Financial Intermediation*, 9(1), 90–109.

Diamond, D. W. (1984): "Financial Intermediation and Delegated Monitoring," *Review of Economic Studies*, 51(3), 393–414.

Drucker, S., and M. Puri (2005): "On the Benefits of Concurrent Lending and Underwriting," *Journal of Finance*, 60(6), 2763–2799.

Evans, J. H., and S. S. Sridhar (2002): "Disclosure Disciplining Mechanisms: Capital Markets, Product Markets, and Shareholder Litigation," *The Accounting Review*, 77(3), 595–626.

Foley, C. F., and K. Manova (2015): "International Trade, Multinational Activity, and Corporate Finance," *Annual Review of Economics*, 7(1), 119–146.

Ganglmair, B., and J.-M. Oh (2014): "Strategic Secrecy of Pending Patents," *UT Dallas Working Paper*.

Gigler, F. (1994): "Self-Enforcing Voluntary Disclosures," *Journal of Accounting Research*, 32(2), 224–240.

Gopalan, R., G. F. Udell, and V. Yerramilli (2011): "Why Do Firms Form New Banking Relationships?," *Journal of Financial and Quantitative Analysis*, 46(05), 1335–1365.

Graham, S., and D. Hegde (2015): "Disclosing patents' secrets," *Science*, 347(6219), 236–237.

Hall, B., C. Helmers, M. Rogers, and V. Sena (2014): "The Choice between Formal and Informal Intellectual Property: A Review," *Journal of Economic Literature*, 52(2), 375–423.

Hall, B. H., A. B. Jaffe, and M. Trajtenberg (2001): "The NBER Patent Citation Data File: Lessons, Insights and Methodological Tools," *NBER Working Paper No. 8498*.

Houston, J., and C. James (1996): "Bank Information Monopolies and the Mix of Private and Public Debt Claims," *Journal of Finance*, 51(5), 1863–1889.

Imrohoroglu, A., and S. Tuzel (2014): "Firm Level Productivity, Risk and Return," *Management Science*, 60(8), 2073–2090.

Johnson, D. K. N., and D. Popp (2003): "Forced out of the Closet: The Impact of the American Inventors Protection Act on the Timing of Patent Disclosure," *RAND Journal of Economics*, 34(1), 96–112.

Kerr, W. R., and R. Nanda (2014): "Financing Innovation," *Harvard Business School Entrepreneurial Management Working Paper No. 15-034*.

Kogan, L., D. Papanikolaou, A. Seru, and N. Stoffman (2012): "Technological Innovation, Resource Allocation, and Growth," *NBER Working Paper No. 17769*.

Koh, P.-S., and D. M. Reeb (2015): "Missing R&D," *Journal of Accounting and Economics*, 60(1), 73–94.

Mann, W. (2014): "Creditor Rights and Innovation: Evidence from Patent Collateral," *UCLA Working Paper*.

Manova, K. (2013): "Credit Constraints, Heterogeneous Firms, and International Trade," *Review of Economic Studies*, 80(2), 711–744.

Mukherjee, A., M. Singh, and A. Žaldokas (2015): "Do Corporate Taxes Hinder Innovation?," *HKUST Working Paper*.

Neuhann, D., and F. Saidi (2014): "Are Universal Banks Better Intermediaries?," *Cambridge University Working Paper*.

Olley, G. S., and A. Pakes (1996): "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica*, 64(6), 1263–1297.

Ongena, S., and D. C. Smith (2001): "The Duration of Bank Relationships," *Journal of Financial Economics*, 61(3), 449–475.

Rajan, R. G. (1992): "Insiders and Outsiders: The Choice between Informed and Arm's-Length Debt," *Journal of Finance*, 47(4), 1367–1400.

Rajan, R. G., and L. Zingales (1998): "Financial Dependence and Growth," *American Economic Review*, 88(3), 559–86.

Ramakrishnan, R. T. S., and A. V. Thakor (1984): "Information Reliability and a Theory of Financial Intermediation," *Review of Economic Studies*, 51(3), 415–432.

Winton, A. (1995): "Delegated Monitoring and Bank Structure in a Finite Economy," *Journal of Financial Intermediation*, 4(2), 158–187.

5 Figures

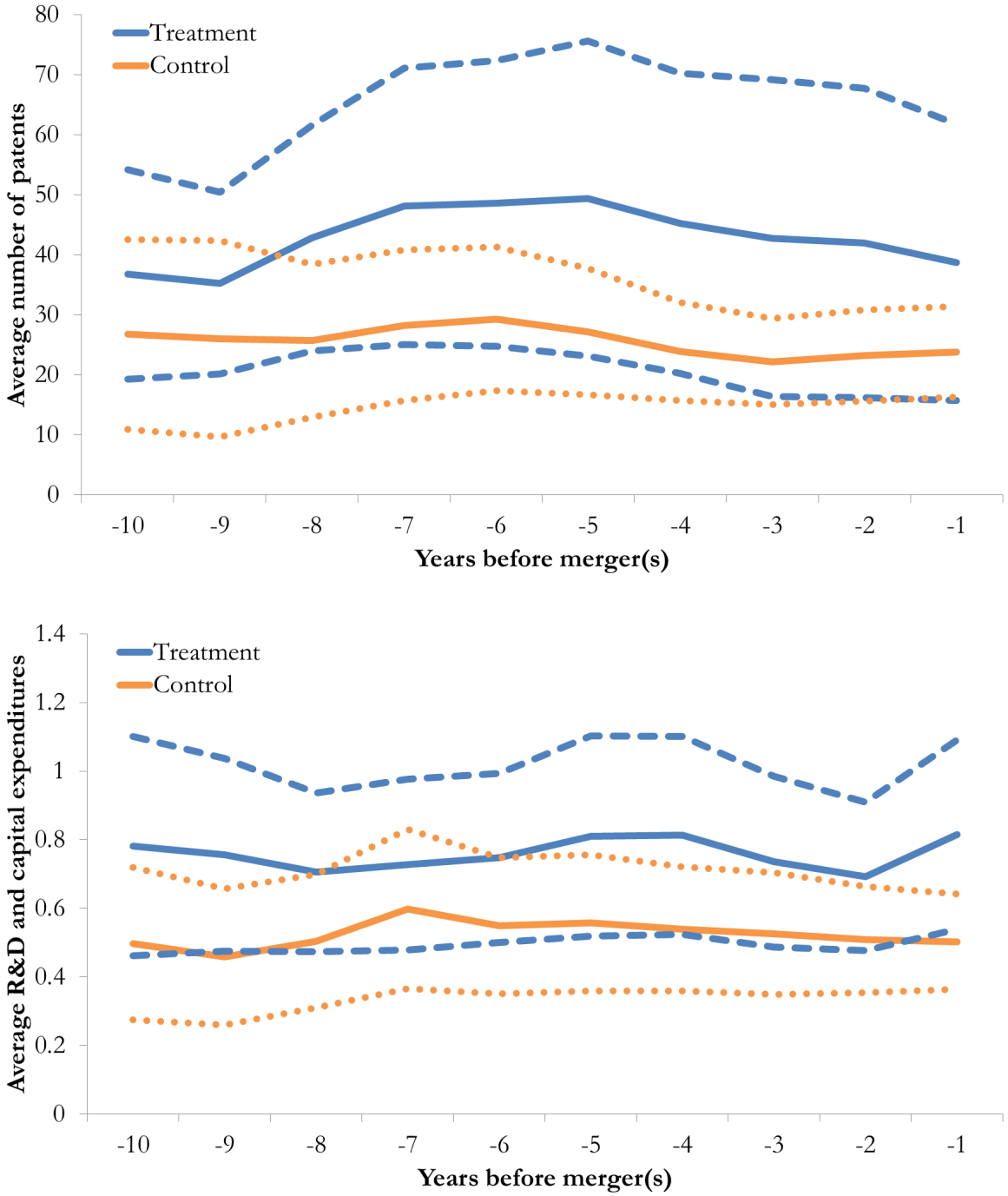

Figure 1: **Pre-trends among Treatment and Control Firms Contracting with Universal Banks.** The graphs in the top panel and the bottom panel plot, respectively, the average number of patents and the average sum of research and development (R&D) and capital expenditures in 2010 $bn by firms in the treatment and the control group over ten years. Firms in both groups received a loan from a commercial or universal bank as well as an underwriting product from an investment bank anytime from year -10 to -1, and both banks merged with each other (treatment group) or with other banks of complementary scope (control group) in year 0.

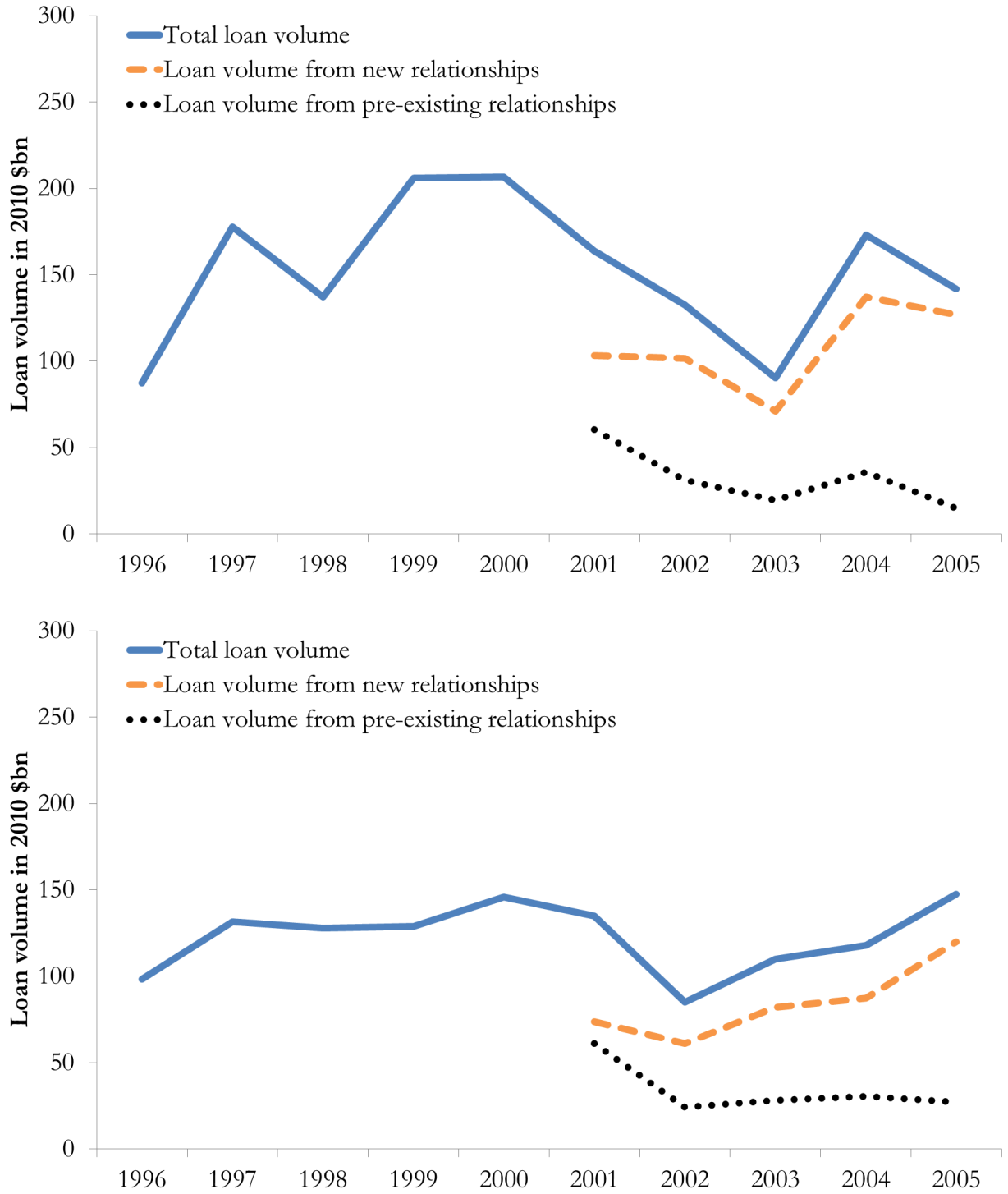

Figure 2: **The Effect of AIPA on the Composition of Total Loan Volume: New vs. Old Bank Relationships (1996-2005).** In the post-AIPA period starting in 2001, the two dotted lines add up to the solid line, i.e., total loan volume. The top panel comprises "treated" firms in the top quintile of the distribution of the mean difference between the filing date and the grant date across all patents granted to publicly listed firms in a given SIC2 industry between 1996 and 2000, whereas the bottom panel comprises "control" firms in the bottom quintile.

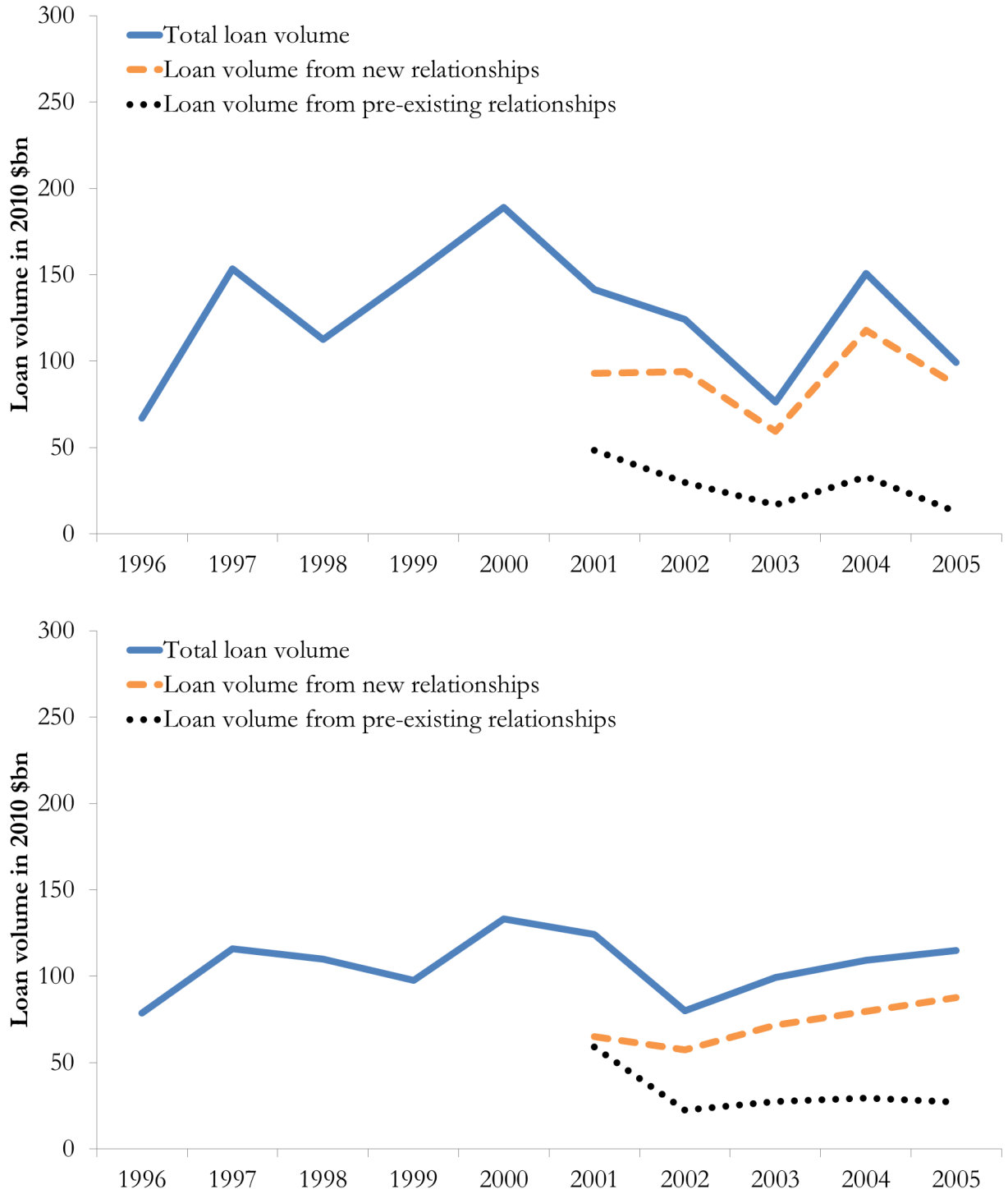

Figure 3: **The Effect of AIPA on the Composition of Total Loan Volume: New vs. Old Universal-bank Relationships (1996-2005).** In the post-AIPA period starting in 2001, the two dotted lines add up to the solid line, i.e., total loan volume from commercial banks that had already become universal banks before 1996. The top panel comprises "treated" firms in the top quintile of the distribution of the mean difference between the filing date and the grant date across all patents granted to publicly listed firms in a given SIC2 industry between 1996 and 2000, whereas the bottom panel comprises "control" firms in the bottom quintile.

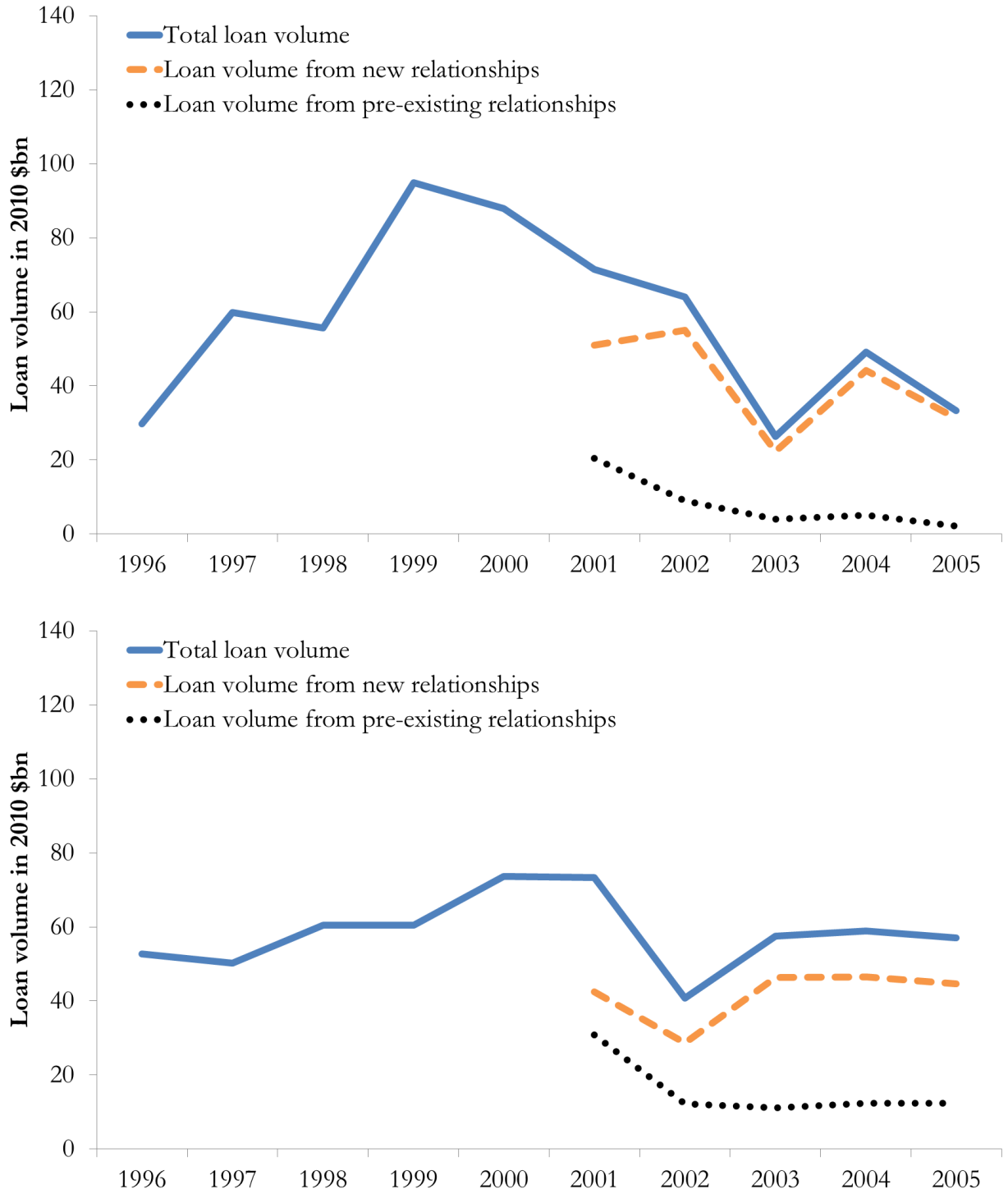

Figure 4: **The Effect of AIPA on the Composition of Total Loan Volume for Patenting Firms: New vs. Old Bank Relationships (1996-2005).** The sample is limited to firms that issued at least one patent in the pre-AIPA period from 1996 to 2000. In the post-AIPA period starting in 2001, the two dotted lines add up to the solid line, i.e., total loan volume. The top panel comprises "treated" firms in the top quintile of the distribution of the mean difference between the filing date and the grant date across all patents granted to publicly listed firms in a given SIC2 industry between 1996 and 2000, whereas the bottom panel comprises "control" firms in the bottom quintile.

6 Tables

Table 1: **Summary Statistics**

Compustat sample (firm-year level)	Mean	Std. dev.	Min	Max	N
Number of patents	11.898	90.989	0	4,344	61,036
Total cites of patents	90.240	797.546	0	45,559	61,036
R&D expenditures in 2010 $bn	0.098	0.528	0.000	14.434	66,773
Capital expenditure in 2010 $bn	0.184	1.098	0.000	45.078	109,968
SG&A expenditures in 2010 $bn	0.425	1.870	0.000	79.347	100,278
q ratio	2.157	2.946	0.093	190.543	106,731
New-product announcements	0.226	1.801	0	110	111,299
New-product announcements*	0.114	0.905	0	56	111,299
Book value of assets in 2010 $bn	2.763	13.924	0.000	553.853	111,295
Gross PP&E in 2010 $bn	1.860	10.916	0.000	458.276	110,634
Net PP&E in 2010 $bn	0.991	5.352	0.000	218.567	110,920
UB loan (anytime between year t and $t-4$)	0.234	0.423	0	1	111,299
Loan from UB, underwriting from IB, both merged (from $t-10$ to $t-1$)	0.028	0.165	0	1	111,299
Loan from UB that merged	0.271	0.444	0	1	111,299
Underwriting from IB that merged	0.167	0.373	0	1	111,299
AIPA sample (bank-firm level)	Mean	Std. dev.	Min	Max	N
Number of bank-firm pairs					8,110
Number of firms					4,079
Number of banks					405
Loan indicator (sum over both periods)	1.118	0.323	1	2	8,110
Initial relationship in pre-AIPA period	0.658	0.474	0	1	8,110
Proportion of recurrent relationships	0.179	0.384	0	1	5,339
Patenting firm in pre-AIPA period	0.368	0.482	0	1	7,511
Total number of patents in pre-AIPA period	59.758	512.618	0	18,632	7,511
Average cites per patent in pre-AIPA period	2.263	4.965	0	89.3	7,511
UB relationship in pre-AIPA period	0.690	0.463	0	1	8,110
Total loan volume per period in 2010 $bn	0.376	1.456	0	38.525	15,116
Mean delay from filing to grant in years (per SIC2 industry in pre-AIPA period)	2.201	0.223	1.656	2.778	64
Median delay from filing to grant in years (per SIC2 industry in pre-AIPA period)	2.048	0.225	1.656	2.726	64

Notes: The variables in the top panel correspond to the respective descriptions in Tables 4, 5, A.1 and A.2, and those in the bottom panel correspond to their descriptions in Tables 6 to 9.

Table 2: **Correlation between Treatment and Other Industry Characteristics**

Panel A: SIC2-industry cross section

	Mean delay	Mean delay	Mean delay	Mean delay	Median delay	Median delay	Median delay	Median delay
Export penetration	135.047				131.525			
	(124.258)				(113.655)			
Import penetration	-51.806				29.563			
	(68.311)				(65.070)			
Number of patents filed		-0.000				-0.000		
		(0.000)				(0.000)		
Industry productivity			293.335				232.444	
			(249.255)				(243.033)	
Financial dependency				13.297				-2.137
				(15.396)				(7.667)
N	20	58	54	53	20	58	54	53

Panel B: SIC2-industry-year panel

	Mean delay	Mean delay	Mean delay	Mean delay	Median delay	Median delay	Median delay	Median delay
Export penetration	-84.298				-245.577			
	(303.004)				(270.027)			
Import penetration	219.273				373.826***			
	(128.411)				(114.148)			
Number of patents filed		-0.002				-0.002		
		(0.002)				(0.002)		
Industry productivity			182.436				307.848*	
			(180.114)				(179.271)	
Financial dependency				-0.422				-0.490
				(0.467)				(0.731)
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
N	280	725	666	694	280	725	666	694

Notes: Regressions are run at the industry level (based on SIC2 codes). The top panel displays cross-sectional regressions, and the bottom panel

displays time-series regressions, which include industry (based on SIC2 codes) as well as year fixed effects. In the top panel, the dependent variables in the first four and last four columns are, respectively, the mean and median differences in days between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. In the bottom panel, the dependent variables in the first four and last four columns are, respectively, the mean and median differences in days between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry in a given year. Independent variables are measured as sums from 1996 to 2000 in the top panel, and annually from 1996 to 2000 in the bottom panel. Export penetration refers to total exports over the total value of shipments in a given SIC2 industry. Import penetration refers to total imports over the total value of shipments plus total imports minus total exports in a given SIC2 industry. Number of patents filed is the number of patents filed in a given SIC2 industry. Industry productivity is the average total factor productivity in a given SIC2 industry from Imrohoroglu and Tuzel (2014). Financial dependency is measured as the median value of financing needs across SIC2 firms, as in Rajan and Zingales (1998). Financing needs is measured as total capital expenditures minus total operating cash flows, over total capital expenditures. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the industry level based on SIC2 codes) are in parentheses.

Table 3: **Overview of Universal Banks in DealScan**

Section 20	M&A
Established before August 1, 1996	
BankBoston (later acquired by Fleet)	Credit Suisse (First Boston)
Bankers Trust (later acquired by Bank of America)	Deutsche Bank USA
Bank of America	Equitable (later acquired by SunTrust)
Bank of New England (defunct since 1991)	HSBC Bank USA
Bank One (later acquired by J.P. Morgan)	Sovran Bank (later acquired by NationsBank)
BankSouth	Travelers Group*
Barnett Bank (later acquired by NationsBank)	
Chase Manhattan (later acquired by J.P. Morgan)	
Chemical Bank (later acquired by Chase Manhattan)	
Citicorp*	
Dauphin Deposit Corp.	
First Chicago NBD	
First Union	
Fleet (later acquired by Bank of America)	
Huntington Bancshares	
J.P. Morgan	
Liberty National Bank	
Marine Midland Bank (later acquired by HSBC Bank USA)	
Mellon (later acquired by BNY)	
National City (later acquired by PNC)	
National Westminster Bank USA (later acquired by Fleet)	
NationsBank (later acquired by Bank of America)	
Norstar (later acquired by Fleet)	
Norwest (later acquired by Wells Fargo)	
PNC	
Security Pacific Bank (later acquired by Bank of America)	
SouthTrust (later acquired by Wachovia/First Union)	
SunTrust	
Established on or after August 1, 1996	
BB&T	Citigroup*
BNY	Wells Fargo
Commerce Bancshares	
CoreStates/Philadelphia National Bank (later acquired by First Union)	
Crestar Bank	
First Tennessee	
KeyBank	
U.S. Bancorp	
Wachovia (first acquired by First Union and later by Wells Fargo	

* Citigroup emerged as a result of the merger of Travelers Group and Citicorp on October 8, 1998. Before, Travelers Group became a universal bank by our definition through a series of mergers, most notably with investment banks Smith Barney and Salomon Brothers, and Citicorp had registered a Section 20 subsidiary. Given the size of this merger of equals, we do not treat either one as the surviving entity and, instead, label Citigroup as a separate universal bank established through M&A in 1998.

Table 4: **Bank Information Acquisition through Cross-selling and Patenting by Borrowers**

	ln(1+Patents)			
UB loan	0.065***	0.075***	0.073***	0.082***
	(0.014)	(0.018)	(0.015)	(0.018)
UB loan × After(1996)	-0.076***	-0.042***	-0.037*	-0.032*
	(0.016)	(0.016)	(0.019)	(0.019)
UB loan × After(1996) × Cross-selling			-0.110***	-0.075***
			(0.017)	(0.018)
UB loan × After(1996) × Non-cross-sold underw.			-0.020	-0.006
			(0.020)	(0.021)
Any loan × Any underwriting			-0.015	-0.027*
			(0.013)	(0.014)
Any loan × Any underwriting × After(1996)			0.047***	0.048***
			(0.017)	(0.017)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Bank FE	N	Y	N	Y
Other controls	N	Y	N	Y
N	61,036	61,036	61,036	61,036

Notes: All regressions are run at the firm level, and include firm as well as year fixed effects. The dependent variable is the logged number of firm i's number of patents in year t. *UB loan*$_{ijt}$ is an indicator variable for whether, given any loans received by firm i from (and including) year $t-4$ to (and including) year t, at the time of any loan transaction any one of the lead arrangers j was a universal bank. *After*$_t$(1996) is an indicator for whether the year in question was in 1996 or later. *Cross-selling*$_{ijt}$ is an indicator for whether any universal-bank loan of firm i from year $t-4$ to t was associated with a cross-sold underwriting product by the same universal bank j anytime from $t-4$ to t. Conversely, *Non-cross-sold underwriting*$_{ijt}$ indicates whether firm i that received a universal-bank loan anytime from $t-4$ to t also received an underwriting product during the same time period which was not issued by the same universal bank j. *Any loan*$_{ijt}$ and *Any underwriting*$_{ijt}$ are indicator variables for whether firm i received a loan from any commercial or universal bank, or an underwriting product from any investment or universal bank, respectively, anytime from $t-4$ to t. Other control variables are measured in year t, and include the log of firm i's sales, the log of its number of employees, the log of the average ratio of deal size across all loans over the firm's assets from $t-4$ to t, and the proportion of refinancing loans from $t-4$ to t. Bank fixed effects are included for *all* lead arrangers of all loans from year $t-4$ to t that were or eventually become universal banks, whereas all remaining commercial banks are grouped together (and, thus, captured by *Any loan*$_{ijt}$). Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the firm-year level) are in parentheses.

Table 5: **Impact of Bank Information Acquisition on Firm-level Patenting and Innovation**

	ln(1+Patents)		ln(R&D+CapEx)	ln(q ratio)	ln(1+Products)
Loan from UB, underwriting from IB, both merged	-0.285***	-0.152***	-0.024	-0.015	0.031***
	(0.034)	(0.036)	(0.018)	(0.010)	(0.011)
Loan from UB that merged × Underwriting from IB that merged	-0.055**	-0.008	-0.064***	0.012	-0.017**
	(0.022)	(0.022)	(0.017)	(0.010)	(0.008)
Loan from UB that merged	0.041***	0.002	0.005	-0.038***	-0.007
	(0.012)	(0.016)	(0.012)	(0.007)	(0.005)
Underwriting from IB that merged	0.049***	0.076***	0.105***	-0.015*	0.013**
	(0.017)	(0.018)	(0.013)	(0.009)	(0.006)
Any loan	-0.017**				
	(0.010)				
Any underwriting	0.035***				
	(0.008)				
Firm FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
All UB and IB FE	N	Y	Y	Y	Y
Other controls	N	Y	Y	Y	Y
N	61,036	61,036	54,134	106,731	111,299

Notes: All regressions are run at the firm level, and include firm as well as year fixed effects. The dependent variable in the first two columns is the logged number of firm i's number of patents in year t, in the third column the logged sum of firm i's research and development (R&D) and capital expenditures in year t, in the fourth column the log of firm i's q ratio in year t, which is defined as firm i's market value of equity plus assets minus the book value of equity, all over assets, and in the last column the logged number of firm i's new-product announcements in year t, for which we use event-study methodology by fitting a market model over the (-246,-30) period to yield the expected returns on the firm's stock, estimating cumulative abnormal returns (CARs) over the (-1,1) period around the announcement, and finally counting all announcements associated with positive CARs over the year. *Loan from UB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-10$ to $t-1$, firm i received a loan from a commercial or universal bank that merged with an investment bank thereafter. *Underwriting from IB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-10$ to $t-1$, firm i received an underwriting product from an investment bank that merged with a commercial or universal bank thereafter. The interaction of the latter two indicator variables is to be distinguished from the explanatory variable of interest in the first row, which indicates whether anytime from $t-10$ to $t-1$, firm i received a loan from a commercial or universal bank, an underwriting product from an investment bank, and both banks merged with each other until year t. *Any loan*$_{ijt}$ and *Any underwriting*$_{ijt}$ are indicator variables for whether firm i received a loan from any commercial or universal bank, or an underwriting product from any investment or universal bank, respectively, anytime from $t-10$ to $t-1$. Other control variables are measured in year t, and include the log of firm i's sales, the log of its number of employees, the log of the average ratio of deal size across all loans over the firm's assets from $t-10$ to $t-1$, and the proportion of refinancing loans from $t-10$ to $t-1$. Universal-bank (UB) fixed effects are included for *all* lead arrangers of all loans from year $t-10$ to $t-1$ that were or eventually become universal banks, whereas all remaining commercial banks are grouped together. Investment-bank (IB) fixed effects are included for all universal banks that provided firm i with an underwriting product anytime from year $t-10$ to $t-1$, whereas all remaining investment banks are grouped together. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the firm-year level) are in parentheses.

Table 6: **Impact of AIPA on Intensive Margin of Lending Relationships**

	ln(1+Loan volume)		
Sample	At least one loan in pre- or post-period		
Treatment × Initial relationship × Post	-1.938***	2.461**	0.254
	(0.677)	(1.158)	(0.791)
Initial relationship × Post	-26.999***	-37.268***	-31.575***
	(1.526)	(2.547)	(1.712)
Treatment × Initial relationship × UB × Post		-5.599***	
		(1.447)	
Treatment × UB × Post		1.343	
		(1.027)	
Initial relationship × UB × Post		13.163***	
		(3.087)	
Treatment × Initial relationship × Patenting × Post			-7.159***
			(2.411)
Initial relationship × Patenting × Post			15.258***
			(5.175)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	7,558	7,558	6,973

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample is limited to bank-firm (ij) pairs with at least one loan within the previous five years leading up to AIPA (pre-period from 1996 to 2000) or within the first five years after AIPA (post-period from 2001 to 2005). The dependent variable is the log of the total volume of all loan transactions between firm i and bank j, separately for the pre- and post-period. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the post-period from 2001 to 2005. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Table 7: **Impact of AIPA on Extensive Margin of Lending Relationships**

	Loan from bank $\in \{0,1\}$		
Sample	At least one loan in pre- or post-period		
Treatment × Initial relationship × Post	-0.089***	0.153***	0.015
	(0.027)	(0.055)	(0.038)
Initial relationship × Post	-1.439***	-2.073***	-1.669***
	(0.067)	(0.119)	(0.083)
Treatment × Initial relationship × UB × Post		-0.292***	
		(0.065)	
Treatment × UB × Post		0.036	
		(0.049)	
Initial relationship × UB × Post		0.780***	
		(0.137)	
Treatment × Initial relationship × Patenting × Post			-0.406***
			(0.102)
Initial relationship × Patenting × Post			0.900***
			(0.226)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	8,110	8,110	7,511

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample is limited to bank-firm (ij) pairs with at least one loan within the previous five years leading up to AIPA (pre-period from 1996 to 2000) or within the first five years after AIPA (post-period from 2001 to 2005). The dependent variable is an indicator for the occurrence of any loan transaction between firm i and bank j. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the post-period from 2001 to 2005. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Table 8: **Impact of AIPA on Intensive Margin of Lending Relationships – Placebo**

	ln(1+Loan volume)		
Sample	At least one loan in pre- or post-period		
Treatment × Initial relationship × Post	-0.755	0.297	-1.895**
	(0.678)	(1.254)	(0.840)
Initial relationship × Post	-29.561***	-32.443***	-26.405***
	(1.566)	(2.725)	(1.895)
Treatment × Initial relationship × UB × Post		-1.626	
		(1.639)	
Treatment × UB × Post		0.112	
		(1.179)	
Initial relationship × UB × Post		4.401	
		(3.654)	
Treatment × Initial relationship × Patenting × Post			2.970
			(2.266)
Initial relationship × Patenting × Post			-7.382
			(4.865)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	6,728	6,728	5,801

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample is limited to bank-firm (ij) pairs with at least one loan in the pre-period from 1993 to 1997 or in the post-period from 1998 to 2002, whereas AIPA was implemented in late 2000. The dependent variable is the log of the total volume of all loan transactions between firm i and bank j, separately for the pre- and post-period. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the placebo post-period from 1998 to 2002. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Table 9: **Impact of AIPA on Extensive Margin of Lending Relationships – Placebo**

	Loan from bank $\in \{0, 1\}$		
Sample	At least one loan in pre- or post-period		
Treatment × Initial relationship × Post	-0.039	-0.006	-0.115***
	(0.032)	(0.061)	(0.039)
Initial relationship × Post	-1.584***	-1.751***	-1.406***
	(0.078)	(0.139)	(0.091)
Treatment × Initial relationship × UB × Post		-0.058	
		(0.073)	
Treatment × UB × Post		-0.022	
		(0.060)	
Initial relationship × UB × Post		0.258	
		(0.174)	
Treatment × Initial relationship × Patenting × Post			0.195**
			(0.095)
Initial relationship × Patenting × Post			-0.422**
			(0.210)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	7,145	7,145	6,195

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample is limited to bank-firm (ij) pairs with at least one loan in the pre-period from 1993 to 1997 or in the post-period from 1998 to 2002, whereas AIPA was implemented in late 2000. The dependent variable is an indicator for the occurrence of any loan transaction between firm i and bank j. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the placebo post-period from 1998 to 2002. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Supplementary Appendix (Not for Publication)

A Supplementary Tables

Table A.1: **Impact of Bank Information Acquisition on Firm-level Innovation**

	ln(R&D)	ln(R&D+SG&A)	ln(CapEx)	ln(1+Products*)
Loan from UB, underwriting	-0.040*	0.005	0.050***	0.010
from IB, both merged	(0.022)	(0.011)	(0.017)	(0.008)
Loan from UB that merged	-0.066***	-0.035***	-0.070***	-0.013**
× Underwriting from IB	(0.019)	(0.010)	(0.017)	(0.006)
that merged				
Loan from UB that merged	0.032**	0.031***	0.022*	-0.006
	(0.015)	(0.007)	(0.012)	(0.004)
Underwriting from IB	0.107***	0.074***	0.047***	0.012**
that merged	(0.014)	(0.009)	(0.015)	(0.005)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
All UB and IB FE	Y	Y	Y	Y
Other controls	Y	Y	Y	Y
N	54,944	49,652	109,228	111,299

Notes: All regressions are run at the firm level, and include firm as well as year fixed effects. The dependent variable in the first column is the log of firm i's research and development (R&D) expenditures in year t, in the second column the logged sum of firm i's R&D and selling, general, and administrative (SG&A) expenditures in year t, in the third column the log of firm i's capital expenditure in year t, and in the last column the logged number of firm i's new-product announcements in year t, for which we use event-study methodology by fitting a market model over the (-246,-30) period to yield the expected returns on the firm's stock, estimating cumulative abnormal returns (CARs) over the (-1,1) period around the announcement, and finally counting all announcements associated with CARs above the 75th percentile in the sample over the year. *Loan from UB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-10$ to $t-1$, firm i received a loan from a commercial or universal bank that merged with an investment bank thereafter. *Underwriting from IB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-10$ to $t-1$, firm i received an underwriting product from an investment bank that merged with a commercial or universal bank thereafter. The interaction of the latter two indicator variables is to be distinguished from the explanatory variable of interest in the first row, which indicates whether anytime from $t-10$ to $t-1$, firm i received a loan from a commercial or universal bank, an underwriting product from an investment bank, and both banks merged with each other until year t. Other control variables are measured in year t, and include the log of firm i's sales, the log of its number of employees, the log of the average ratio of deal size across all loans over the firm's assets from $t-10$ to $t-1$, and the proportion of refinancing loans from $t-10$ to $t-1$. Universal-bank (UB) fixed effects are included for *all* lead arrangers of all loans from year $t-10$ to $t-1$ that were or eventually become universal banks, whereas all remaining commercial banks are grouped together. Investment-bank (IB) fixed effects are included for all universal banks that provided firm i with an underwriting product anytime from year $t-10$ to $t-1$, whereas all remaining investment banks are grouped together. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the firm-year level) are in parentheses.

Table A.2: **Impact of Bank Information Acquisition on Firm-level Quality of Patents and Assets**

	ln(1+Cites)	ln(Assets)	ln(Gross PP&E)	ln(Net PP&E)
Loan from UB, underwriting from IB, both merged	-0.225***	0.024***	0.033***	0.069***
	(0.060)	(0.009)	(0.010)	(0.011)
Loan from UB that merged × Underwriting from IB that merged	-0.058	-0.017*	-0.050***	-0.065***
	(0.040)	(0.009)	(0.010)	(0.011)
Loan from UB that merged	-0.028	0.036***	0.064***	0.063***
	(0.028)	(0.006)	(0.007)	(0.008)
Underwriting from IB that merged	0.137***	0.052***	0.050***	0.045***
	(0.033)	(0.008)	(0.008)	(0.010)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
All UB and IB FE	Y	Y	Y	Y
Other controls	Y	Y	Y	Y
N	61,036	111,295	110,634	110,920

Notes: All regressions are run at the firm level, and include firm as well as year fixed effects. The dependent variable in the first column is the log of the total number of forward citations across all patents issued by firm i in year t, in the second column the logged book value of firm i's assets in year t, in the third column the log of firm i's gross property, plant, and equipment (PP&E) in year t, and in the last column the log of firm i's net property, plant, and equipment (PP&E) in year t. *Loan from UB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-10$ to $t-1$, firm i received a loan from a commercial or universal bank that merged with an investment bank thereafter. *Underwriting from IB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-10$ to $t-1$, firm i received an underwriting product from an investment bank that merged with a commercial or universal bank thereafter. The interaction of the latter two indicator variables is to be distinguished from the explanatory variable of interest in the first row, which indicates whether anytime from $t-10$ to $t-1$, firm i received a loan from a commercial or universal bank, an underwriting product from an investment bank, and both banks merged with each other until year t. Other control variables are measured in year t, and include the log of firm i's sales, the log of its number of employees, the log of the average ratio of deal size across all loans over the firm's assets from $t-10$ to $t-1$, and the proportion of refinancing loans from $t-10$ to $t-1$. Universal-bank (UB) fixed effects are included for *all* lead arrangers of all loans from year $t-10$ to $t-1$ that were or eventually become universal banks, whereas all remaining commercial banks are grouped together. Investment-bank (IB) fixed effects are included for all universal banks that provided firm i with an underwriting product anytime from year $t-10$ to $t-1$, whereas all remaining investment banks are grouped together. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the firm-year level) are in parentheses.

Table A.3: **Impact of Bank Information Acquisition on Firm-level Patenting and Innovation – Robustness**

	ln(1+Patents)		ln(R&D+CapEx)	ln(q ratio)	ln(1+Products)
Loan from UB, underwriting	-0.272***	-0.118***	-0.012	-0.019*	0.019
from IB, both merged	(0.037)	(0.039)	(0.019)	(0.010)	(0.012)
Loan from UB that merged	-0.037*	-0.002	-0.056***	-0.004	-0.022***
× Underwriting from IB	(0.022)	(0.024)	(0.017)	(0.010)	(0.008)
that merged					
Loan from UB that merged	0.036***	0.016	0.001	-0.033***	-0.006
	(0.012)	(0.016)	(0.012)	(0.006)	(0.006)
Underwriting from IB	0.021	0.033*	0.107***	0.011	0.020***
that merged	(0.017)	(0.018)	(0.013)	(0.009)	(0.006)
Any loan	-0.012				
	(0.010)				
Any underwriting	0.026***				
	(0.008)				
Firm FE	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y
All UB and IB FE	N	Y	Y	Y	Y
Other controls	N	Y	Y	Y	Y
N	61,036	61,036	54,134	106,731	111,299

Notes: All regressions are run at the firm level, and include firm as well as year fixed effects. The dependent variable in the first two columns is the logged number of firm i's number of patents in year t, in the third column the logged sum of firm i's research and development (R&D) and capital expenditures in year t, in the fourth column the log of firm i's q ratio in year t, which is defined as firm i's market value of equity plus assets minus the book value of equity, all over assets, and in the last column the logged number of firm i's new-product announcements in year t, for which we use event-study methodology by fitting a market model over the (-246,-30) period to yield the expected returns on the firm's stock, estimating cumulative abnormal returns (CARs) over the (-1,1) period around the announcement, and finally counting all announcements associated with positive CARs over the year. *Loan from UB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-8$ to $t-1$, firm i received a loan from a commercial or universal bank that merged with an investment bank thereafter. *Underwriting from IB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-8$ to $t-1$, firm i received an underwriting product from an investment bank that merged with a commercial or universal bank thereafter. The interaction of the latter two indicator variables is to be distinguished from the explanatory variable of interest in the first row, which indicates whether anytime from $t-8$ to $t-1$, firm i received a loan from a commercial or universal bank, an underwriting product from an investment bank, and both banks merged with each other until year t. *Any loan*$_{ijt}$ and *Any underwriting*$_{ijt}$ are indicator variables for whether firm i received a loan from any commercial or universal bank, or an underwriting product from any investment or universal bank, respectively, anytime from $t-8$ to $t-1$. Other control variables are measured in year t, and include the log of firm i's sales, the log of its number of employees, the log of the average ratio of deal size across all loans over the firm's assets from $t-8$ to $t-1$, and the proportion of refinancing loans from $t-8$ to $t-1$. Universal-bank (UB) fixed effects are included for *all* lead arrangers of all loans from year $t-8$ to $t-1$ that were or eventually become universal banks, whereas all remaining commercial banks are grouped together. Investment-bank (IB) fixed effects are included for all universal banks that provided firm i with an underwriting product anytime from year $t-8$ to $t-1$, whereas all remaining investment banks are grouped together. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the firm-year level) are in parentheses.

Table A.4: **Impact of Bank Information Acquisition on Firm-level Innovation – Robustness**

	ln(R&D)	ln(R&D+SG&A)	ln(CapEx)	ln(1+Products*)
Loan from UB, underwriting from IB, both merged	-0.017	0.023**	0.029*	-0.001
	(0.022)	(0.011)	(0.017)	(0.009)
Loan from UB that merged × Underwriting from IB that merged	-0.044**	-0.036***	-0.073***	-0.015**
	(0.019)	(0.010)	(0.018)	(0.006)
Loan from UB that merged	0.032**	0.030***	0.022*	-0.004
	(0.015)	(0.007)	(0.012)	(0.004)
Underwriting from IB that merged	0.106***	0.065***	0.056***	0.017***
	(0.014)	(0.008)	(0.015)	(0.005)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
All UB and IB FE	Y	Y	Y	Y
Other controls	Y	Y	Y	Y
N	54,944	49,652	109,228	111,299

Notes: All regressions are run at the firm level, and include firm as well as year fixed effects. The dependent variable in the first column is the log of firm i's research and development (R&D) expenditures in year t, in the second column the logged sum of firm i's R&D and selling, general, and administrative (SG&A) expenditures in year t, in the third column the log of firm i's capital expenditure in year t, and in the last column the logged number of firm i's new-product announcements in year t, for which we use event-study methodology by fitting a market model over the (-246,-30) period to yield the expected returns on the firm's stock, estimating cumulative abnormal returns (CARs) over the (-1,1) period around the announcement, and finally counting all announcements associated with CARs above the 75th percentile in the sample over the year. *Loan from UB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-8$ to $t-1$, firm i received a loan from a commercial or universal bank that merged with an investment bank thereafter. *Underwriting from IB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-8$ to $t-1$, firm i received an underwriting product from an investment bank that merged with a commercial or universal bank thereafter. The interaction of the latter two indicator variables is to be distinguished from the explanatory variable of interest in the first row, which indicates whether anytime from $t-8$ to $t-1$, firm i received a loan from a commercial or universal bank, an underwriting product from an investment bank, and both banks merged with each other until year t. Other control variables are measured in year t, and include the log of firm i's sales, the log of its number of employees, the log of the average ratio of deal size across all loans over the firm's assets from $t-8$ to $t-1$, and the proportion of refinancing loans from $t-8$ to $t-1$. Universal-bank (UB) fixed effects are included for *all* lead arrangers of all loans from year $t-8$ to $t-1$ that were or eventually become universal banks, whereas all remaining commercial banks are grouped together. Investment-bank (IB) fixed effects are included for all universal banks that provided firm i with an underwriting product anytime from year $t-8$ to $t-1$, whereas all remaining investment banks are grouped together. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the firm-year level) are in parentheses.

Table A.5: **Impact of Bank Information Acquisition on Firm-level Quality of Patents and Assets – Robustness**

	ln(1+Cites)	ln(Assets)	ln(Gross PP&E)	ln(Net PP&E)
Loan from UB, underwriting from IB, both merged	-0.143**	0.027***	0.031***	0.049***
	(0.065)	(0.009)	(0.010)	(0.012)
Loan from UB that merged × Underwriting from IB that merged	-0.088**	-0.022**	-0.059***	-0.070***
	(0.041)	(0.009)	(0.010)	(0.012)
Loan from UB that merged	-0.005	0.033***	0.067***	0.066***
	(0.029)	(0.006)	(0.007)	(0.008)
Underwriting from IB that merged	0.076**	0.054***	0.055***	0.066***
	(0.032)	(0.008)	(0.008)	(0.010)
Firm FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
All UB and IB FE	Y	Y	Y	Y
Other controls	Y	Y	Y	Y
N	61,036	111,295	110,634	110,920

Notes: All regressions are run at the firm level, and include firm as well as year fixed effects. The dependent variable in the first column is the log of the total number of forward citations across all patents issued by firm i in year t, in the second column the logged book value of firm i's assets in year t, in the third column the log of firm i's gross property, plant, and equipment (PP&E) in year t, and in the last column the log of firm i's net property, plant, and equipment (PP&E) in year t. *Loan from UB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-8$ to $t-1$, firm i received a loan from a commercial or universal bank that merged with an investment bank thereafter. *Underwriting from IB that merged*$_{ijt}$ is an indicator variable for whether anytime from $t-8$ to $t-1$, firm i received an underwriting product from an investment bank that merged with a commercial or universal bank thereafter. The interaction of the latter two indicator variables is to be distinguished from the explanatory variable of interest in the first row, which indicates whether anytime from $t-8$ to $t-1$, firm i received a loan from a commercial or universal bank, an underwriting product from an investment bank, and both banks merged with each other until year t. Other control variables are measured in year t, and include the log of firm i's sales, the log of its number of employees, the log of the average ratio of deal size across all loans over the firm's assets from $t-8$ to $t-1$, and the proportion of refinancing loans from $t-8$ to $t-1$. Universal-bank (UB) fixed effects are included for *all* lead arrangers of all loans from year $t-8$ to $t-1$ that were or eventually become universal banks, whereas all remaining commercial banks are grouped together. Investment-bank (IB) fixed effects are included for all universal banks that provided firm i with an underwriting product anytime from year $t-8$ to $t-1$, whereas all remaining investment banks are grouped together. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the firm-year level) are in parentheses.

Table A.6: **Impact of AIPA on Lending Relationships – Quality of Pre-AIPA Patents**

	ln(1+Loan volume)	Loan from bank
Sample	At least one loan in pre- or post-period	
Treatment × Initial relationship × Post	-0.491	-0.025
	(0.717)	(0.034)
Initial relationship × Post	-30.030***	-1.579***
	(1.596)	(0.078)
Treatment × Initial relationship × Avg. cites × Post	-0.752***	-0.044***
	(0.285)	(0.012)
Initial relationship × Avg. cites × Post	1.639***	0.097***
	(0.619)	(0.026)
Treatment × Initial relationship × Patents × Post	0.004***	0.000
	(0.001)	(0.000)
Initial relationship × Patents × Post	-0.010***	-0.000
	(0.004)	(0.000)
Bank-firm FE	Y	Y
Bank-year FE	Y	Y
Firm-year FE	Y	Y
N	6,973	7,511

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample is limited to bank-firm (ij) pairs with at least one loan within the previous five years leading up to AIPA (pre-period from 1996 to 2000) or within the first five years after AIPA (post-period from 2001 to 2005). The dependent variable in the first column is the log of the total volume of all loan transactions between firm i and bank j, separately for the pre- and post-period. The dependent variable in the second column is an indicator for the occurrence of any loan transaction between firm i and bank j. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the post-period from 2001 to 2005. $Avg.\ cites_i$ is the average number of forward citations per patent across all patents issued by firm i in the pre-period. $Patents_i$ is the total number of patents issued by firm i in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.7: **Impact of AIPA on Intensive Margin of Lending Relationships – Bank-firm Combinations**

	ln(1+Loan volume)		
Sample	All possible bank-firm combinations		
Treatment × Initial relationship × Post	-1.112**	0.671	-0.736
	(0.527)	(0.814)	(0.606)
Initial relationship × Post	-13.054***	-17.280***	-13.977***
	(1.391)	(1.951)	(1.450)
Treatment × Initial relationship × UB × Post		-11.322***	
		(1.025)	
Treatment × UB × Post		8.750***	
		(0.120)	
Initial relationship × UB × Post		6.476**	
		(2.633)	
Treatment × Initial relationship × Patenting × Post			-1.961
			(1.603)
Initial relationship × Patenting × Post			4.832
			(3.532)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	1,651,443	1,651,443	1,508,492

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample comprises all theoretically possible bank-firm (ij) pairs, i.e., including those with zero transactions throughout. The dependent variable is the log of the total volume of all loan transactions between firm i and bank j, separately for the pre- and post-period. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the post-period from 2001 to 2005. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.8: **Impact of AIPA on Extensive Margin of Lending Relationships – Bank-firm Combinations**

	Loan from bank $\in \{0, 1\}$		
Sample	All possible bank-firm combinations		
Treatment × Initial relationship × Post	-0.067**	0.012	-0.035
	(0.026)	(0.042)	(0.032)
Initial relationship × Post	-0.695***	-0.926***	-0.775***
	(0.066)	(0.093)	(0.071)
Treatment × Initial relationship × UB × Post		-0.559***	
		(0.052)	
Treatment × UB × Post		0.449***	
		(0.001)	
Initial relationship × UB × Post		0.352***	
		(0.124)	
Treatment × Initial relationship × Patenting × Post			-0.159*
			(0.086)
Initial relationship × Patenting × Post			0.394**
			(0.189)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	1,651,995	1,651,995	1,509,030

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample comprises all theoretically possible bank-firm (ij) pairs, i.e., including those with zero transactions throughout. The dependent variable is an indicator for the occurrence of any loan transaction between firm i and bank j. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the post-period from 2001 to 2005. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.9: **Impact of AIPA on Intensive Margin of Lending Relationships – Robustness, Treatment Measure**

	ln(1+Loan volume)		
Sample	At least one loan in pre- or post-period		
Treatment × Initial relationship × Post	-1.936***	1.718	-0.072
	(0.574)	(1.154)	(0.729)
Initial relationship × Post	-27.294***	-35.397***	-30.863***
	(1.236)	(2.350)	(1.484)
Treatment × Initial relationship × UB × Post		-4.687***	
		(1.306)	
Treatment × UB × Post		1.075	
		(1.015)	
Initial relationship × UB × Post		10.469***	
		(2.606)	
Treatment × Initial relationship × Patenting × Post			-5.995***
			(1.691)
Initial relationship × Patenting × Post			11.692***
			(3.312)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	7,558	7,558	6,973

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample is limited to bank-firm (ij) pairs with at least one loan within the previous five years leading up to AIPA (pre-period from 1996 to 2000) or within the first five years after AIPA (post-period from 2001 to 2005). The dependent variable is the log of the total volume of all loan transactions between firm i and bank j, separately for the pre- and post-period. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the median difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the post-period from 2001 to 2005. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.10: **Impact of AIPA on Extensive Margin of Lending Relationships – Robustness, Treatment Measure**

	Loan from bank $\in \{0, 1\}$		
Sample	At least one loan in pre- or post-period		
Treatment × Initial relationship × Post	-0.093***	0.131**	0.013
	(0.030)	(0.055)	(0.039)
Initial relationship × Post	-1.444***	-2.008***	-1.661***
	(0.070)	(0.110)	(0.081)
Treatment × Initial relationship × UB × Post		-0.273***	
		(0.061)	
Treatment × UB × Post		0.047	
		(0.051)	
Initial relationship × UB × Post		0.700***	
		(0.123)	
Treatment × Initial relationship × Patenting × Post			-0.380***
			(0.086)
Initial relationship × Patenting × Post			0.778***
			(0.175)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	8,110	8,110	7,511

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample is limited to bank-firm (ij) pairs with at least one loan within the previous five years leading up to AIPA (pre-period from 1996 to 2000) or within the first five years after AIPA (post-period from 2001 to 2005). The dependent variable is an indicator for the occurrence of any loan transaction between firm i and bank j. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the median difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the post-period from 2001 to 2005. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.11: **Impact of AIPA on Intensive Margin of Lending Relationships – Robustness, 3-year Window**

	ln(1+Loan volume)		
Sample	At least one loan in pre- or post-period		
Treatment × Initial relationship × Post	-1.681*	0.456	0.426
	(0.866)	(2.835)	(1.011)
Initial relationship × Post	-28.801***	-34.213***	-33.225***
	(1.862)	(6.106)	(2.249)
Treatment × Initial relationship × UB × Post		-2.473	
		(2.997)	
Treatment × UB × Post		-0.491	
		(1.844)	
Initial relationship × UB × Post		6.439	
		(6.490)	
Treatment × Initial relationship × Patenting × Post			-7.122**
			(3.196)
Initial relationship × Patenting × Post			15.437**
			(6.939)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	4,434	4,434	4,148

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample is limited to bank-firm (ij) pairs with at least one loan within the previous three years leading up to AIPA (pre-period from 1998 to 2000) or within the first three years after AIPA (post-period from 2001 to 2003). The dependent variable is the log of the total volume of all loan transactions between firm i and bank j, separately for the pre- and post-period. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the post-period from 2001 to 2003. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.12: **Impact of AIPA on Extensive Margin of Lending Relationships – Robustness, 3-year Window**

	Loan from bank $\in \{0, 1\}$		
Sample	At least one loan in pre- or post-period		
Treatment × Initial relationship × Post	-0.067**	0.031	0.024
	(0.029)	(0.123)	(0.045)
Initial relationship × Post	-1.534***	-1.870***	-1.739***
	(0.063)	(0.262)	(0.100)
Treatment × Initial relationship × UB × Post		-0.106	
		(0.140)	
Treatment × UB × Post		-0.096	
		(0.089)	
Initial relationship × UB × Post		0.393	
		(0.300)	
Treatment × Initial relationship × Patenting × Post			-0.377***
			(0.136)
Initial relationship × Patenting × Post			0.855***
			(0.306)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	4,784	4,784	4,495

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample is limited to bank-firm (ij) pairs with at least one loan within the previous three years leading up to AIPA (pre-period from 1998 to 2000) or within the first three years after AIPA (post-period from 2001 to 2003). The dependent variable is an indicator for the occurrence of any loan transaction between firm i and bank j. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the post-period from 2001 to 2003. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.13: **Impact of AIPA on Intensive Margin of Lending Relationships – Robustness, 4-year Window**

	ln(1+Loan volume)		
Sample	At least one loan in pre- or post-period		
Treatment × Initial relationship × Post	-2.258***	0.455	-0.508
	(0.623)	(1.594)	(0.849)
Initial relationship × Post	-26.933***	-33.672***	-30.460***
	(1.436)	(3.512)	(1.878)
Treatment × Initial relationship × UB × Post		-3.419*	
		(1.985)	
Treatment × UB × Post		1.319	
		(1.387)	
Initial relationship × UB × Post		8.617**	
		(4.330)	
Treatment × Initial relationship × Patenting × Post			-4.676$^{(*)}$
			(2.912)
Initial relationship × Patenting × Post			9.701
			(6.323)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	6,247	6,247	5,821

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample is limited to bank-firm (ij) pairs with at least one loan within the previous four years leading up to AIPA (pre-period from 1997 to 2000) or within the first four years after AIPA (post-period from 2001 to 2004). The dependent variable is the log of the total volume of all loan transactions between firm i and bank j, separately for the pre- and post-period. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the post-period from 2001 to 2004. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.14: **Impact of AIPA on Extensive Margin of Lending Relationships – Robustness, 4-year Window**

	Loan from bank $\in \{0,1\}$		
Sample	At least one loan in pre- or post-period		
Treatment × Initial relationship × Post	-0.118***	0.015	-0.042
	(0.029)	(0.074)	(0.043)
Initial relationship × Post	-1.397***	-1.811***	-1.564***
	(0.074)	(0.161)	(0.100)
Treatment × Initial relationship × UB × Post		-0.152*	
		(0.089)	
Treatment × UB × Post		0.006	
		(0.068)	
Initial relationship × UB × Post		0.500**	
		(0.195)	
Treatment × Initial relationship × Patenting × Post			-0.260**
			(0.120)
Initial relationship × Patenting × Post			0.579**
			(0.269)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	6,710	6,710	6,274

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample is limited to bank-firm (ij) pairs with at least one loan within the previous four years leading up to AIPA (pre-period from 1997 to 2000) or within the first four years after AIPA (post-period from 2001 to 2004). The dependent variable is an indicator for the occurrence of any loan transaction between firm i and bank j. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the post-period from 2001 to 2004. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.15: **Impact of AIPA on Intensive Margin of Lending Relationships – Robustness, No Bankruptcy**

	ln(1+Loan volume)		
Sample	At least one loan in pre- or post-period		
Treatment × Initial relationship × Post	-1.694*	3.236	0.665
	(1.021)	(2.033)	(0.992)
Initial relationship × Post	-26.374***	-38.907***	-31.232***
	(2.340)	(4.449)	(2.254)
Treatment × Initial relationship × UB × Post		-5.804**	
		(2.375)	
Treatment × UB × Post		2.087	
		(1.531)	
Initial relationship × UB × Post		14.968***	
		(5.112)	
Treatment × Initial relationship × Patenting × Post			-8.663***
			(2.390)
Initial relationship × Patenting × Post			18.362***
			(5.083)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	3,574	3,574	3,562

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample is limited to bank-firm (ij) pairs with at least one loan within the previous five years leading up to AIPA (pre-period from 1996 to 2000) or within the first five years after AIPA (post-period from 2001 to 2005). Furthermore, firms that were delisted for bankruptcy-related reasons anytime until (and including) 2005 were also dropped from the sample. Bankruptcy is identified using the following CRSP delisting codes: any type of liquidation (400-490); price fell below acceptable level; insufficient capital, surplus, and/or equity; insufficient (or non-compliance with rules of) float or assets; company request, liquidation; bankruptcy, declared insolvent; delinquent in filing; non-payment of fees; does not meet exchange's financial guidelines for continued listing; protection of investors and the public interest; corporate governance violation; and delist required by Securities Exchange Commission (SEC). The dependent variable is the log of the total volume of all loan transactions between firm i and bank j, separately for the pre- and post-period. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the post-period from 2001 to 2005. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.

Table A.16: **Impact of AIPA on Extensive Margin of Lending Relationships – Robustness, No Bankruptcy**

	Loan from bank $\in \{0, 1\}$		
Sample	At least one loan in pre- or post-period		
Treatment × Initial relationship × Post	-0.086*	0.213**	0.033
	(0.044)	(0.099)	(0.053)
Initial relationship × Post	-1.370***	-2.195***	-1.632***
	(0.111)	(0.224)	(0.127)
Treatment × Initial relationship × UB × Post		-0.329***	
		(0.113)	
Treatment × UB × Post		0.039	
		(0.070)	
Initial relationship × UB × Post		0.935***	
		(0.251)	
Treatment × Initial relationship × Patenting × Post			-0.463***
			(0.106)
Initial relationship × Patenting × Post			1.021***
			(0.231)
Bank-firm FE	Y	Y	Y
Bank-year FE	Y	Y	Y
Firm-year FE	Y	Y	Y
N	3,964	3,964	3,951

Notes: All regressions are run at the bank-firm level (two observations per bank-firm pair), and include bank-firm, bank-year, and firm-year fixed effects. The sample is limited to bank-firm (ij) pairs with at least one loan within the previous five years leading up to AIPA (pre-period from 1996 to 2000) or within the first five years after AIPA (post-period from 2001 to 2005). Furthermore, firms that were delisted for bankruptcy-related reasons anytime until (and including) 2005 were also dropped from the sample. Bankruptcy is identified using the following CRSP delisting codes: any type of liquidation (400-490); price fell below acceptable level; insufficient capital, surplus, and/or equity; insufficient (or non-compliance with rules of) float or assets; company request, liquidation; bankruptcy, declared insolvent; delinquent in filing; non-payment of fees; does not meet exchange's financial guidelines for continued listing; protection of investors and the public interest; corporate governance violation; and delist required by Securities Exchange Commission (SEC). The dependent variable is an indicator for the occurrence of any loan transaction between firm i and bank j. $Treatment_i$ is defined at the industry level (based on SIC2 codes), and measures the mean difference in years between the filing date and the grant date, across all patents granted to publicly listed firms in the respective industry between 1996 and 2000. $Initial\ relationship_{ij}$ is an indicator variable for whether firm i received a loan from bank j anytime in the pre-period. $Post_t$ is a dummy variable for the post-period from 2001 to 2005. UB_j indicates whether bank j was a universal bank in the pre-period. $Patenting_i$ is an indicator variable for whether firm i issued any patents in the pre-period. Bank fixed effects are defined for all commercial and universal banks. Public-service, energy, and financial-services firms are dropped. Robust standard errors (clustered at the bank level) are in parentheses.