# Processing Public Information and Lender Composition in Syndicated Lending*

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**Abstract**

How do reductions in the cost of processing public financial information affect syndicated lending? Using the SEC's staggered introduction of eXtensible Business Reporting Language, we show that lower processing costs increase the value of public relative to private information, shifting comparative advantage toward lenders that rely more on public information. Nonbanks increase participation, especially when they lack industry expertise, and enter new borrower relationships, whereas banks do not respond. Nonbanks rely more on public financial information and less on lead arrangers' relationship-based inputs when making participation decisions, while delegated monitoring remains unchanged. EDGAR download patterns support the processing-cost channel.

**Keywords**: Information processing costs, Public financial information, Participation decisions, Delegated monitoring, Syndicated lending, Nonbanks, XBRL

**JEL classification**: D83, G14, G21, G23, M48, O33

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# 1 Introduction

Lending decisions rely on both publicly available information and private information. Because lenders vary in their ability to acquire and produce private information relevant to those decisions, they differ in their reliance on public information. Recent advances in financial reporting technology have substantially reduced the cost of processing public financial information at scale (hereafter, processing costs) without changing the underlying information itself. These reductions in processing costs can increase the economic value of public information relative to private information in lending decisions, potentially shifting comparative advantage among lenders. Whether lower processing costs change lenders' reliance on public relative to private information, thereby reshaping which lenders finance borrowers, remains an open question.

Syndicated lending is well-suited to examining this question because it separates participant lenders' decisions to join a syndicate from the due diligence and monitoring delegated to lead arrangers. Participant lenders decide whether to join a syndicate, drawing on public financial information and private information available to them, including information provided by lead arrangers. Lead arrangers, in contrast, conduct due diligence, monitor borrowers, and maintain lending relationships through which they acquire and produce borrower-specific private information. This separation is useful because participation decisions can draw on both public and private information, whereas delegated monitoring depends primarily on borrower-specific private information. As a result, lower processing costs can alter the information on which participant lenders rely when deciding whether to join a syndicate while leaving the private-information-intensive functions of delegated monitoring largely unchanged.

To identify the effects of lower processing costs, we need a setting in which processing costs change without changing the underlying information available to lenders. We address this challenge by exploiting the SEC's staggered introduction of eXtensible Business Re-

porting Language (XBRL), which transformed existing financial statement disclosures into a machine-readable format without materially changing their content. Unlike settings that reduce the cost of locating and retrieving public information (e.g., EDGAR), XBRL primarily reduces the cost of processing that information once retrieved, providing plausibly exogenous variation in processing costs while holding the underlying information largely fixed. More recent technologies, including large language models and artificial intelligence (AI)-driven analytics, can similarly reduce information-processing costs but diffuse too broadly to isolate the effect as precisely. XBRL therefore provides an unusually clean setting for identifying how lower processing costs affect lenders' reliance on public relative to private information in syndicated lending.

Using this setting, we find that lower processing costs shift participant composition toward nonbank lenders, which generally rely more heavily on public information. Because banks generally have greater private-information-production capabilities developed through repeated lending relationships, due diligence, and ongoing monitoring, they can rely relatively more on private information in participation decisions and therefore should respond less to reductions in public-information processing costs. Following XBRL adoption, the probability that a loan includes at least one nonbank participant increases by almost ten percentage points (pp), and the number of nonbank participants per syndicate increases significantly, while bank participation shows no corresponding increase. The nonbank share of syndicate lenders increases by approximately 25% relative to the sample mean, indicating that lower processing costs reallocate participation toward nonbank lenders rather than merely expanding syndicate size.

We next examine additional predictions about when lower processing costs should matter most for nonbank participation. Following XBRL adoption, syndicates become more likely to attract new nonbank participants, but not new bank participants, indicating that lower processing costs facilitate nonbank entry when lenders lack borrower-specific private information accumulated through prior lending relationships. The increase in nonbank participation

is also concentrated among nonspecialized nonbanks, suggesting that lower processing costs are more valuable when lenders lack industry-specific expertise.

Our strongest evidence that lower processing costs change nonbank participants' reliance on public relative to private information comes from the information participants use when making participation decisions. Following XBRL adoption, the association between nonbank participation and lead-arranger relationship information weakens, whereas nonbank participation becomes more strongly associated with borrowers' debt-to-EBITDA and interest coverage ratios. These patterns are consistent with nonbank participants relying less on borrower-specific private information conveyed through lead arrangers and more on public financial information when deciding whether to participate. This joint pattern provides the strongest evidence for the proposed mechanism.

We next examine SEC EDGAR download logs to provide direct evidence on the processing-cost channel. We document a sharp increase in machine downloads of XBRL-formatted filings following adoption, consistent with greater machine-based processing of public financial information. Moreover, firms experiencing greater machine-download activity subsequently attract higher nonbank participation, whereas non-machine download activity does not, and neither type of download predicts greater bank participation. Together, these findings support the interpretation that lower processing costs increase nonbank participation through greater machine-based processing of public financial information.

A key implication of our framework is that lower processing costs should not draw nonbanks into functions that require the acquisition and production of borrower-specific private information. Consistent with this implication, we find that XBRL adoption does not affect the likelihood that a nonbank serves as a lead arranger. This null result is not merely the absence of an effect; it is a boundary condition predicted by our framework. It indicates that lower processing costs reshape the information participants use in making participation decisions while leaving the private-information-intensive functions of delegated monitoring unchanged.

Our primary contribution is to show that reductions in information-processing costs reshape financial intermediation not by changing the information available to lenders, but by changing the relative value of public and private information. This finding complements theories that emphasize the acquisition and production of borrower-specific private information through relationship-based lending (e.g., Diamond, 1984; Boot, 2000; Sufi, 2007). Lower processing costs increase the value of scalable public information in lenders' participation decisions while leaving borrower-specific private information central to delegated monitoring. As a result, information-processing technologies can reshape comparative advantages among lenders without displacing relationship-based information production.

Our paper also contributes to the literature on nonbank intermediation by identifying information-processing costs as an important determinant of nonbank participation in credit markets. Whereas prior research emphasizes funding advantages, regulatory arbitrage, and information-motivated trading (Ivashina and Sun, 2011; Chernenko et al., 2022), we show that reductions in public-information processing costs also shape nonbank participation by lowering the cost of public financial information used in participation decisions.

We also contribute to the literature on information-processing technologies in lending markets. Prior research shows that advances in information-processing technologies facilitate nonbank lending in residential mortgages and small-business credit markets (Buchak et al., 2018; Fuster et al., 2019; Erel and Liebersohn, 2022). We extend this literature to syndicated lending, where private-information production remains central to credit intermediation. It is therefore unclear whether lower processing costs should similarly reshape lender participation. Our findings show that they nevertheless do.

Chen et al. (2018) show that XBRL adoption affects loan pricing. Loan-pricing effects do not necessarily imply changes in lender composition; for example, nonbank tranches often carry higher, rather than lower, interest rates (Lim et al., 2014). We therefore examine lender participation, showing that lower processing costs reshape the composition of lending syndicates—a margin of adjustment that cannot be inferred from loan pricing alone. Our

paper differs from studies of EDGAR, which examine how lower access costs affect syndicated lending (Chi et al., 2025). Whereas EDGAR reduces the cost of locating and retrieving borrower disclosures, XBRL reduces the cost of processing those disclosures, allowing us to isolate the effects of lower processing costs while holding information availability largely fixed.

The remainder of the paper is organized as follows. Section 2 develops the testable hypotheses. Section 3 provides institutional background and outlines the empirical strategy. Section 4 describes the data and sample construction. Section 5 presents the results. Section 6 reports robustness checks and discusses alternative explanations. Section 7 concludes.

# 2 Hypothesis Development

Figure 1 illustrates the conceptual framework underlying our hypotheses. Borrower information consists of publicly available information and private information. Public information is observable to all lenders, whereas private information requires investment to acquire and produce through lending and information-production activities. Because lenders differ in their ability to acquire and produce private information relevant for lending decisions, they also differ in their reliance on public information in those decisions. Lower processing costs induced by XBRL increase the relative value of public financial information by reducing the cost of extracting, comparing, and incorporating it into lending decisions while leaving private-information production unaffected.

In syndicated lending, these differences are reflected in the distinct roles of participant lenders and lead arrangers. Participant lenders draw on both public and private information when deciding whether to join a syndicate, whereas lead arrangers assume screening and monitoring responsibilities that rely primarily on borrower-specific private information. Consequently, lower processing costs should primarily affect participation decisions while leaving delegated monitoring largely unchanged.

The effect of lower processing costs on participation decisions should, however, vary across lender types because banks and nonbanks differ in their ability to produce private information. Commercial banks generally have greater private-information-production capabilities because repeated lending relationships, due diligence, and ongoing monitoring generate borrower-specific private information and strengthen banks' ability to acquire and interpret private information (Stein, 2002; Boot, 2000). Even when participating rather than leading a particular syndicate, banks can draw on their broader lending relationships and information-production activities to acquire and produce private information relevant to participation decisions. Consistent with this institutional feature, commercial banks overwhelmingly perform the information-intensive lead-arranger role. In DealScan, more than 80% of syndicated loans between 1982 and 2020 have commercial banks as lead arrangers.

By contrast, nonbank participants generally have fewer opportunities than banks to produce private information through relationship-based lending. Because they are less likely to establish repeated borrower relationships or conduct delegated monitoring, they are generally less able to generate borrower-specific private information independently and therefore depend more heavily on public information and private information conveyed through lead arrangers in participation decisions. Since banks can supplement public information with private information acquired and produced through their broader lending activities, lower processing costs should disproportionately benefit nonbank participants.

These differences in lenders' reliance on public information motivate five hypotheses. The first three concern lender participation, the fourth concerns the informational basis of nonbank lenders' participation decisions, and the fifth examines whether lower processing costs also affect delegated monitoring.

Our first prediction concerns participant composition. Because lower processing costs increase the relative value of public financial information, their effects should be stronger for nonbanks than for banks.

**Hypothesis 1.** Reductions in the cost of processing public financial information increase

nonbank participation in syndicated loans, with a weaker or no comparable increase in bank participation.

Informational frictions are especially high when lenders evaluate unfamiliar borrowers. Without prior lending relationships, lenders cannot benefit from borrower-specific private information accumulated through previous interactions with the borrower and therefore rely more heavily on public financial information when assessing creditworthiness (Sharpe, 1990; Rajan, 1992; Boot, 2000). Consequently, reductions in processing costs should facilitate entry into new lending relationships primarily by nonbank participants.

**Hypothesis 2.** Reductions in the cost of processing public financial information increase entry by nonbank participants into lending relationships with previously unconnected borrowers.

The mechanism also generates cross-sectional predictions within nonbanks. Industry-specific expertise provides lenders with an informational advantage in evaluating borrowers in familiar industries. Consequently, if lower processing costs are particularly valuable when lenders have weaker preexisting informational advantages, the increase in nonbank participation should be stronger among nonspecialized nonbanks.

**Hypothesis 3.** The increase in nonbank participation following reductions in the cost of processing public financial information is stronger among nonbank participants with less industry-specific expertise.

The first three hypotheses establish whether lower processing costs reshape participant composition. However, changes in participation alone do not reveal the underlying mechanism. The central implication of our framework is that lower processing costs should also change the informational basis of nonbank lenders' participation decisions by shifting their reliance from private information toward public information. When processing public financial information is costly, nonbank participants rely relatively more on borrower-specific private

information conveyed through lead arrangers in making participation decisions (Sufi, 2007; Ivashina, 2009; Bharath et al., 2011). Consequently, lower processing costs should reduce the weight participants place on borrower-specific private information conveyed through lead arrangers and increase the weight they place on public financial information when deciding to participate in a loan syndicate.

**Hypothesis 4.** Reductions in the cost of processing public financial information reduce nonbank participants' reliance on borrower-specific private information conveyed through lead arrangers and increase their reliance on public financial information in making participation decisions.

The proposed mechanism also implies a sharp boundary condition. If lower processing costs primarily increase participant lenders' reliance on public relative to private information when making participation decisions, they should have little effect on lead arrangers, whose comparative advantage lies in acquiring and producing borrower-specific private information through delegated monitoring and ongoing lending relationships (Sufi, 2007; Ivashina, 2009).

**Hypothesis 5.** Reductions in the cost of processing public financial information do not increase the likelihood that nonbanks serve as lead arrangers.

# 3 Institutional Background and Research Design

## 3.1 Institutional Background: XBRL Adoption

A defining feature of the SEC's XBRL mandate is that it changes how corporate disclosures are processed without materially changing what firms disclose.[1] Firms continue to file the same Forms 10-K, 10-Q, and 8-K under unchanged accounting standards and disclosure

[1] Although firms may make modest discretionary adjustments to disclosures following XBRL adoption (Blankespoor, 2019), these changes are likely second-order relative to the mandate-driven change in machine readability.

requirements; XBRL simply furnishes existing financial statement information in a structured, machine-readable format. Because XBRL changes the format rather than the content of financial statement disclosures, it primarily reduces the cost of processing public financial information rather than changing the information available to lenders. Accordingly, the staggered introduction of XBRL provides plausibly exogenous variation in the cost of processing public financial information while holding firms' disclosure obligations largely fixed.

Before XBRL, SEC filings were publicly available primarily in static formats such as HTML and PDF. Although lenders could access these disclosures, extracting, comparing, and incorporating financial information into participation decisions required substantial manual effort. XBRL assigns standardized digital tags to individual financial statement items, allowing accounting information to be extracted, compared, and analyzed automatically. The SEC launched a voluntary XBRL filing program in 2005 and subsequently phased in mandatory adoption beginning in 2009, requiring large accelerated filers to comply first, followed by other accelerated filers in 2010 and remaining firms in 2011. An illustrative example appears in Figure A.1.

Processing costs decline through both direct and indirect channels. Under the direct channel, processing costs decline as participant lenders extract and process machine-readable filings when making participation decisions. Access to structured disclosures lowers the cost of processing public financial information by enabling automated extraction, comparison, and incorporation of financial statement data into these decisions.

Under the indirect channel, processing costs decline as data vendors, such as Compustat, FactSet, S&P LCD, and Refinitiv, standardize and redistribute financial information from machine-readable filings, facilitating its use in participation decisions. XBRL reduces the manual extraction and reconciliation burden these vendors face, enabling them to update and distribute standardized financial information more quickly and consistently. For example, EDGAR Online reports that its XBRL "As Reported" dataset delivers new information

"within seconds" of SEC filing while "hid[ing] the complexity of XBRL" from end users,[2] illustrating how vendors absorbed the complexity of parsing XBRL while passing the resulting efficiency gains on to downstream users. Consequently, lenders relying on these commercial databases benefit from lower processing costs even without directly processing XBRL-tagged filings.

Whether lenders process XBRL filings directly or obtain standardized financial information from commercial data providers, the common economic effect is a reduction in processing costs. Importantly, the relevant economic margin is the cost of processing information contained in SEC filings rather than the cost of locating those filings, which is the focus of Chi et al. (2025). Syndicated lending decisions typically unfold over weeks or months, giving participants ample time to retrieve borrower disclosures but not to eliminate the ongoing costs of extracting, standardizing, comparing, and updating information across many firms. Consequently, the primary effect of machine-readable reporting is not faster retrieval of individual filings, but lower costs of processing public financial information at scale for participation decisions.

Although the SEC subsequently introduced Inline XBRL (iXBRL), we use the initial XBRL mandate as our primary source of variation because it provides the first large-scale and relatively clean reduction in the cost of processing public financial information. Unlike the original mandate, which introduced machine-readable reporting, iXBRL primarily improves the implementation and quality of existing machine-readable disclosures. Moreover, iXBRL adoption coincides with substantially lower DealScan–Compustat coverage and increased missingness in EDGAR log files, materially reducing the available sample. We therefore use iXBRL only in supplementary analyses to examine whether improvements in tagging quality further strengthen the effects of lower processing costs.

[2]Source: `https://www.prnewswire.com/news-releases/edgar-online-advances-financial-transparency-with-first-as-reported-xbrl-dataset-for-sec-filings-103281414.html`

## 3.2 Research Design

Compliance with the XBRL mandate was phased in based on filer status, so firms adopted XBRL in different years for regulatory reasons plausibly unrelated to their borrowing activity. We leverage this staggered treatment timing in a loan-facility-level two-way fixed effects difference-in-differences (DiD) framework to examine how lower processing costs affect participant composition, the informational basis of nonbank lenders' participation decisions, and delegated monitoring. Our baseline specification is:

$$\text{NonbankParticipation}_{i,j,t} = \alpha + \beta\,\text{XBRL}_{i,t} + \gamma\,X_{i,t-1} + \rho\,Y_{j,t} + \delta_i + \tau_j + \theta_t + \epsilon_{i,j,t}, \qquad (1)$$

where $i$ indexes the borrower, $j$ the loan facility, and $t$ the year. $XBRL_{i,t}$ is an indicator equal to one if borrower $i$ has adopted XBRL in year $t$. $X_{i,t-1}$ includes lagged borrower characteristics, and $Y_{j,t}$ includes loan-level controls. Borrower fixed effects $\delta_i$ absorb time-invariant firm characteristics. $\tau_j$ denotes loan-type and loan-purpose fixed effects. Year fixed effects $\theta_t$ account for common macroeconomic and time-specific shocks. Standard errors are clustered at the borrower level.

This specification identifies the effect of XBRL adoption by comparing lending outcomes before and after adoption within the same borrower, while controlling for observable borrower and loan characteristics and common time trends. In our setting, changes in participant composition are primarily reflected through changes in nonbank participation. We use variants of equation (1) to examine how lower processing costs affect participant composition, including overall nonbank participation, entry into new lending relationships, and participation by specialized and nonspecialized nonbanks; the informational basis of nonbank lenders' participation decisions, reflected in the relative importance of public financial information and borrower-specific private information conveyed through lead arrangers; and delegated monitoring.

In implementing this specification, we measure XBRL adoption at the annual level based

on the borrower's first XBRL filing year rather than exact filing dates. We do so because machine-readable disclosures reduce processing costs through changes in lender workflows rather than through immediate reactions to individual filings, making it unlikely that lenders respond to the precise timing of individual filings. In addition, lenders evaluate many firms simultaneously, including both potential borrowers and industry peers, who may adopt XBRL at different points within the same year, making exact filing dates less relevant for participation decisions. Accordingly, the effective availability of machine-readable information is better captured at an annual frequency.

We next examine whether lower processing costs facilitate the formation of new lending relationships. We define new lenders as those without prior lending relationships with the borrower and estimate variants of equation (1), using an indicator for whether a facility includes at least one new lender as the dependent variable, separately for nonbanks and banks to assess whether reductions in processing costs differentially affect entry across lender types.

To examine which nonbank participant lenders benefit most from declining processing costs, we follow Blickle et al. (2026) and identify each lender's industry expertise based on prior lending activity. We estimate variants of equation (1) in which the dependent variable indicates whether a facility includes at least one specialized nonbank participant or, separately, at least one nonspecialized nonbank participant.

To examine whether lower processing costs alter the informational basis of nonbank lenders' participation decisions, we augment the baseline specification with interaction terms, continuing to use nonbank participation as the dependent variable. First, we interact the XBRL indicator with prior lending relationships between the borrower and the lead arrangers, which capture information and certification benefits associated with lead-arranger relationships, and examine whether their importance for nonbank participation declines following XBRL adoption. Second, we interact the XBRL indicator with two widely used EBITDA-based credit metrics: the *Debt-to-EBITDA* ratio and the *Interest Coverage Ratio*

*(ICR)*, and examine whether nonbank participation becomes more strongly associated with these public financial measures following XBRL adoption.

To provide direct evidence that XBRL lowers information-processing costs, we use machine downloads of EDGAR filings as a proxy for machine-based processing of public disclosures. We first compare machine- and non-machine-download activity before and after XBRL adoption and estimate borrower-level regressions relating download intensity to XBRL adoption. We then examine whether pre-loan machine- and non-machine-download activity predicts nonbank participation using facility-level regressions.

Finally, to examine whether the effects of lower processing costs extend beyond participation decisions to delegated monitoring, we estimate a variant of equation (1) in which the dependent variable is an indicator equal to one if the lead arranger is a nonbank and zero otherwise.

# 4 Data

In this section, we describe the construction of our sample, define the key variables used in the analysis, and present summary statistics.

## 4.1 Sample Construction and Variables

Our primary dataset consists of U.S. syndicated loan facilities from DealScan. We exclude loan facilities led by nonbanks from the main analysis because serving as a lead arranger allows nonbanks to acquire substantial borrower-specific private information through due diligence, delegated monitoring, and lending relationships, reducing their reliance on public disclosures. Following prior literature, we also exclude loan facilities originated to firms in the utility (SIC 4900–4999) and financial (SIC 6000–6999) sectors, given their distinct reporting and regulatory environments.

Following prior literature, we classify lenders as banks or nonbanks using DealScan lender

codes, supplemented with publicly available information on institutional type (Lim et al., 2014; Aldasoro et al., 2025). Nonbanks include non-depository financial institutions such as investment banks, insurance companies, pension funds, hedge funds, and other nonbank financial intermediaries (Chernenko et al., 2022). We measure nonbank participation at the facility level using three metrics: an indicator of whether at least one nonbank lender participates, the number of nonbank participants in the syndicate, and the fraction of syndicate lenders that are nonbanks.[3]

We focus on the period 2005–2012, which provides symmetric four-year pre- and post-adoption periods around the initiation of the SEC's staggered mandatory XBRL adoption. Firms that adopt XBRL prior to their first observed loan during the sample period are excluded, as they do not provide pre-treatment observations for identification.

To identify the timing of XBRL adoption, we collect SEC filings for borrowers using their Central Index Key (CIK). We focus on Forms 10-K, 10-Q, and 8-K and compile all filing URLs between 2005 and 2012. A filing is classified as XBRL-tagged if its "Data Files" section contains XBRL-related elements, including references to "XBRL," "XML," or "EX-101" taxonomy identifiers. Figure A.2 in Appendix A.1 illustrates the differences between a typical non-XBRL filing and an XBRL-formatted filing.

For each loan facility, we collect contract characteristics, including $Loan\,Size$ (defined as the logarithm of the facility commitment), $Maturity$ (measured in years), loan type, and loan purpose. We link syndicated loans from DealScan to firm-level financial data in Compustat using the Chava and Roberts (2008) linking table. Borrower characteristics include $Size$ (log of total assets), $Market\text{-}to\text{-}Book$ (market value of equity divided by book value of equity), $Leverage$ (total debt divided by total assets), $Return\,on\,Assets\,(ROA)$ (income before extraordinary items divided by total assets), $Tangibility$ (net property, plant, and equipment divided by total assets), $Cash$ (cash holdings divided by total assets), and $Credit\,Rating$ (S&P long-term issuer credit rating, rescaled to lie in the interval [0,1]). All

[3]We do not examine the funding amounts provided by nonbanks, as DealScan does not reliably report lender-level allocation amounts (Mueller et al., 2025).

continuous control variables are winsorized at the 1% level.

We define a new lender as one without any prior lending relationship with the borrower. Following Blickle et al. (2026), we construct measures of relative and excess industry specialization for each nonbank based on its prior lending activity and historical loan portfolio composition. Borrower–lead arranger relationship strength is measured using two variables: an indicator equal to one if the lead arranger has extended credit to the same borrower within the preceding three years, and the number of facilities extended by the lead arranger to the same borrower over the same period. To capture public financial information relevant to participation decisions, we compute two widely used EBITDA-based credit metrics: *Debt-to-EBITDA*, defined as total debt divided by EBITDA, and the *Interest Coverage Ratio (ICR)*, defined as EBITDA divided by interest expense. Finally, we supplement the loan-level data with SEC EDGAR download logs and use machine downloads of SEC filings as a proxy for machine-based processing of public financial information.

## 4.2 Summary Statistics

Table 1 reports summary statistics for the sample. Panel A reports the distribution of borrowers and loan facilities by treatment status, distinguishing between treatment switcher and non-switcher groups. *Switchers* are borrowers that originate at least one syndicated loan facility both before and after XBRL adoption. *Non-switchers* include firms that remain untreated throughout the sample, plus firms that adopt XBRL but originate no loan facilities afterward, contributing only pre-treatment observations to the estimation sample.

The estimation sample consists of 6,287 loan facilities originated to 1,924 unique borrowers. Of these, 5,089 originated before the borrower's first XBRL filing year and 1,198 originated in or after that year. Among the 1,924 borrowers in our sample, 613 (32%) obtain at least one syndicated loan facility both before and after XBRL adoption. These borrowers originate, on average (median), 2.88 (2) facilities before adoption and 1.95 (2) facilities after adoption. Together, they account for 2,965 facilities (47% of the estimation

sample), including 1,767 pre-adoption facilities and 1,198 post-adoption facilities, providing the within-borrower variation underlying our difference-in-differences estimates.

Panel B presents the annual distribution of loan facilities and borrowers for the full sample and separately for facilities originated before and after borrowers' first XBRL filing. As the SEC phased in mandatory XBRL adoption between 2009 and 2011, the number of post-adoption facilities increased steadily, peaking in 2011, the final year of the mandatory adoption period. The staggered timing of XBRL adoption across borrowers provides the time-series and cross-sectional variation underlying our difference-in-differences identification strategy.

Panel C presents summary statistics for the main variables used in the analysis. Approximately 43.5% of facilities include at least one nonbank lender ($Nonbank = 1$). The average number of nonbank lenders per facility is 0.925. The average fraction of syndicate lenders that are nonbanks ($Nonbank\%$) is 0.091, indicating that nonbanks represent 9.1% of syndicate lenders on average (standard deviation = 0.145). The indicator variable $XBRL$ equals one for 19.1% of the loan facilities.

# 5 Results

## 5.1 Lower Processing Costs and Nonbank Participation

Hypothesis 1 predicts that if lower processing costs increase participant lenders' reliance on public relative to private information, they should disproportionately increase participation by lenders that rely most heavily on public information. Table 2 reports difference-in-differences estimates of the effect of XBRL adoption on nonbank participation. Consistent with Hypothesis 1, nonbank participation increases significantly across all three measures: the likelihood that a loan includes at least one nonbank participant, the number of nonbank participants, and the fraction of syndicate lenders that are nonbanks.

Columns (2), (4), and (6), which include the full set of borrower and loan controls,

indicate economically meaningful effects. Following XBRL adoption, the probability that a loan includes at least one nonbank participant increases by 8.9 pp relative to a sample mean of 43.5%, while the number of nonbank participants increases by approximately 0.21 per syndicate from the sample mean.[4] The similarity of the estimates across specifications indicates that the results are not sensitive to the inclusion of observable controls.

An important question is whether these results reflect a shift in participant composition or simply larger syndicates. If lower processing costs simply increased lenders' overall willingness to participate, syndicates might grow larger without changing composition. To distinguish a compositional shift from a general expansion in participation, column (6) of Table 2 indicates that the nonbank share of syndicate lenders rises by approximately 2.3 pp following XBRL adoption, about 25% relative to a sample mean of 9.1%, providing evidence of a compositional shift.

Table 3 decomposes the change in syndicate size by lender type. Total syndicate size increases following XBRL adoption, while bank participation does not change. The increase in syndicate size is therefore driven by additional nonbank participation rather than proportional expansion across lender types. These findings indicate that lower processing costs reshape participant composition rather than simply expanding syndicate size.

A causal interpretation of these results requires that, absent XBRL adoption, treated and control borrowers would have followed parallel trends in nonbank participation. To assess this assumption, we estimate an event-study specification that traces dynamic treatment effects relative to the year immediately preceding adoption.

Table 4 reports the event-study estimates. The coefficients on the pre-adoption indicators (i.e., $XBRL^{t\leq -3}$ and $XBRL^{t=-2}$) are small and statistically indistinguishable from zero, indicating no differential pre-trends between treated and control borrowers. In contrast, the post-adoption coefficients turn positive beginning in the adoption year and persist at longer

[4] A coefficient of 0.105 in a *Log(1+NumNonbanks)* specification implies an approximate 11.1% increase in *(1+NumNonbanks)*: $\exp(0.105) - 1 = 11.1\%$. Because the sample mean of *NumNonbanks* is 0.925, the implied mean of *(1+NumNonbanks)* is 1.925, and the corresponding increase is $1.925 \times 11.1\% = 0.21$. For *NumNonbanks*, the estimated effect remains positive and statistically significant using a Poisson specification.

horizons. This pattern indicates that the effect of XBRL adoption emerges at implementation and persists over time, consistent with a causal interpretation of the difference-in-differences estimates. Figures 2–4 illustrate the absence of differential pre-trends and the persistence of the treatment effects following XBRL adoption.

## 5.2 Entry by New Participant Lenders

Hypothesis 2 examines whether lower processing costs facilitate the formation of new lending relationships, where informational frictions are greater because lenders have no prior lending relationship with the borrower.

Table 5 reports the results. Consistent with Hypothesis 2, XBRL adoption facilitates entry by new nonbank participants but not by new bank participants. Columns (1) and (2) show no statistically significant change in the likelihood of attracting new lenders overall or new bank lenders in particular following XBRL adoption, whereas column (3) shows a significant increase in the probability that a new nonbank participant enters the syndicate. These findings indicate that lower processing costs facilitate entry by nonbank lenders when informational frictions are greater.

Column (4) shows a strong effect among nonbanks that have never served as a syndicated loan lead arranger during the preceding three years—that is, participants with fewer opportunities to produce borrower-specific private information through lead-arranger activities. This result further supports the information-processing mechanism by showing that lower processing costs facilitate new nonbank entry even among lenders with limited prior experience producing borrower-specific private information.

## 5.3 Nonbank Industry Expertise

Hypothesis 3 provides a within-nonbank test of whether lower processing costs are particularly valuable to lenders with weaker preexisting informational advantages. We focus on industry-specific expertise, which provides lenders with an informational advantage when

evaluating borrowers in familiar industries.

Following Blickle et al. (2026), we classify nonbanks using two complementary measures of industry specialization constructed from their historical lending portfolios. Using lending activity during the three years preceding each loan, we identify whether participating nonbanks possess industry-specific expertise in the borrower's industry.

Table 6 reports the regression results. Across both measures of industry specialization, the coefficients on *XBRL* are positive and statistically significant for *Nonspecialized Nonbank*, but close to zero and statistically insignificant for *Specialized Nonbank*. Together, these findings show that the increase in nonbank participation is concentrated among nonbanks with weaker preexisting informational advantages.

## 5.4 How Do Lower Processing Costs Change the Informational Basis of Nonbank Participation?

Hypothesis 4 provides the central test of the proposed mechanism. If lower processing costs increase participant lenders' reliance on public relative to private information, they should not only change who participates in syndicated lending but also change the informational basis of nonbank lenders' participation decisions. We examine this prediction in two complementary ways: first, by testing whether the importance of prior borrower–lead arranger relationships for nonbank participation declines following XBRL adoption; and second, by testing whether nonbank participation becomes more strongly associated with public financial information.

Table 7 reports the results. Panel A examines whether the importance of prior borrower–lead arranger relationships for nonbank participation declines following XBRL adoption. Prior relationships allow lead arrangers to acquire and produce borrower-specific private information and can also strengthen their certification role. In columns (1) to (4), the coefficients on *Dummy: Lead Prior* and *Lead Prior Loans* are positive and significant in three of the four specifications, consistent with the information and certification benefits provided

by lead arrangers with prior borrower relationships. More importantly, the coefficients on *XBRL* × *Dummy: Lead Prior* and *XBRL* × *Lead Prior Loans* are negative and significant, indicating that the positive association between prior borrower–lead arranger relationships and nonbank participation weakens following XBRL adoption. This pattern is consistent with nonbank participants relying less on borrower-specific private information conveyed through lead arrangers when making participation decisions. In columns (5) and (6), where the dependent variable is the fraction of syndicate lenders that are nonbanks, the coefficients on the two measures of prior borrower–lead arranger relationships are positive but insignificant. The interaction coefficients are negative for both measures and statistically significant for *Lead Prior Loans* in column (6), providing weaker but directionally consistent evidence that the association between prior borrower–lead arranger relationships and the nonbank share declines following XBRL adoption.

Panel B examines whether nonbank participation becomes more strongly associated with two widely used public financial credit metrics—Debt-to-EBITDA and the Interest Coverage Ratio (ICR)—following XBRL adoption. The coefficients on *XBRL* × *Low Debt-to-EBITDA* are positive and significant for two of the three participation measures, and those on *XBRL* × *High ICR* are positive and significant across all three, indicating that, following XBRL adoption, nonbank participation becomes more strongly associated with lower Debt-to-EBITDA ratios and higher interest coverage ratios. This pattern is consistent with nonbank participants placing greater reliance on public financial information in making participation decisions.

Taken together, these findings provide the strongest evidence for the proposed mechanism. Following XBRL adoption, nonbank participation becomes less associated with prior borrower–lead arranger relationships and more strongly associated with credit metrics based on public financial information. This joint pattern is consistent with lower processing costs shifting the informational basis of nonbank lenders' participation decisions toward public financial information and away from relationship-based inputs. Because the evidence extends

beyond changes in participation to changes in the factors associated with nonbank participation, it is difficult to reconcile with alternative explanations that predict greater nonbank participation without a corresponding change in its informational basis.

## 5.5 Evidence on the Processing-Cost Channel

The preceding evidence shows that XBRL changes the informational basis of nonbank lenders' participation decisions. We next provide more direct evidence linking this change to machine-based processing of public financial information. We first examine whether XBRL increases machine-based processing of public financial information using SEC EDGAR download logs. We then test whether borrowers receiving greater machine-based processing immediately before loan origination attract greater nonbank participation.

Importantly, machine downloads are informative because they capture large-scale, machine-based processing of public financial information rather than borrower attention alone. Accordingly, if XBRL operates through lower processing costs rather than greater borrower attention, machine-download activity should be more strongly associated with subsequent nonbank participation than non-machine download activity.

### 5.5.1 Machine-Based Processing of Public Financial Information

We first examine whether XBRL adoption increases machine-based processing of public financial disclosures. Using SEC EDGAR log files, we measure machine downloads of SEC filings as observable evidence of machine-based processing of public financial information. Because EDGAR logs exclude downloads through the FTP site and requests served from Internet Service Provider caches, our measures should be interpreted as a lower bound on total filing access (Iliev et al., 2021; Bauguess et al., 2025).

For each borrower, we retrieve EDGAR log files for the week following its first XBRL-tagged Form 8-K, 10-Q, or 10-K filing and construct a comparable one-week pre-adoption window approximately one year earlier. Following Lee et al. (2015) and Cao et al. (2023),

we classify an IP address as engaging in machine downloads if it accesses filings of more than 50 unique firms in a single day. We then construct two measures: *Machine*, the average daily number of machine downloads, and *Non-machine*, the corresponding measure for all remaining downloads. In this setting, *XBRL* equals one for post-adoption observations and zero otherwise.

Panel A of Table 8 shows that machine downloads increase sharply following XBRL adoption, whereas non-machine downloads increase much less. Figure 5 illustrates this difference graphically. Panel B confirms this finding in multivariate regressions, providing direct evidence that XBRL increases machine-based processing of public financial information.

### 5.5.2 Pre-Loan Machine-Download Activity and Nonbank Participation

If lower processing costs increase nonbank participation by facilitating machine-based processing of public financial information, borrowers receiving greater machine-based processing prior to loan origination should attract greater nonbank participation. We test this prediction using pre-loan EDGAR download activity. For each firm issuing a loan after adopting XBRL, we compute the average daily number of machine and non-machine downloads during the 10 days preceding loan origination (days $[-10,-1]$), a period immediately preceding loan origination during which participant lenders finalize syndicate participation decisions (Bruche et al., 2020; Bruche et al., 2023). We construct two indicators: *High Machine*, equal to one if machine-download activity exceeds the annual cross-sectional median, and *High Non-machine*, defined analogously using non-machine downloads.

Panel A of Table 9 shows that higher machine-download activity during the 10-day window predicts significantly greater nonbank participation, whereas *High Non-machine* is unrelated to nonbank participation in the corresponding specifications. Because both measures reflect attention to borrower filings but only machine downloads capture machine-based processing, this contrast supports the processing-cost mechanism rather than a general attention explanation. These results are robust to nearby windows (8-day and 12-day periods;

Appendix Table A.1).

To examine whether this relation is specific to nonbank participants, Panel B repeats the analysis using bank participation as the dependent variable. In contrast to the nonbank results, neither *High Machine* nor *High Non-machine* predicts bank participation.

Panel C shows that this association weakens when the measurement window is extended to 20 days before loan origination, suggesting that machine-based processing immediately before loan origination is more closely related to nonbank participation decisions.

Taken together, these findings provide direct evidence for the processing-cost channel. XBRL increases machine-based processing of public financial information, and greater machine-download activity immediately before loan origination is associated with higher nonbank participation.

Appendix A.3 presents an illustrative case study based on SEC EDGAR log files. We identify a nonbank participant whose masked IP address can be linked to machine downloads of borrower filings within ten days of loan origination. Although illustrative, this evidence is consistent with the identified nonbank participant using machine-readable disclosures when making its participation decisions.

## 5.6 Lead Arrangers and Delegated Monitoring

Finally, we examine whether lower processing costs affect the private-information-intensive functions performed by lead arrangers. This test establishes the boundary condition of the proposed mechanism. Lead arrangers acquire and produce borrower-specific private information through due diligence, delegated monitoring, and ongoing lending relationships (Sufi, 2007; Ivashina, 2009). If lower processing costs primarily affect the information participant lenders use in participation decisions, they should increase nonbank participation without affecting whether nonbanks assume lead arranger responsibilities.

Table 10 reports estimates using an indicator equal to one if the lead arranger is a nonbank. Because the main analyses exclude facilities led by nonbanks, this test restores those

facilities to examine whether XBRL adoption affects the likelihood that a nonbank serves as lead arranger, resulting in a larger estimation sample. Across both specifications, the coefficient on *XBRL* is small, negative, and statistically insignificant, indicating no evidence that XBRL adoption increases the likelihood that nonbanks serve as lead arrangers.

These results support Hypothesis 5 and establish the boundary condition of our framework. In contrast to the documented changes in participant composition and the informational basis of nonbank lenders' participation decisions, XBRL adoption does not affect nonbanks' likelihood of serving as lead arrangers. This contrast indicates that lower processing costs reshape participant lenders' use of information without altering the acquisition and production of borrower-specific private information through delegated monitoring.

Taken together, the results impose a series of increasingly restrictive predictions of the processing-cost mechanism. XBRL adoption increases nonbank but not bank participation; facilitates new nonbank entry when informational frictions are greater; within nonbanks, the increase is concentrated among lenders with weaker preexisting informational advantages; nonbank participation shifts away from relationship-based inputs and toward public financial information; machine-based processing of borrower disclosures is associated specifically with nonbank participation; and the effects do not extend to delegated monitoring. The consistency of these findings across lender composition, lender heterogeneity, information underlying participation decisions, processing activity, and lending roles is difficult to explain through a general increase in nonbank lending alone.

# 6 Robustness and Alternative Explanations

This section examines whether the documented findings can be explained by mechanisms other than lower public-information processing costs. A compelling alternative explanation must account not only for the increase in nonbank participation following XBRL adoption, but also for the facilitation of new nonbank entry when informational frictions are

greater, the concentration of the participation response among nonbanks with weaker pre-existing informational advantages, the changing associations between nonbank participation and relationship-based versus public financial inputs, the link between machine-based processing and nonbank participation, and the absence of a corresponding increase in nonbank lead arrangers. We address, in turn, identification concerns from non-random treatment assignment, staggered adoption timing, and contemporaneous shocks; borrower- and lender-side alternative explanations; sensitivity to omitted-variable bias; and whether effects vary with the scale and technical quality of machine-readable disclosures.

## 6.1 Non-Random Adoption, Treatment Timing, and Confounding Shocks

A key identification concern is that XBRL adoption is not randomly assigned, since the phase-in schedule is tied to filer status and public float thresholds: if these characteristics are associated with differential trends in nonbank participation, our baseline estimates could reflect firm-specific dynamics rather than reductions in processing costs. A further concern is that XBRL's rollout coincides with the aftermath of the 2008 financial crisis and subsequent bank capital tightening, so our estimates could instead capture contemporaneous macroeconomic or regulatory shocks affecting participant composition (Irani et al., 2021).

To address this concern, we conduct three complementary robustness tests. First, we include size-group $\times$ year fixed effects to allow fully flexible size-specific time trends, absorbing shocks common to similarly sized firms in a given year, including differential exposure to post-crisis credit conditions or regulatory pressures correlated with filer status. Second, we implement a propensity score matching (PSM) design pairing treated and control firms comparable in borrower characteristics within the same industry, combined with a hand-constructed clean 2$\times$2 DiD sample so that treated firms are compared only with not-yet-treated or never-treated firms in the same calendar period. This design mitigates concerns about selection on observed firm characteristics, staggered-DiD contamination (Goodman-

Bacon, 2021; Sun and Abraham, 2021), and coincident macroeconomic shocks. Third, we conduct a pseudo-event analysis with randomly assigned adoption years to test whether our results reflect generic calendar-time effects or broader post-crisis trends unrelated to XBRL adoption. The results, reported in Appendix A.4.1–A.4.3, consistently confirm our main findings.

## 6.2 Alternative Borrower Information Environment Channels

An alternative interpretation is that XBRL increases nonbank participation by improving borrowers' overall information environment rather than by reducing lenders' public-information processing costs. We consider two related explanations: (i) XBRL stimulates secondary information production by analysts, investors, or other market participants, and (ii) XBRL increases borrower visibility and attracts greater lender attention.

One alternative is that XBRL improves the broader information environment by stimulating analyst coverage, investor monitoring, or other forms of secondary information production. Such improvements could facilitate nonbank participation, but they do not readily explain the broader pattern of results. In particular, this explanation does not directly predict why XBRL adoption facilitates entry by new nonbank participants but not new bank participants, why the increase in participation is concentrated among nonbanks with weaker preexisting informational advantages, why nonbank participation becomes less associated with prior borrower–lead arranger relationships and more strongly associated with credit metrics based on public financial information, or why delegated monitoring remains unchanged.

A related explanation is that XBRL increases borrower visibility and attracts greater attention from nonbank lenders. However, this interpretation is difficult to reconcile with the EDGAR evidence. Machine-download activity immediately before loan origination predicts greater nonbank participation, whereas non-machine download activity does not. Because both measures capture attention to borrower filings but machine downloads more directly

capture machine-based processing, this contrast is more consistent with lower processing costs than with greater borrower attention alone. Moreover, an attention explanation does not naturally predict the joint pattern of weaker associations with prior borrower–lead arranger relationships and stronger associations with credit metrics based on public financial information following XBRL adoption.

Overall, broader information-environment and attention-based explanations may account for greater nonbank participation in isolation, but they do not readily account for the joint pattern across lender heterogeneity, the information underlying participation decisions, machine-based processing, and delegated monitoring. The combined evidence is more consistent with lower processing costs changing the informational basis of nonbank lenders' participation decisions and thereby reshaping lender participation.

## 6.3 Lender-Side Alternative Explanations

We next consider whether the documented patterns reflect lender-side mechanisms rather than borrower-level reductions in public-information processing costs. Specifically, we examine four alternatives: banks' regulatory or balance-sheet constraints, changes in lenders' own disclosure processing costs, lender technology upgrades, and nonbanks' incentives to acquire borrower-specific private information.

First, the increase in nonbank participation could reflect post-crisis regulatory or balance-sheet pressures that reduced banks' willingness to lend. These pressures are aggregate in nature and therefore should affect borrowers broadly, rather than generate changes in lender composition around individual borrowers' XBRL adoption. Moreover, bank participation does not decline following XBRL adoption; instead, the increase in syndicate size is driven by additional nonbank participation. Bank constraints therefore have difficulty explaining both the borrower-specific timing of the effect and the absence of a corresponding contraction in bank participation.

Second, XBRL could improve funding conditions for publicly listed lenders by reducing

the cost of processing lenders' own disclosures. This channel operates at the lender level, whereas our treatment varies with borrowers' XBRL adoption. It therefore cannot readily account for the borrower-level timing of the documented effects.

Third, nonbanks may have upgraded their own information-processing technologies during our sample period. Such upgrades could increase nonbank participation generally, but they should affect participation decisions across many borrowers simultaneously. By contrast, the documented effects emerge around individual borrowers' XBRL adoption, making a common lender-side technology shock an unlikely explanation. Such a common technology shock also does not naturally explain why the increase is concentrated among nonspecialized nonbanks or why machine-based processing of individual borrowers immediately before loan origination predicts their subsequent nonbank participation.

Finally, nonbanks may participate in syndicated loans to acquire borrower-specific private information for purposes beyond lending (e.g., Bushman et al., 2010; Ivashina and Sun, 2011). This explanation may predict greater nonbank participation, but it does not predict the documented change in the informational basis of nonbank participation following XBRL adoption. Specifically, nonbank participation becomes less associated with prior borrower–lead arranger relationships and more associated with public financial information, a pattern more consistent with reduced reliance on borrower-specific private information than with participation motivated by its acquisition.

Overall, lender-side explanations may account for a general increase in nonbank participation, but they do not readily explain why the effects emerge around individual borrowers' XBRL adoption, facilitate new nonbank entry but not new bank entry, are concentrated among nonbanks with weaker preexisting informational advantages, coincide with changes in the factors associated with nonbank participation, and are linked specifically to machine-based processing of borrower disclosures. The joint evidence therefore points to borrower-level reductions in public-information processing costs rather than lender-side changes in regulation, funding conditions, technology, or incentives for nonbanks to acquire borrower-

specific private information.

## 6.4 Bounding Omitted-Variable Bias

To assess how sensitive our baseline estimates are to omitted confounders, Appendix A.4.4 conducts a formal benchmarking analysis following Cinelli and Hazlett (2020), using *Size* and *Loan Size*—the strongest observed controls—as benchmark covariates. The results indicate that the estimated effect of XBRL remains positive and statistically significant under omitted confounding substantially stronger than these observed benchmarks, suggesting that our findings are unlikely to be driven by omitted-variable bias.

## 6.5 Scale and Quality of Machine Readability

We also examine whether the effects we document vary with the usability of machine-readable disclosures, reflecting both the scale of XBRL adoption and the technical reliability of the tagged data. We separate these dimensions in two complementary analyses, reported in Appendix A.5.

First, because voluntary adoption was sparse, machine-readable disclosures were available at limited scale, reducing incentives for lenders and data intermediaries to invest in automated processing. Consistent with this, we find no effect of voluntary adoption on nonbank participation, with the effect emerging primarily during the mandatory adoption phase. Second, Inline XBRL (iXBRL), which improves the technical quality and consistency of tagged disclosures by embedding them in human-readable filings, is followed by a significant increase in nonbank participation. Together, these results provide an additional restriction consistent with the processing-cost mechanism: the effects emerge when machine-readable disclosures become available at scale and strengthen as their technical quality improves.

# 7 Conclusion

This paper shows that reductions in the cost of processing public financial information reshape financial intermediation by changing lenders' reliance on public relative to private information. Using the SEC's staggered introduction of eXtensible Business Reporting Language (XBRL) as a clean identification setting, we show that lower costs of processing public financial information shift lender participation toward nonbanks. These lower processing costs also shift nonbank participants' reliance toward scalable public information when making participation decisions, while leaving the private-information-intensive functions of delegated monitoring unchanged.

Although we study XBRL, the underlying mechanism extends well beyond structured financial reporting. Similar patterns following the subsequent introduction of Inline XBRL suggest that the documented effects are not unique to the initial rollout of machine-readable reporting. XBRL provides a uniquely clean setting for identifying how lower processing costs affect lenders' reliance on public relative to private information, but similar reductions in processing costs are increasingly generated by advances in artificial intelligence and other information-processing technologies. Unlike XBRL, these technologies reduce the cost of processing a much broader range of public information, suggesting that future technological advances may further shift comparative advantage toward lenders that rely more heavily on scalable analysis of public information. Our findings therefore identify a mechanism that is likely to become increasingly important as these technologies continue to evolve.

Our findings highlight a broader implication for theories of financial intermediation. Technological change can transform lending not only by creating new information, but also by changing the economic value of existing information. Understanding how technology alters the value of information, even when the underlying information itself remains unchanged, is therefore important for understanding the organization of lending markets.

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**Figure 1**

Conceptual Framework and Testable Predictions

This figure illustrates the conceptual framework and hypothesis development. It distinguishes between public and private information, shows how lead arrangers and participant lenders rely on these information sources in syndicated lending, and summarizes the predictions for Hypotheses 1–5.

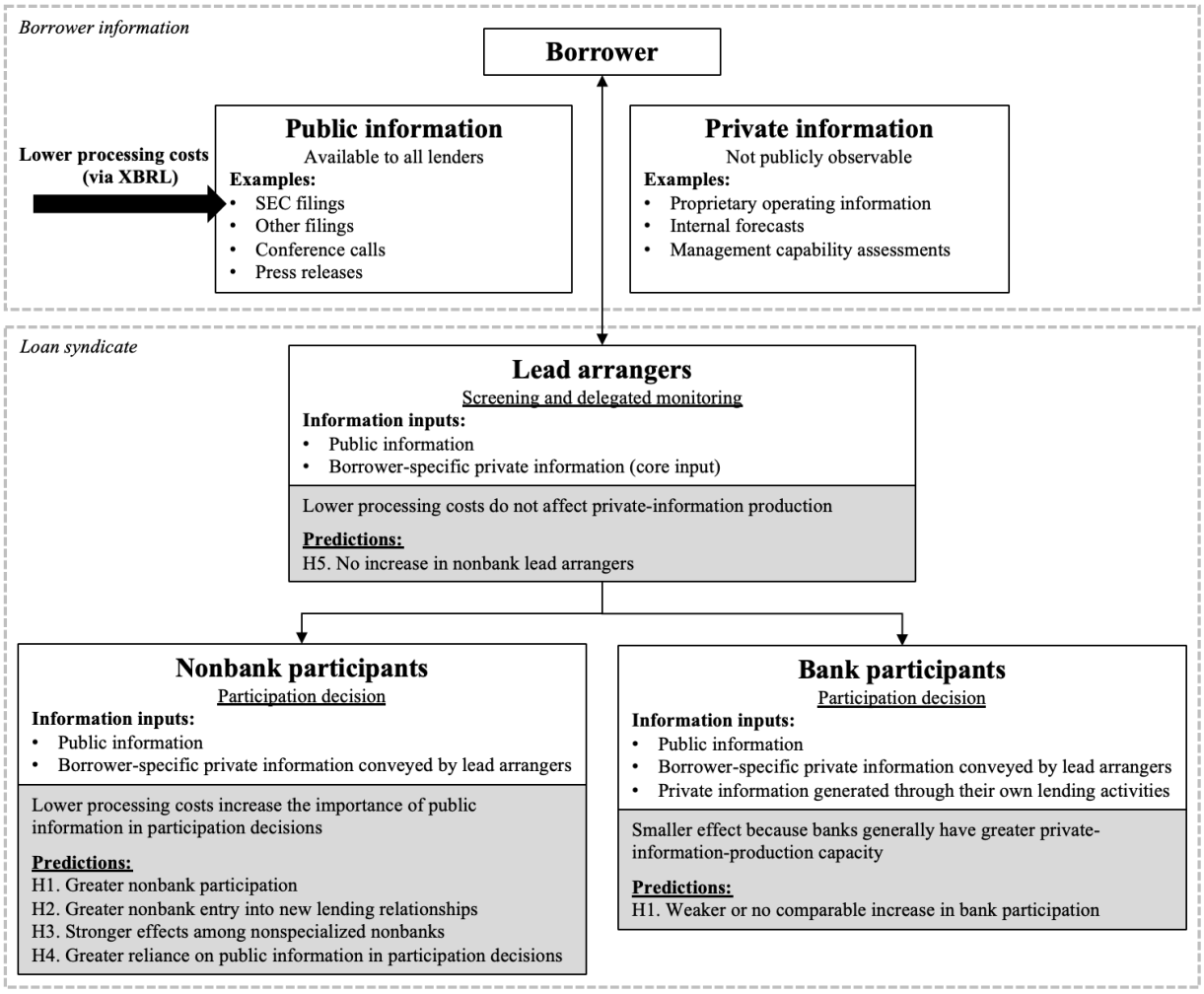


**Figure 2**

Parallel Trends Test: Nonbank Participation Around XBRL Adoption (*Nonbank*)

This figure plots event-time coefficients from a difference-in-differences specification estimating the effect of XBRL adoption on *Nonbank*. *Nonbank* is an indicator equal to one if the loan facility includes at least one nonbank participant, and zero otherwise. The sample consists of facility-level observations for U.S. syndicated loans from 2005 to 2012. The regression specification corresponds to column (1) of Table 4. Event time $t = -1$ is the omitted reference period. Vertical bars denote 90% confidence intervals.

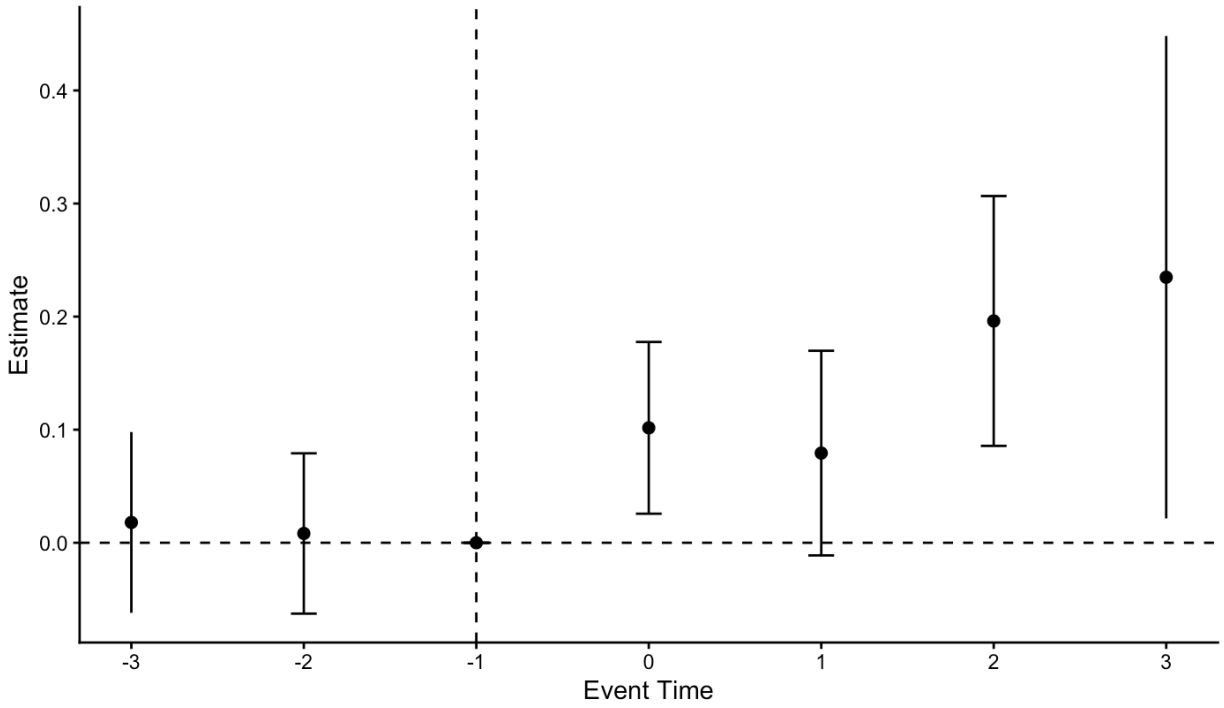


**Figure 3**

Parallel Trends Test: Nonbank Participation Around XBRL Adoption (*Log(1+NumNonbanks)*)

This figure plots event-time coefficients from a difference-in-differences specification estimating the effect of XBRL adoption on *Log(1+NumNonbanks)*. *NumNonbanks* is the number of nonbank participants in the loan facility. The sample consists of facility-level observations for U.S. syndicated loans from 2005 to 2012. The regression specification corresponds to column (2) of Table 4. Event-time $t = -1$ is the omitted reference period. Vertical bars denote 90% confidence intervals.

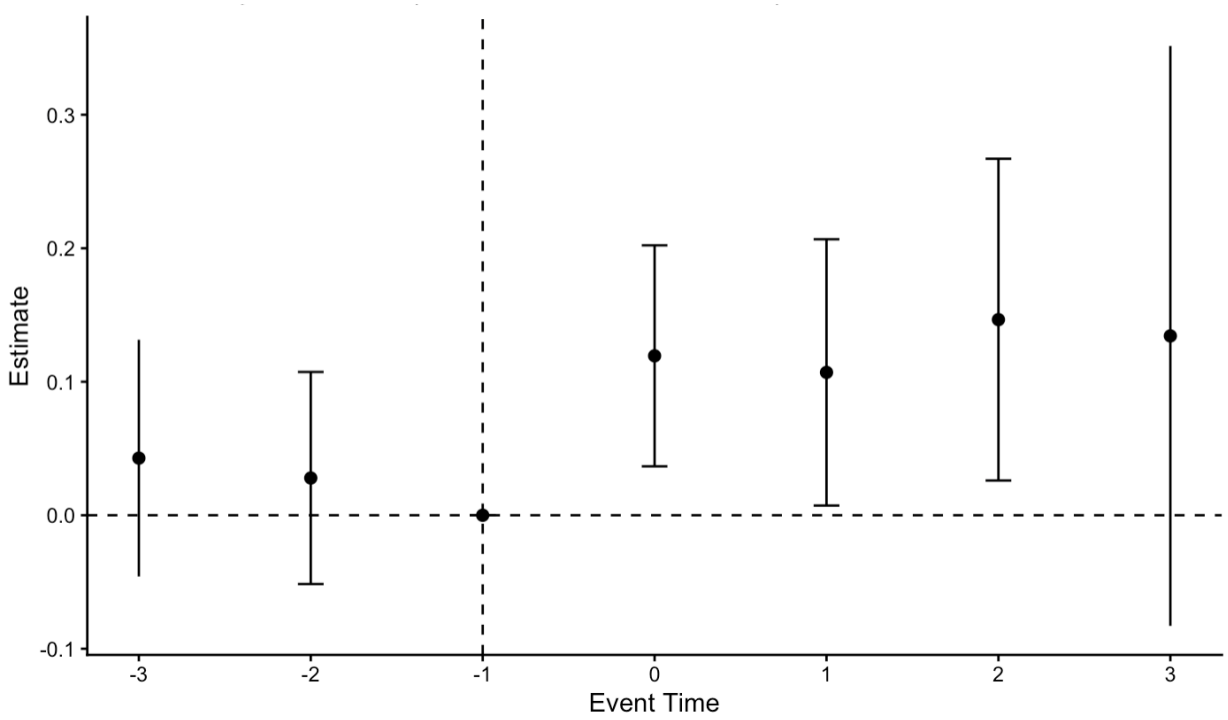


**Figure 4**

Parallel Trends Test: Nonbank Participation Around XBRL Adoption (*Nonbank%*)

This figure plots event-time coefficients from a difference-in-differences specification estimating the effect of XBRL adoption on *Nonbank%*. *Nonbank%* is the fraction of syndicate lenders that are nonbanks. The sample consists of facility-level observations for U.S. syndicated loans from 2005 to 2012. The regression specification corresponds to column (3) of Table 4. Event-time $t = -1$ is the omitted reference period. Vertical bars denote 90% confidence intervals.

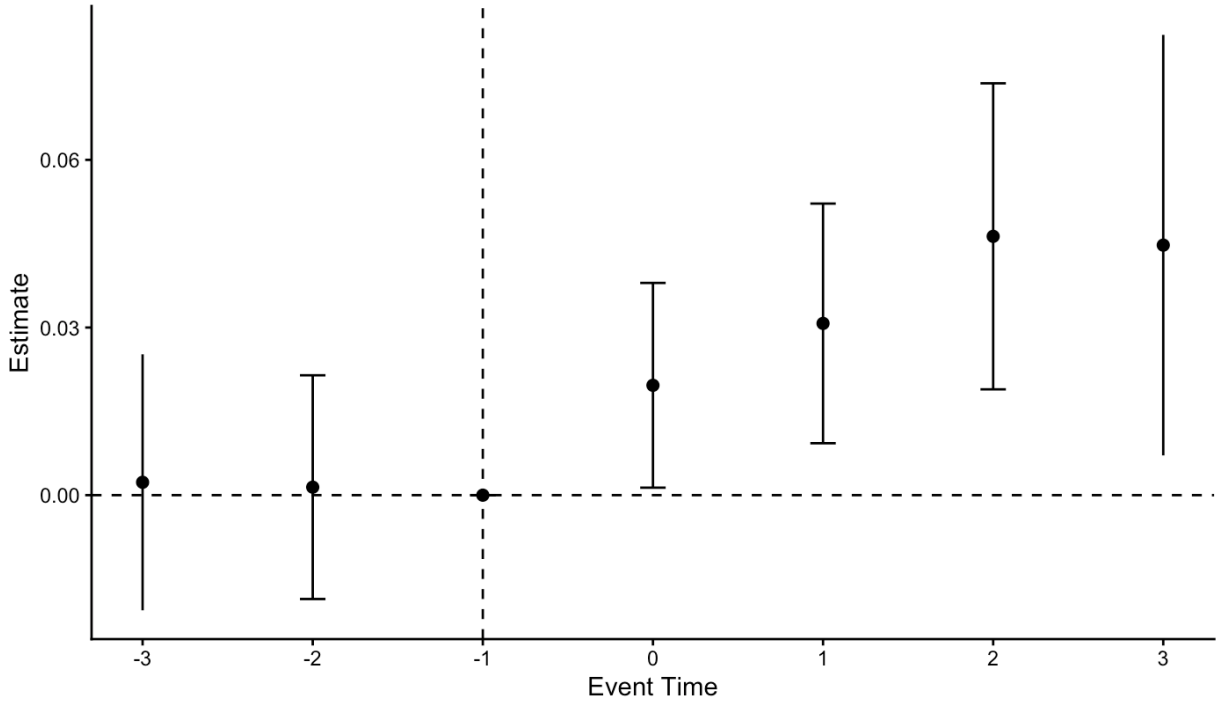


**Figure 5**

Comparison of SEC Filing Downloads Before and After XBRL Adoption

This figure compares the average daily number of SEC filing downloads before and after XBRL adoption. *Machine* is the average number of machine downloads of SEC filings for the week following the borrower's first XBRL-tagged filing of Form 8-K, 10-Q, or 10-K, while *Non-machine* is the average daily number of non-machine (i.e., human-driven) downloads over the same period. The comparison corresponds to Panel A of Table 8.

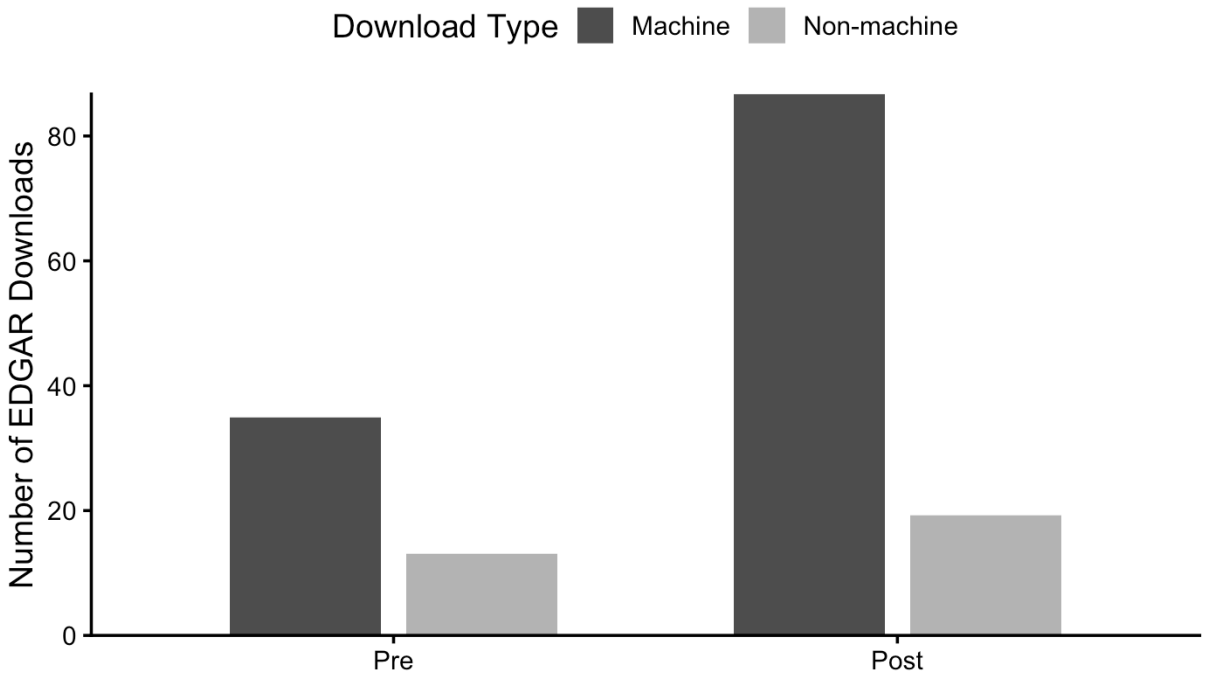


**Table 1**

Summary Statistics

This table reports summary statistics for the final sample. Panel A reports the distribution of borrowers and loan facilities by treatment status, classifying borrowers into treatment switcher and non-switcher groups. *Switchers* are firms whose XBRL treatment status changes from 0 to 1 during the sample period and that issue at least one syndicated loan facility both before and after XBRL adoption. *Non-switchers* are firms that remain untreated throughout the sample period, as well as firms that adopt XBRL but do not issue any loan facilities after adoption and therefore do not contribute post-treatment observations. The table also reports the mean and median number of loan facilities per borrower within each group. Panel B presents the annual distribution of loan facilities and borrower firms, and Panel C reports descriptive statistics for the main variables used in the empirical analysis. The sample consists of facility-level observations for U.S. syndicated loans from 2005 to 2012. *Nonbank* is an indicator equal to one if the loan facility includes at least one nonbank participant, and zero otherwise. *NumNonbanks* is the number of nonbank participants in the loan facility. *Nonbank%* is the fraction of syndicate lenders that are nonbanks. *New Lender* equals one if the facility includes at least one lender that has not previously extended credit to the borrower. *New Bank* (*New Nonbank*) equals one if the facility includes at least one new bank (nonbank) participant. *New Non-Lead Nonbank* equals one if the new nonbank participant has not served as a syndicated loan lead arranger in the three years preceding the facility's origination date. *XBRL* equals one if the loan facility is originated during or after the borrower's first XBRL filing year, and zero otherwise. *Size* is the natural logarithm of total assets. *ROA* is income before extraordinary items divided by total assets. *Leverage* is total debt divided by total assets. *Market-to-Book* is the ratio of the market value of equity to its book value. *Cash* is cash holdings divided by total assets. *Tangibility* is net property, plant, and equipment divided by total assets. *Credit Rating* is the S&P long-term issuer credit rating, rescaled to lie in the interval [0,1]. *Loan Size* is the natural logarithm of the facility amount, and *Maturity* is the facility's maturity in years.

**Panel A: Distribution of Borrowers and Facilities by Treatment Group**

| Group | All | | | | $XBRL = 0$ | | | $XBRL = 1$ | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Borrowers | % | Facilities | % | Facilities | Mean | Median | Facilities | Mean | Median |
| *Switchers* | 613 | 32 | 2,965 | 47 | 1,767 | 2.88 | 2 | 1,198 | 1.95 | 2 |
| *Non-switchers* | 1,311 | 68 | 3,322 | 53 | 3,322 | 2.53 | 2 | 0 | 0 | 0 |
| **Total** | 1,924 | 100 | 6,287 | 100 | 5,089 | 2.65 | 2 | 1,198 | 1.95 | 2 |

**Panel B: Distribution of Facilities and Borrowers by Year and XBRL Treatment**

| Year | All | | $XBRL = 0$ | | $XBRL = 1$ | |
|---|---|---|---|---|---|---|
| | Facilities | Borrowers | Facilities | Borrowers | Facilities | Borrowers |
| 2005 | 1,266 | 816 | 1,266 | 816 | 0 | 0 |
| 2006 | 1,081 | 702 | 1,081 | 702 | 0 | 0 |
| 2007 | 1,142 | 693 | 1,142 | 693 | 0 | 0 |
| 2008 | 691 | 468 | 690 | 467 | 1 | 1 |
| 2009 | 451 | 328 | 405 | 296 | 46 | 32 |
| 2010 | 701 | 436 | 404 | 261 | 297 | 175 |
| 2011 | 532 | 336 | 69 | 40 | 463 | 296 |
| 2012 | 423 | 244 | 32 | 19 | 391 | 225 |
| **Total** | 6,287 | – | 5,089 | – | 1,198 | – |

**Table 1 (continued)**

**Panel C: Main Variables**

| Variable | N | Mean | SD | P5 | Q1 | Median | Q3 | P95 |
|---|---|---|---|---|---|---|---|---|
| *Nonbank* | 6,287 | 0.435 | 0.496 | 0 | 0 | 0 | 1 | 1 |
| *NumNonbanks* | 6,287 | 0.925 | 2.226 | 0 | 0 | 0 | 1 | 4 |
| *Nonbank%* | 6,287 | 0.091 | 0.145 | 0.000 | 0.000 | 0.000 | 0.143 | 0.400 |
| *New Lender* | 6,287 | 0.700 | 0.458 | 0 | 0 | 1 | 1 | 1 |
| *New Bank* | 6,287 | 0.680 | 0.467 | 0 | 0 | 1 | 1 | 1 |
| *New Nonbank* | 6,287 | 0.242 | 0.428 | 0 | 0 | 0 | 0 | 1 |
| *New Non-Lead Nonbank* | 6,287 | 0.235 | 0.424 | 0 | 0 | 0 | 0 | 1 |
| *XBRL* | 6,287 | 0.191 | 0.393 | 0 | 0 | 0 | 0 | 1 |
| *Size* | 6,287 | 7.213 | 1.687 | 4.490 | 6.079 | 7.141 | 8.272 | 10.229 |
| *ROA* | 6,287 | 0.035 | 0.097 | -0.138 | 0.013 | 0.047 | 0.082 | 0.149 |
| *Leverage* | 6,287 | 0.279 | 0.214 | 0.000 | 0.127 | 0.248 | 0.388 | 0.662 |
| *Market-to-Book* | 6,287 | 2.689 | 3.384 | -0.006 | 1.334 | 2.087 | 3.375 | 7.512 |
| *Cash* | 6,287 | 0.101 | 0.116 | 0.003 | 0.021 | 0.059 | 0.138 | 0.337 |
| *Tangibility* | 6,287 | 0.298 | 0.243 | 0.027 | 0.107 | 0.220 | 0.441 | 0.828 |
| *Credit Rating* | 6,287 | 0.259 | 0.271 | 0.000 | 0.000 | 0.227 | 0.545 | 0.682 |
| *Loan Size* | 6,287 | 5.068 | 1.467 | 2.303 | 4.131 | 5.193 | 6.109 | 7.313 |
| *Maturity* | 6,287 | 4.415 | 1.843 | 0.997 | 3.003 | 5.003 | 5.005 | 7.005 |

**Table 2**

The Effect of XBRL Adoption on Nonbank Participation

This table reports estimates of the effect of XBRL adoption on nonbank participation in the syndicated loan market. The sample consists of facility-level observations for U.S. syndicated loans from 2005 to 2012. All variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

| | *Nonbank* | | *Log(1+NumNonbanks)* | | *Nonbank%* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *XBRL* | 0.086* | 0.089** | 0.107** | 0.105** | 0.021** | 0.023** |
| | (0.044) | (0.043) | (0.048) | (0.046) | (0.010) | (0.010) |
| *Size* | | 0.066** | | 0.121*** | | 0.022** |
| | | (0.031) | | (0.039) | | (0.009) |
| *ROA* | | 0.080 | | 0.029 | | -0.003 |
| | | (0.133) | | (0.145) | | (0.049) |
| *Leverage* | | -0.015 | | -0.076 | | 0.030 |
| | | (0.097) | | (0.121) | | (0.030) |
| *Market-to-Book* | | -0.004 | | -0.006 | | -0.0003 |
| | | (0.004) | | (0.004) | | (0.001) |
| *Cash* | | -0.240 | | -0.129 | | -0.009 |
| | | (0.146) | | (0.157) | | (0.040) |
| *Tangibility* | | -0.003 | | 0.208 | | 0.049 |
| | | (0.197) | | (0.243) | | (0.058) |
| *Credit Rating* | | 0.033 | | -0.043 | | 0.016 |
| | | (0.078) | | (0.087) | | (0.025) |
| *Loan Size* | | 0.051*** | | 0.063*** | | 0.003 |
| | | (0.008) | | (0.009) | | (0.002) |
| *Maturity* | | 0.013** | | 0.011* | | 0.0004 |
| | | (0.005) | | (0.006) | | (0.001) |
| Borrower FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,287 | 6,287 | 6,287 | 6,287 | 6,287 | 6,287 |
| Adjusted $R^2$ | 0.376 | 0.391 | 0.398 | 0.415 | 0.454 | 0.457 |

**Table 3**

The Effect of XBRL Adoption on Syndicate Size and Bank Participation

This table reports estimates of the effect of XBRL adoption on the total number of lenders and the number of bank participants in the syndicated loan market. The sample consists of facility-level observations for U.S. syndicated loans from 2005 to 2012. *Log(Total Lenders)* is the natural logarithm of the total number of lenders in a loan syndicate. *Log(1+NumBanks)* is the natural logarithm of one plus the number of bank participants in the syndicate. All other variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

| | *Log(Total Lenders)* | | *Log(1+NumBanks)* | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| *XBRL* | 0.150** | 0.136** | 0.114 | 0.099 |
| | (0.071) | (0.060) | (0.077) | (0.070) |
| *Size* | | 0.242*** | | 0.220*** |
| | | (0.049) | | (0.055) |
| *ROA* | | 0.328* | | 0.105 |
| | | (0.184) | | (0.216) |
| *Leverage* | | -0.228 | | -0.468*** |
| | | (0.146) | | (0.149) |
| *Market-to-Book* | | -0.009* | | -0.008 |
| | | (0.005) | | (0.005) |
| *Cash* | | -0.550** | | -0.673** |
| | | (0.223) | | (0.261) |
| *Tangibility* | | -0.130 | | -0.316 |
| | | (0.281) | | (0.329) |
| *Credit Rating* | | -0.243** | | -0.258* |
| | | (0.120) | | (0.139) |
| *Loan Size* | | 0.213*** | | 0.196*** |
| | | (0.015) | | (0.015) |
| *Maturity* | | 0.064*** | | 0.043*** |
| | | (0.009) | | (0.009) |
| Borrower FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes | Yes |
| Observations | 6,287 | 6,287 | 6,287 | 6,287 |
| Adjusted $R^2$ | 0.564 | 0.634 | 0.512 | 0.571 |

**Table 4**

Dynamic Effects of XBRL Adoption on Nonbank Participation

This table reports event-time estimates of the effect of XBRL adoption on nonbank participation in the syndicated loan market. The sample consists of facility-level observations for U.S. syndicated loans from 2005 to 2012. The regression specification follows the event-study difference-in-differences design described in Section 5.1. $XBRL^{t\leq -3}$ and $XBRL^{t=-2}$ are indicator variables equal to one if the loan is issued three or more years before, or two years before the borrower's XBRL adoption year, respectively, and zero otherwise. $XBRL^{t=0}$, $XBRL^{t=1}$, $XBRL^{t=2}$, and $XBRL^{t\geq 3}$ are indicator variables equal to one if the loan is issued in the adoption year or one, two, or three or more years after the borrower's XBRL adoption year, respectively, and zero otherwise. Event time $t = -1$ is the omitted reference period. All other variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

| | *Nonbank* | *Log(1+NumNonbanks)* | *Nonbank%* |
|---|---|---|---|
| | (1) | (2) | (3) |
| $XBRL^{t\leq -3}$ | 0.018 | 0.043 | 0.002 |
| | (0.049) | (0.054) | (0.014) |
| $XBRL^{t=-2}$ | 0.008 | 0.028 | 0.001 |
| | (0.043) | (0.048) | (0.012) |
| $XBRL^{t=0}$ | 0.102** | 0.119** | 0.020* |
| | (0.046) | (0.050) | (0.011) |
| $XBRL^{t=1}$ | 0.079 | 0.107* | 0.031** |
| | (0.055) | (0.061) | (0.013) |
| $XBRL^{t=2}$ | 0.196*** | 0.147** | 0.046*** |
| | (0.067) | (0.073) | (0.017) |
| $XBRL^{t\geq 3}$ | 0.235* | 0.134 | 0.045* |
| | (0.130) | (0.132) | (0.023) |
| Borrower Controls | Yes | Yes | Yes |
| Loan Controls | Yes | Yes | Yes |
| Borrower FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes |
| Observations | 6,287 | 6,287 | 6,287 |
| Adjusted $R^2$ | 0.392 | 0.415 | 0.457 |

**Table 5**

The Effect of XBRL Adoption on Entry by New Lenders

This table reports estimates of the effect of XBRL adoption on the entry of new lenders into syndicated loan facilities. The sample consists of facility-level observations for U.S. syndicated loans from 2005 to 2012. All variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

| | *New Lender* | *New Bank* | *New Nonbank* | *New Non-Lead Nonbank* |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| *XBRL* | 0.011 | 0.006 | 0.085*** | 0.079** |
| | (0.029) | (0.029) | (0.032) | (0.032) |
| *Size* | -0.018 | -0.010 | 0.021 | 0.021 |
| | (0.021) | (0.021) | (0.021) | (0.021) |
| *ROA* | -0.153 | -0.147 | 0.131 | 0.126 |
| | (0.098) | (0.100) | (0.100) | (0.100) |
| *Leverage* | -0.049 | -0.051 | 0.027 | 0.020 |
| | (0.077) | (0.077) | (0.069) | (0.069) |
| *Market-to-Book* | 0.006** | 0.008*** | -0.003 | -0.003 |
| | (0.002) | (0.003) | (0.003) | (0.003) |
| *Cash* | 0.132 | 0.196 | -0.192* | -0.204* |
| | (0.118) | (0.120) | (0.106) | (0.105) |
| *Tangibility* | -0.009 | 0.039 | -0.006 | 0.003 |
| | (0.128) | (0.129) | (0.133) | (0.134) |
| *Credit Rating* | -0.093 | -0.119** | -0.029 | -0.022 |
| | (0.059) | (0.060) | (0.054) | (0.054) |
| *Loan Size* | 0.054*** | 0.052*** | 0.040*** | 0.041*** |
| | (0.007) | (0.007) | (0.007) | (0.007) |
| *Maturity* | 0.012*** | 0.015*** | 0.010** | 0.011** |
| | (0.005) | (0.005) | (0.004) | (0.004) |
| Borrower FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes | Yes |
| Observations | 6,287 | 6,287 | 6,287 | 6,287 |
| Adjusted $R^2$ | 0.019 | 0.032 | 0.094 | 0.091 |

**Table 6**

The Effect of XBRL Adoption on Nonbank Participation: Heterogeneity by Lender Specialization
This table reports estimates of the effect of XBRL adoption on the participation of specialized and nonspecialized nonbank lenders in the syndicated loan market. The sample consists of facility-level observations for U.S. syndicated loans from 2005 to 2012. Lender specialization is defined using relative specialization and excess specialization, following Blickle et al. (2026). *Nonspecialized Nonbank* is an indicator equal to one if a loan facility includes at least one nonbank participant that is not specialized in the borrower's industry, and zero otherwise. *Specialized Nonbank* is an indicator equal to one if a loan facility includes at least one nonbank participant that is specialized in the borrower's industry, and zero otherwise. All other variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

| | Relative | | Excess | |
|---|---|---|---|---|
| | *Nonspecialized Nonbank* | *Specialized Nonbank* | *Nonspecialized Nonbank* | *Specialized Nonbank* |
| *XBRL* | 0.050** | -0.005 | 0.051** | -0.006 |
| | (0.025) | (0.015) | (0.025) | (0.015) |
| *Size* | 0.037* | 0.008 | 0.038** | 0.008 |
| | (0.019) | (0.012) | (0.019) | (0.012) |
| *ROA* | 0.020 | -0.024 | 0.023 | -0.026 |
| | (0.086) | (0.058) | (0.086) | (0.058) |
| *Leverage* | -0.101* | 0.039 | -0.097 | 0.035 |
| | (0.059) | (0.040) | (0.059) | (0.040) |
| *Market-to-Book* | -0.002 | -0.001 | -0.002 | -0.001 |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| *Cash* | -0.111 | 0.041 | -0.105 | 0.038 |
| | (0.083) | (0.063) | (0.083) | (0.063) |
| *Tangibility* | -0.086 | 0.106 | -0.082 | 0.103 |
| | (0.125) | (0.101) | (0.125) | (0.102) |
| *Credit Rating* | 0.095* | 0.058 | 0.096* | 0.061 |
| | (0.055) | (0.037) | (0.055) | (0.037) |
| *Loan Size* | 0.009*** | 0.005** | 0.009*** | 0.005*** |
| | (0.003) | (0.002) | (0.003) | (0.002) |
| *Maturity* | 0.004* | 0.0004 | 0.005** | -0.000 |
| | (0.002) | (0.002) | (0.002) | (0.002) |
| Borrower FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes | Yes |
| Observations | 6,287 | 6,287 | 6,287 | 6,287 |
| Adjusted $R^2$ | 0.516 | 0.366 | 0.521 | 0.370 |

**Table 7**

XBRL Adoption and Nonbank Participation: Heterogeneity by Borrower–Lead Arranger Relationships and Borrower Financial Characteristics

This table reports estimates of the effect of XBRL adoption on nonbank participation in syndicated loans, conditional on borrower–lead arranger relationships (Panel A) and standard financial ratios (Panel B). The sample consists of facility-level observations for U.S. syndicated loans from 2005 to 2012. *Dummy: Lead Prior* is an indicator equal to one if the lead arranger has extended credit to the same borrower within the three years preceding the facility's origination date, and zero otherwise. *Lead Prior Loans* is the number of facilities the lead arranger has extended to the same borrower within the three years preceding the facility's origination date. *Low Debt-to-EBITDA* is an indicator equal to one if the borrower's *Debt-to-EBITDA* ratio falls below the sample median within its one-digit SIC industry, and zero otherwise. Following Chernenko et al. (2022), we set *Debt-to-EBITDA* to zero when EBITDA is negative to avoid mechanically large and economically uninformative values. *High ICR* is an indicator equal to one if the borrower's interest coverage ratio (*ICR*) exceeds the sample median within its one-digit SIC industry, and zero otherwise. All other variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

**Panel A: Prior Borrower–Lead Arranger Relationships**

| | *Nonbank* | | *Log(1+NumNonbanks)* | | *Nonbank%* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *XBRL* × *Dummy: Lead Prior* | -0.073* | | -0.105** | | -0.012 | |
| | (0.043) | | (0.047) | | (0.010) | |
| *XBRL* × *Lead Prior Loans* | | -0.034** | | -0.046*** | | -0.006* |
| | | (0.014) | | (0.017) | | (0.003) |
| *XBRL* | 0.121*** | 0.120*** | 0.151*** | 0.148*** | 0.027** | 0.028*** |
| | (0.047) | (0.044) | (0.050) | (0.047) | (0.011) | (0.011) |
| *Dummy: Lead Prior* | 0.042** | | 0.063*** | | 0.001 | |
| | (0.021) | | (0.024) | | (0.007) | |
| *Lead Prior Loans* | | 0.008 | | 0.025*** | | 0.003 |
| | | (0.008) | | (0.009) | | (0.002) |
| Borrower Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Borrower FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,281 | 6,281 | 6,281 | 6,281 | 6,281 | 6,281 |
| Adjusted $R^2$ | 0.392 | 0.392 | 0.417 | 0.418 | 0.457 | 0.457 |

**Table 7 (continued)**

**Panel B: Standard Financial Ratios**

| | *Nonbank* | | *Log(1+NumNonbanks)* | | *Nonbank%* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *XBRL* × *Low Debt-to-EBITDA* | 0.068 | | 0.120** | | 0.030*** | |
| | (0.045) | | (0.047) | | (0.010) | |
| *XBRL* × *High ICR* | | 0.085* | | 0.135*** | | 0.033*** |
| | | (0.046) | | (0.050) | | (0.011) |
| *XBRL* | 0.052 | 0.043 | 0.044 | 0.036 | 0.008 | 0.007 |
| | (0.048) | (0.050) | (0.053) | (0.057) | (0.012) | (0.012) |
| *Low Debt-to-EBITDA* | 0.009 | | -0.037 | | -0.018** | |
| | (0.028) | | (0.031) | | (0.008) | |
| *High ICR* | | -0.030 | | -0.060* | | -0.021** |
| | | (0.030) | | (0.035) | | (0.009) |
| Borrower Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Borrower FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,282 | 6,047 | 6,282 | 6,047 | 6,282 | 6,047 |
| Adjusted $R^2$ | 0.391 | 0.389 | 0.417 | 0.415 | 0.458 | 0.459 |

**Table 8**

XBRL Adoption and SEC Filing Downloads

This table reports estimates of the effect of XBRL adoption on EDGAR filing download activity. *Machine* is the average daily number of machine downloads of SEC filings for the week following the borrower's first XBRL-tagged filing of Form 8-K, 10-Q, or 10-K, while *Non-machine* is the average daily number of non-machine (i.e., human-driven) downloads over the same period. Panel A reports univariate comparisons of machine and non-machine download activity before and after XBRL adoption; values in parentheses denote standard deviations. Panel B reports regression estimates in which the dependent variable is the logarithm of one plus the number of downloads; values in parentheses denote robust standard errors clustered at the borrower level. All other variables are defined in Table 1. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

**Panel A: Univariate Analysis**

| | Pre (N=1,244) | Post (N=1,244) | Change | Difference in Changes |
|---|---|---|---|---|
| *Machine* | 34.914 (45.201) | 86.720 (95.917) | 51.806*** | 45.612*** |
| *Non-machine* | 13.030 (14.032) | 19.224 (25.067) | 6.194*** | |

**Panel B: Multivariate Analysis**

| | *Log(1+Machine)* (1) | *Log(1+Non-machine)* (2) |
|---|---|---|
| *XBRL* | 0.916*** | 0.279*** |
| | (0.019) | (0.016) |
| *Size* | 0.048 | 0.081 |
| | (0.085) | (0.085) |
| *ROA* | -0.352*** | -0.105 |
| | (0.136) | (0.120) |
| *Leverage* | 0.104 | 0.076 |
| | (0.177) | (0.169) |
| *Market-to-Book* | -0.019*** | -0.013*** |
| | (0.006) | (0.003) |
| *Cash* | -0.352 | -0.268 |
| | (0.279) | (0.221) |
| *Tangibility* | 0.053 | 0.047 |
| | (0.357) | (0.352) |
| *Credit Rating* | -0.017 | 0.044 |
| | (0.122) | (0.166) |
| Borrower FE | Yes | Yes |
| Observations | 2,430 | 2,430 |
| Adjusted $R^2$ | 0.693 | 0.775 |

**Table 9**

Pre-Loan Download Activity and Lender Participation

This table reports estimates of how pre-loan filing download intensity predicts lender participation in the syndicated loan market following XBRL adoption. The sample consists of facility-level observations for firms that adopted XBRL reporting between 2005 and 2012. Panel A examines the relation between machine-download intensity and nonbank participation using a 10-day pre-loan window (days [−10,−1]). Panel B examines bank participation using the 10-day window. Panel C uses a longer 20-day window (days [−20,−1]) to assess the role of timing. *High Machine* is an indicator equal to one if the firm's average daily machine-download count in the pre-loan window exceeds the annual cross-sectional median across sample firms, and zero otherwise. *High Non-machine* is defined analogously using non-machine downloads. *Bank* is an indicator equal to one if the loan syndicate includes at least one bank participant, and zero otherwise. *NumBanks* is the number of bank participants in the loan syndicate. *Bank%* is the fraction of syndicate lenders that are banks. All other variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

**Panel A: Nonbank Participation (10-Day Window [−10,−1])**

| | *Nonbank* | | *Log(1+NumNonbanks)* | | *Nonbank%* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *High Machine* | 0.187** | | 0.165** | | 0.036** | |
| | (0.074) | | (0.071) | | (0.015) | |
| *High Non-machine* | | 0.006 | | 0.054 | | 0.008 |
| | | (0.104) | | (0.100) | | (0.016) |
| Borrower Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Borrower FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,198 | 1,198 | 1,198 | 1,198 | 1,198 | 1,198 |
| Adjusted $R^2$ | 0.530 | 0.522 | 0.540 | 0.535 | 0.600 | 0.593 |

**Panel B: Bank Participation (10-Day Window [−10,−1])**

| | *Bank* | | *Log(1+NumBanks)* | | *Bank%* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *High Machine* | -0.021 | | 0.080 | | -0.005 | |
| | (0.063) | | (0.144) | | (0.049) | |
| *High Non-machine* | | -0.044 | | -0.087 | | -0.057 |
| | | (0.059) | | (0.164) | | (0.053) |
| Borrower Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Borrower FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,198 | 1,198 | 1,198 | 1,198 | 1,198 | 1,198 |
| Adjusted $R^2$ | 0.414 | 0.415 | 0.518 | 0.518 | 0.428 | 0.429 |

**Table 9 (continued)**

**Panel C: Nonbank Participation (20-Day Window [−20,−1])**

| | *Nonbank* | | *Log(1+NumNonbanks)* | | *Nonbank%* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *High Machine* | 0.111 | | 0.090 | | 0.028 | |
| | (0.090) | | (0.115) | | (0.018) | |
| *High Non-machine* | | -0.007 | | 0.014 | | -0.010 |
| | | (0.105) | | (0.102) | | (0.016) |
| Borrower Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Borrower FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,198 | 1,198 | 1,198 | 1,198 | 1,198 | 1,198 |
| Adjusted $R^2$ | 0.525 | 0.522 | 0.536 | 0.534 | 0.598 | 0.593 |

**Table 10**

The Effect of XBRL Adoption on Nonbank Lead Arrangers

This table reports estimates of the effect of XBRL adoption on the likelihood that a nonbank serves as the lead arranger of a loan facility. The sample consists of facility-level observations for U.S. syndicated loans from 2005 to 2012, including facilities led by nonbanks that are excluded from the participant-lender analyses. *Nonbank Lead* is an indicator equal to one if the facility's lead arranger is a nonbank, and zero otherwise. All other variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

| | *Nonbank Lead* | |
|---|---|---|
| | (1) | (2) |
| *XBRL* | -0.025 | -0.019 |
| | (0.035) | (0.035) |
| *Size* | | -0.012 |
| | | (0.024) |
| *ROA* | | -0.193* |
| | | (0.106) |
| *Leverage* | | 0.156* |
| | | (0.081) |
| *Market-to-Book* | | -0.001 |
| | | (0.002) |
| *Cash* | | -0.005 |
| | | (0.146) |
| *Tangibility* | | -0.048 |
| | | (0.166) |
| *Credit Rating* | | -0.008 |
| | | (0.067) |
| *Loan Size* | | -0.020*** |
| | | (0.006) |
| *Maturity* | | 0.015*** |
| | | (0.004) |
| Borrower FE | Yes | Yes |
| Year FE | Yes | Yes |
| Loan Type FE | Yes | Yes |
| Loan Purpose FE | Yes | Yes |
| Observations | 8,852 | 8,757 |
| Adjusted $R^2$ | 0.379 | 0.387 |

# A Appendix

## A.1 Examples of SEC Filings

This appendix provides illustrative examples of XBRL tagging of financial statement information (Figure A.1) and contrasts non-XBRL and XBRL SEC filings used to identify the timing of XBRL adoption (Figure A.2).

Figure A.1 illustrates XBRL tagging of financial statement data using Towers Watson's Form 10-Q for the quarter ended September 30, 2011. Panel A displays the machine-readable tagged revenue information extracted from the XBRL filing, while Panel B shows the corresponding revenue item as presented in the human-readable financial statement.

Figure A.2 provides examples of SEC filings before and after XBRL adoption. Panel A presents Towers Watson's non-XBRL Form 10-Q filed on September 30, 2010, while Panel B presents Towers Watson's XBRL Form 10-Q filed on September 30, 2011.

**Figure A.1**

Examples of Tagged Financial Statement Information

```
"FROM_Jul01_2010_TO_Sep30_2010" decimals="INF" id="ID_15_USDollar_Thousands" unitRef="USDollar">751441000</us-gaap:SalesRevenueNet>

"FROM_Jul01_2011_TO_Sep30_2011" decimals="INF" id="ID_27_USDollar_Thousands" unitRef="USDollar">810351000</us-gaap:SalesRevenueNet>
```

Panel A: Machine-Readable Tagged Revenue Information from an XBRL Filing

**PART I. FINANCIAL INFORMATION**

**Item 1. Financial Statements (Unaudited)**

**TOWERS WATSON & CO.**

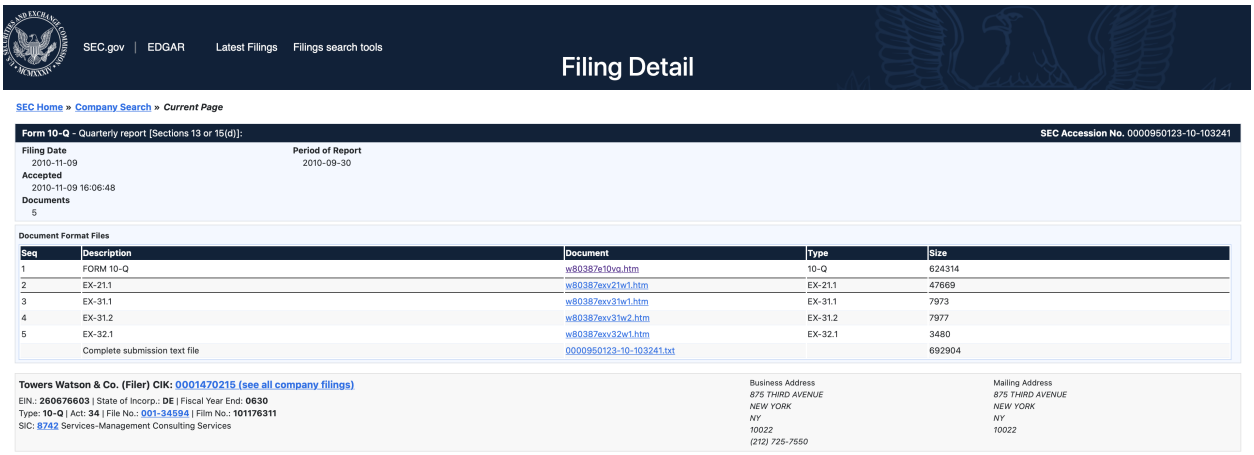
**Condensed Consolidated Statements of Operations**
(In thousands of U.S. dollars, except per share data)
(Unaudited)

| | Three Months Ended September 30, | |
|---|---|---|
| | 2011 | 2010 |
| Revenue | $ 810,351 | $ 751,441 |

Panel B: Corresponding Revenue Line Item in the Financial Statement

**Figure A.2**

Examples of Non-XBRL and XBRL Filings



SEC.gov | EDGAR  Latest Filings  Filings search tools

Filing Detail

SEC Home » Company Search » *Current Page*

**Form 10-Q** - Quarterly report [Sections 13 or 15(d)]: **SEC Accession No.** 0000950123-10-103241

**Filing Date** 2010-11-09
**Accepted** 2010-11-09 16:06:48
**Documents** 5
**Period of Report** 2010-09-30

**Document Format Files**

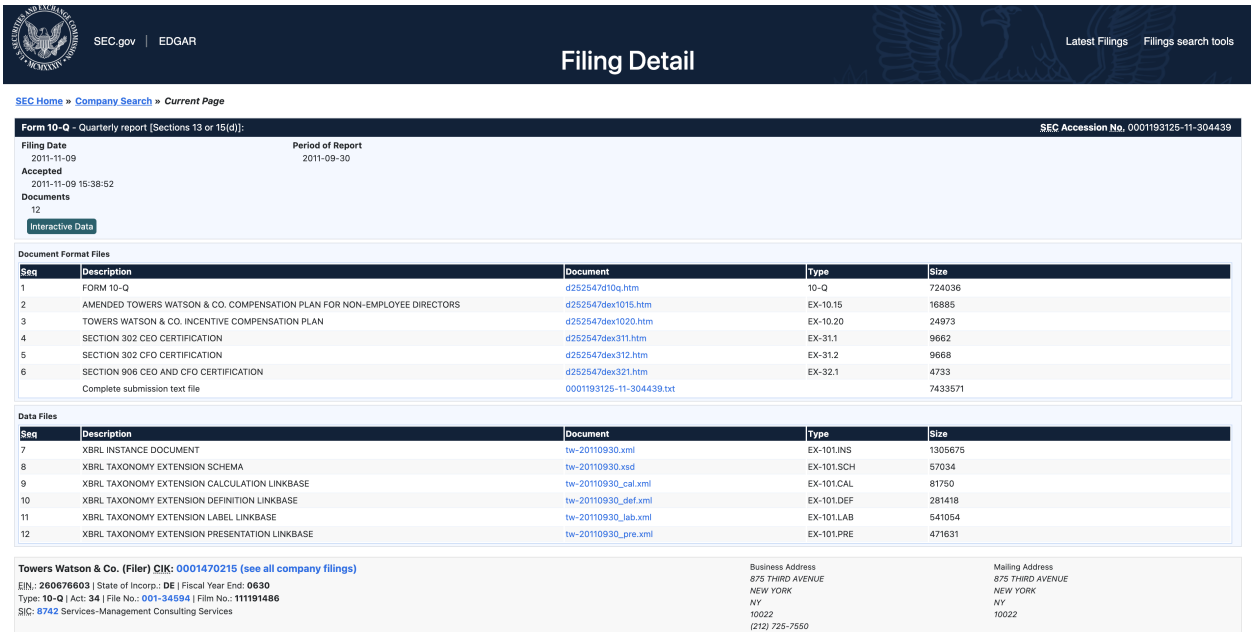
| Seq | Description | Document | Type | Size |
|---|---|---|---|---|
| 1 | FORM 10-Q | w80387e10vq.htm | 10-Q | 624314 |
| 2 | EX-21.1 | w80387exv21w1.htm | EX-21.1 | 47669 |
| 3 | EX-31.1 | w80387exv31w1.htm | EX-31.1 | 7973 |
| 4 | EX-31.2 | w80387exv31w2.htm | EX-31.2 | 7977 |
| 5 | EX-32.1 | w80387exv32w1.htm | EX-32.1 | 3480 |
| | Complete submission text file | 0000950123-10-103241.txt | | 692904 |

**Towers Watson & Co. (Filer) CIK: 0001470215 (see all company filings)**
EIN.: **260676603** | State of Incorp.: **DE** | Fiscal Year End: **0630**
Type: **10-Q** | Act: **34** | File No.: 001-34594 | Film No.: **101176311**
SIC: 8742 Services-Management Consulting Services

Business Address
*875 THIRD AVENUE*
*NEW YORK*
*NY*
*10022*
*(212) 725-7550*

Mailing Address
*875 THIRD AVENUE*
*NEW YORK*
*NY*
*10022*

Panel A: Non-XBRL Filing



SEC.gov | EDGAR  Latest Filings  Filings search tools

Filing Detail

SEC Home » Company Search » *Current Page*

**Form 10-Q** - Quarterly report [Sections 13 or 15(d)]: **SEC Accession No.** 0001193125-11-304439

**Filing Date** 2011-11-09
**Accepted** 2011-11-09 15:38:52
**Documents** 12
Interactive Data
**Period of Report** 2011-09-30

**Document Format Files**

| Seq | Description | Document | Type | Size |
|---|---|---|---|---|
| 1 | FORM 10-Q | d252547d10q.htm | 10-Q | 724036 |
| 2 | AMENDED TOWERS WATSON & CO. COMPENSATION PLAN FOR NON-EMPLOYEE DIRECTORS | d252547dex1015.htm | EX-10.15 | 16885 |
| 3 | TOWERS WATSON & CO. INCENTIVE COMPENSATION PLAN | d252547dex1020.htm | EX-10.20 | 24973 |
| 4 | SECTION 302 CEO CERTIFICATION | d252547dex311.htm | EX-31.1 | 9662 |
| 5 | SECTION 302 CFO CERTIFICATION | d252547dex312.htm | EX-31.2 | 9668 |
| 6 | SECTION 906 CEO AND CFO CERTIFICATION | d252547dex321.htm | EX-32.1 | 4733 |
| | Complete submission text file | 0001193125-11-304439.txt | | 7433571 |

**Data Files**

| Seq | Description | Document | Type | Size |
|---|---|---|---|---|
| 7 | XBRL INSTANCE DOCUMENT | tw-20110930.xml | EX-101.INS | 1305675 |
| 8 | XBRL TAXONOMY EXTENSION SCHEMA | tw-20110930.xsd | EX-101.SCH | 57034 |
| 9 | XBRL TAXONOMY EXTENSION CALCULATION LINKBASE | tw-20110930_cal.xml | EX-101.CAL | 81750 |
| 10 | XBRL TAXONOMY EXTENSION DEFINITION LINKBASE | tw-20110930_def.xml | EX-101.DEF | 281418 |
| 11 | XBRL TAXONOMY EXTENSION LABEL LINKBASE | tw-20110930_lab.xml | EX-101.LAB | 541054 |
| 12 | XBRL TAXONOMY EXTENSION PRESENTATION LINKBASE | tw-20110930_pre.xml | EX-101.PRE | 471631 |

**Towers Watson & Co. (Filer) CIK: 0001470215 (see all company filings)**
EIN.: **260676603** | State of Incorp.: **DE** | Fiscal Year End: **0630**
Type: **10-Q** | Act: **34** | File No.: 001-34594 | Film No.: **111191486**
SIC: 8742 Services-Management Consulting Services

Business Address
*875 THIRD AVENUE*
*NEW YORK*
*NY*
*10022*
*(212) 725-7550*

Mailing Address
*875 THIRD AVENUE*
*NEW YORK*
*NY*
*10022*

Panel B: XBRL Filing

## A.2 Pre-Loan Download Activity: Alternative Pre-Loan Windows

In Section 5.5.2, we measure pre-loan download activity over a 10-day window prior to loan origination (days [−10,−1]). To assess whether the results are sensitive to the precise choice of this window, we re-estimate our specifications using alternative nearby windows, including an 8-day window (days [−8,−1]) and a 12-day window (days [−12,−1]). The results are shown in Table A.1. Across these alternative specifications, we obtain qualitatively similar results: the coefficients on *High Machine* remain positive and statistically significant for nonbank participation, while those on *High Non-machine* remain small and statistically insignificant. These findings indicate that our results are not driven by the specific choice of the baseline window and remain robust when using alternative nearby windows (e.g., 8-day and 12-day periods).

**Table A.1**

Pre-Loan Download Activity and Nonbank Participation: Alternative Pre-Loan Windows

This table reports estimates of how pre-loan filing download intensity predicts lender participation in the syndicated loan market following XBRL adoption, using alternative pre-loan windows. The sample consists of facility-level observations for firms that adopted XBRL reporting between 2005 and 2012. Panel A uses an 8-day pre-loan window (days [−8,−1]), and Panel B uses a 12-day window (days [−12,−1]). *High Machine* is an indicator equal to one if the firm's average daily machine-download count in the specified pre-loan window exceeds the annual cross-sectional median across sample firms, and zero otherwise. *High Non-machine* is defined analogously using non-machine downloads. All other variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

**Panel A: Nonbank Participation (8-Day Window [−8,−1])**

| | *Nonbank* | | *Log(1+NumNonbanks)* | | *Nonbank%* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *High Machine* | 0.186** | | 0.140* | | 0.033** | |
| | (0.076) | | (0.076) | | (0.015) | |
| *High Non-machine* | | 0.021 | | 0.046 | | 0.003 |
| | | (0.099) | | (0.095) | | (0.014) |
| Borrower Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Borrower FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,198 | 1,198 | 1,198 | 1,198 | 1,198 | 1,198 |
| Adjusted $R^2$ | 0.530 | 0.522 | 0.538 | 0.535 | 0.599 | 0.593 |

**Panel B: Nonbank Participation (12-Day Window [−12,−1])**

| | *Nonbank* | | *Log(1+NumNonbanks)* | | *Nonbank%* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *High Machine* | 0.176** | | 0.156** | | 0.033** | |
| | (0.075) | | (0.075) | | (0.015) | |
| *High Non-machine* | | 0.011 | | 0.063 | | 0.004 |
| | | (0.107) | | (0.106) | | (0.018) |
| Borrower Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Borrower FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,198 | 1,198 | 1,198 | 1,198 | 1,198 | 1,198 |
| Adjusted $R^2$ | 0.529 | 0.522 | 0.539 | 0.535 | 0.599 | 0.593 |

## A.3 Illustrative Case Study: Machine SEC Filing Downloads by a Nonbank Lender

One channel through which machine readability may reduce nonbanks' processing costs is by facilitating direct machine-based access to public financial information contained in machine-readable SEC filings. To illustrate the plausibility of this direct channel, we conduct a limited case-study analysis using EDGAR download logs. Although this exercise is not part of our identification strategy and is necessarily illustrative, it provides complementary micro-level evidence that machine-based access to public information occurs in practice.

From the EDGAR log files, we extract IP addresses associated with machine-based access to machine-readable filings. To protect user privacy, the SEC masks the final three characters of each IP address—for example, 24.45.236.100 may appear as 24.45.236.jcf. Following Iliev et al. (2021), we exploit the fact that large institutions frequently register contiguous IP blocks, which can remain identifiable even when partially masked. For IP addresses classified as engaging in machine downloads, we perform ownership identification using the APNIC RDAP lookup service, which provides authoritative registration and ownership information (e.g., `https://rdap.apnic.net/ip/24.45.236.100`).

Because many nonbank participants are not large institutions maintaining identifiable, registered IP address blocks, the set of nonbanks that can be reliably identified in EDGAR log files is limited. We therefore focus on one nonbank lender whose IP ownership can be reliably identified. Table A.2 reports several matched download events for this lender within ten days prior to loan origination. These events take place during 2010–2012, immediately following the introduction of mandatory XBRL reporting. Although the sample is necessarily limited and the evidence is illustrative rather than definitive, the timing of these downloads is consistent with a direct processing channel through which some nonbank lenders access public information contained in machine-readable SEC filings when making participation decisions.

**Table A.2**

Illustrative Case Study: Machine SEC Filing Downloads by a Nonbank Lender

This table reports illustrative matched observations of machine downloads of borrower SEC filings by a nonbank lender shortly before syndicated loan origination. *Gap* denotes the number of days between the SEC filing download date and the loan's origination date.

| Borrower CIK | Loan Origination Date | Download Date | Gap (days) |
|---|---|---|---|
| 1329069 | 2011-09-20 | 2011-09-13 | -7 |
| 1329069 | 2011-09-20 | 2011-09-13 | -7 |
| 949373 | 2012-12-06 | 2012-11-28 | -8 |
| 1304421 | 2012-11-29 | 2012-11-20 | -9 |
| 1196501 | 2011-12-16 | 2011-12-06 | -10 |

## A.4 Robustness of the Main Analysis

Our baseline analysis relies on a staggered difference-in-differences (DiD) framework to estimate the effect of XBRL adoption on nonbank participation. Because the SEC's XBRL phase-in is determined by filer status and public float thresholds, adoption timing is not random but tied to firm size. Consequently, our baseline estimates could reflect correlated firm attributes, differential trends, or coincident time shocks rather than reductions in public-information processing costs. In addition, XBRL's rollout overlaps with the aftermath of the 2008 financial crisis and subsequent bank capital tightening, raising the possibility that changes in participant composition may be driven by contemporaneous macroeconomic or regulatory shocks rather than variation in borrower-level XBRL adoption.

We therefore conduct a series of complementary robustness tests. These include (i) specifications with size-group × year fixed effects to absorb flexible size-specific time trends and differential exposure to post-crisis conditions, (ii) a propensity score matching design combined with clean 2×2 DiD comparisons to address selection on observables and staggered-treatment contamination, and (iii) a placebo event analysis with randomly assigned adoption dates to rule out spurious calendar-time effects. Together, these tests address predictable rollout timing, selection concerns, coincident macroeconomic shocks, and generic time trends. Additionally, we conduct a sensitivity analysis to assess the extent to which our results may be affected by omitted-variable bias.

### A.4.1 Robustness to Size-Specific Time Trends

Firms of different sizes may exhibit distinct time trends in nonbank participation that are unrelated to XBRL adoption. Because the SEC's phase-in schedule is tied to public float thresholds, adoption timing is mechanically linked to firm size. If larger (or smaller) firms were already experiencing systematic changes in their access to nonbank capital, our baseline estimates could capture these size-specific trends rather than the causal effect of XBRL adoption.

To address this concern, we include size-tercile × year fixed effects. In each year, borrowers are sorted into terciles based on their market value. The interaction of size tercile and year absorbs any shocks and trends that are common to firms of a given size in a given year, thereby allowing fully flexible size-specific time paths in nonbank participation.

The odd-numbered columns of Table A.3 report the results. The coefficients on *Nonbank* and *Log(1+NumNonbanks)* remain positive and statistically significant, and their magnitudes are comparable to those in the baseline specifications. For *Nonbank%*, the coefficient remains positive but is not statistically significant at conven-

tional levels, with a p-value close to 0.10.

As a more demanding specification, the even-numbered columns replace size terciles with quintiles and include size-quintile × year fixed effects. The results are similar. The coefficients on *Log(1+NumNonbanks)* and *Nonbank%* remain positive and statistically significant, while the coefficient on *Nonbank* remains positive but is not statistically significant at conventional levels, with a p-value close to 0.14.

Overall, these results indicate that our findings are not driven by differential size-related trends. The positive effect of XBRL adoption on nonbank participation persists even after including flexible size-group × year fixed effects, mitigating concerns about differential post-crisis dynamics or size-related regulatory exposure.

### A.4.2 Propensity Score Matching

To further mitigate concerns that adoption timing is correlated with firm characteristics, we implement a propensity score matching (PSM) design. Because eligibility for mandatory XBRL adoption is determined by public float thresholds, earlier and later adopters may differ systematically in firm size and other borrower characteristics associated with nonbank participation. In addition, because the XBRL rollout overlaps with the post-2008 period, differences between early and later adopters could reflect differential exposure to crisis-related credit conditions rather than the effects of XBRL. We therefore use PSM to construct treated and control groups that are more comparable on pre-adoption borrower characteristics.

Moreover, to address concerns that already treated firms may serve as controls for later-treated firms in staggered-adoption settings, we combine the PSM procedure with a classic 2×2 DiD design. This approach isolates clean treatment and control groups within a narrow pre- and post-adoption window, ensuring that treated firms are compared only with not-yet-treated or never-treated firms within the same calendar period and thereby mitigating the influence of coincident macroeconomic shocks.

Specifically, because mandatory XBRL reporting began in mid-2009, we define the treatment period as beginning in 2010. Treated firms are those that adopt XBRL in 2010 but had not adopted it in 2009. Control firms are those that adopt XBRL after 2010 or do not adopt XBRL during the sample period. Propensity scores are estimated using a logit model based on the borrower characteristics included in our baseline specification. Treated firms are matched to control firms within the same one-digit SIC industry using one-to-one nearest-neighbor matching with replacement and a caliper of 0.1, restricting the sample to the region of common support.

Table A.4 reports the DiD estimates. The coefficients on *Treat* × *YR10* in columns (1) and (2) are positive and statistically significant, while the coefficient in column (3) is positive but statistically insignifi-

cant. Overall, the matched 2×2 DiD results provide further evidence that XBRL adoption increases nonbank participation.

### A.4.3 Pseudo-Event Analysis

While the above analyses mitigate concerns about size-related differential exposure, a remaining possibility is that our results reflect broader calendar-time shocks coinciding with the XBRL rollout period, such as post-crisis credit market adjustments or bank capital tightening, rather than the effects of XBRL adoption itself. To assess whether such time shocks could generate spurious treatment effects, we conduct a pseudo-event (placebo) analysis in which adoption timing is randomly reassigned across firms.

We restrict the sample to borrowers that either adopt XBRL between 2009 and 2011 or never file any XBRL-tagged Form 10-K, 10-Q, or 8-K during the sample period. Within this subsample, we randomly assign each firm a placebo XBRL adoption year—either between 2009 and 2011 or as never treated. This procedure severs any systematic link between true adoption timing and lending outcomes while preserving the underlying panel structure, loan origination timing, and exposure to common macroeconomic conditions.

Table A.5 reports the results. Across all three measures of nonbank participation, the coefficients on the placebo *XBRL* indicator are small and statistically insignificant. The absence of significant effects under random assignment suggests that the positive effects observed in the baseline analysis are unlikely to be driven by spurious time trends, generic post-crisis shifts in participant composition, or coincident macroeconomic shocks during the phase-in period. These results provide additional support for interpreting the documented increase in nonbank participation as attributable to XBRL adoption rather than to contemporaneous calendar-time effects.

### A.4.4 Sensitivity to Omitted-Variable Bias

A remaining concern is whether our main results are driven by omitted variables. To assess the sensitivity of our estimates to omitted-variable bias, we follow Cinelli and Hazlett (2020) and conduct a formal benchmarking analysis that quantifies how strong omitted confounders would need to be to overturn our results. The analysis yields two robustness values (RV). We illustrate these results using the outcome variable *Nonbank* as an example. First, an omitted confounder would need to explain more than 4.15% of the residual variance in both the treatment (*XBRL*) and the outcome (*Nonbank*) to fully eliminate the estimated point effect (i.e., reduce the coefficient to zero). Second, an omitted confounder explaining more than 1.75% of the residual variance in both variables would be sufficient to render the estimate statistically indistinguishable from zero at the 5% level.

We contextualize these thresholds by benchmarking them against our strongest observed covariates—*Size* and *Loan Size*. When borrower size is used as the benchmark, an omitted confounder eight times as strong as *Size* would reduce the point estimate from 0.089 to approximately 0.067, which remains statistically significant at the 5% level. Similarly, when loan size is used as the benchmark, an omitted confounder eight times as strong as *Loan Size* would reduce the estimate only slightly, from 0.089 to approximately 0.086, again remaining statistically significant. The strength required to invalidate our finding (1.75%) far exceeds the observed explanatory power of key controls like *Size* (approximately 0.08%).

Taken together, these results indicate that overturning our main findings would require an omitted confounder substantially stronger than the most influential observed covariates in our model, suggesting that the estimated effect is unlikely to be driven by omitted-variable bias.

**Table A.3**

The Effect of XBRL Adoption on Nonbank Participation: Controlling for Size-Year Fixed Effects
This table reports estimates of the effect of XBRL adoption on nonbank participation in the syndicated loan market. The sample consists of facility-level observations for U.S. syndicated loans from 2005 to 2012. Borrowers are sorted each year based on their market value using the within-year empirical distribution. In the odd-numbered columns, firms are grouped into size terciles and the regressions include size-tercile × year fixed effects. In the even-numbered columns, firms are grouped into size quintiles and the regressions include size-quintile × year fixed effects. All other variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

| | *Nonbank* | | *Log(1+NumNonbanks)* | | *Nonbank%* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *XBRL* | 0.097* | 0.084 | 0.115** | 0.119* | 0.019 | 0.023* |
| | (0.052) | (0.056) | (0.058) | (0.063) | (0.012) | (0.012) |
| Borrower Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Size-Tercile × Year FE | Yes | No | Yes | No | Yes | No |
| Size-Quintile × Year FE | No | Yes | No | Yes | No | Yes |
| Borrower FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 6,287 | 6,287 | 6,287 | 6,287 | 6,287 | 6,287 |
| Adjusted $R^2$ | 0.390 | 0.392 | 0.416 | 0.417 | 0.458 | 0.460 |

**Table A.4**

The Effect of XBRL Adoption on Nonbank Participation: PSM DiD Design

This table reports difference-in-differences estimates using a propensity score-matched sample of firms. Treated firms are those that adopt XBRL in 2010 but not in 2009, whereas control firms are those that adopt XBRL after 2010 or do not adopt XBRL during the sample period. Propensity scores are estimated using a logit model based on the borrower characteristics included in the baseline specification. Treated firms are matched to control firms within the same one-digit SIC industry using one-to-one nearest-neighbor matching with replacement and a caliper of 0.1, restricting the sample to the region of common support. *Treat* equals one for treated firms, and *YR10* equals one for year 2010. All other variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

| | *Nonbank* | *Log(1+NumNonbanks)* | *Nonbank%* |
|---|---|---|---|
| | (1) | (2) | (3) |
| *Treat* × *YR10* | 0.393** | 0.304* | 0.014 |
| | (0.150) | (0.175) | (0.042) |
| Borrower Controls | Yes | Yes | Yes |
| Loan Controls | Yes | Yes | Yes |
| Borrower FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes |
| Observations | 132 | 132 | 132 |
| Adjusted $R^2$ | 0.615 | 0.701 | 0.682 |

**Table A.5**

Pseudo-Event (Placebo) Analysis

This table reports estimates from a pseudo-event (placebo) analysis in which XBRL adoption dates are randomly assigned to firms between 2009 and 2011, including firms that are never treated. The sample consists of facility-level observations for U.S. syndicated loans from 2005 to 2012. All other variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

| | *Nonbank* | *Log(1+NumNonbanks)* | *Nonbank%* |
|---|---|---|---|
| | (1) | (2) | (3) |
| *XBRL* | 0.014 | 0.004 | -0.004 |
| | (0.025) | (0.025) | (0.006) |
| Borrower Controls | Yes | Yes | Yes |
| Loan Controls | Yes | Yes | Yes |
| Borrower FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes |
| Observations | 6,184 | 6,184 | 6,184 |
| Adjusted $R^2$ | 0.389 | 0.413 | 0.457 |

## A.5 Usability of Machine-Readable Disclosures: Scale and Tag Quality

This appendix provides additional evidence on the proposed mechanism by examining whether the effects of XBRL adoption vary with the usability of machine-readable disclosures. We focus on two dimensions of usability: (i) the availability of machine-readable filings at sufficient scale to support automated processing, and (ii) the technical quality of tagged data.

### A.5.1 Voluntary XBRL Adoption

We first examine XBRL adoption during the voluntary XBRL filing period. For this analysis, we classify 2005 through June 14, 2009 as the voluntary filing period, preceding the staggered phase-in of mandatory XBRL reporting. During this phase, adoption was sparse and tagging practices varied substantially across firms. Panel A of Table A.6 reports the annual distribution of firm participation in the XBRL filing programs, covering both the voluntary and mandatory phases. During the voluntary phase from 2005 to 2009, XBRL adopters account for only 1.0% of total adopters, indicating limited early uptake. Adoption increases sharply following the introduction of mandatory filing requirements, with participation peaking in 2011—the third year of the mandatory phase—when the majority of firms transition to XBRL.

Because machine-readable disclosures were available only at limited scale during the voluntary period, lenders and data intermediaries should have weaker incentives to invest in automated extraction and validation systems. Accordingly, reductions in processing costs should be limited during this period.

Consistent with this view, the odd-numbered columns of Table A.7 show that the coefficients on *XBRL* for voluntary adopters are negative and statistically insignificant across all three nonbank participation measures. The absence of any effects suggests that limited scale constrained the usefulness of voluntary XBRL in reducing public-information processing costs.

Next, we introduce an indicator variable, *Mandate*, equal to one for loans issued on or after June 15, 2009, the start of mandatory XBRL reporting. The interaction term $XBRL \times Mandate$ captures the incremental effect of XBRL once adoption becomes widespread. The even-numbered columns of Table A.7 show that this interaction is positive and statistically significant for both *Nonbank* and *Nonbank%*. This stands in contrast to the voluntary period, during which XBRL adoption is not associated with meaningful changes in nonbank participation. For *Log(1+NumNonbanks)*, the coefficient is positive but not statistically significant.

These findings are consistent with the proposed mechanism. Automated processing systems require machine-readable disclosures to be available at sufficient scale before lenders and data intermediaries have

incentives to invest in automated extraction and integration. Once XBRL becomes mandatory and disclosures are broadly machine-readable, reductions in processing costs become economically meaningful, leading to stronger treatment effects.

### A.5.2 Inline XBRL Adoption

We next exploit the introduction of Inline XBRL (iXBRL), which embeds XBRL tags directly into human-readable filings and improves the technical quality and consistency of tagged disclosures. The SEC notes that iXBRL was adopted to "improve the quality and accessibility of XBRL data," allowing filings to be simultaneously human- and machine-readable.[5] Commissioner Kara M. Stein further emphasized that iXBRL enhances "transparency, accessibility, and quality."[6] Industry practitioners similarly note that iXBRL reduces duplication, lowers the risk of tagging errors, and facilitates error detection during review.[7] We examine whether improvements in tagging quality associated with the introduction of iXBRL have an incremental effect on nonbank participation.

We do not use iXBRL adoption as our primary identification shock, because the initial XBRL mandate provides a cleaner source of exogenous variation tied to the introduction of machine-readable reporting, whereas iXBRL represents a subsequent refinement in tagging quality. Empirically, extending the analysis to the iXBRL period is further constrained by data limitations. In particular, coverage of the DealScan–Compustat linking table from Chava and Roberts (2008) declines sharply after 2016. Figure A.3 shows that while the average coverage ratio exceeds 50% during 2005–2012, it declines to at most 30% after 2016, reflecting a divergence between the growing number of syndicated loans in DealScan and the shrinking set of loans that can be reliably matched to Compustat firms. In addition, EDGAR log file data are unavailable from July 1, 2017 to May 18, 2020, and IP address information is no longer provided after 2020.[8] For these reasons, we rely on the initial XBRL mandate as our primary source of variation in the cost of processing public financial information and use iXBRL adoption only as a complementary analysis to examine how improvements in tagging quality affect nonbank participation.

The iXBRL analysis covers 2016 through March 31, 2020.[9] Following the same procedures used in the

[5]See "SEC Adopts Inline XBRL for Tagged Data," available at `https://www.sec.gov/newsroom/press-releases/2018-117` . Accessed November 28, 2025.

[6]See "Statement on Final Rule of Inline XBRL Filing of Tagged Data," available at `https://www.sec.gov/newsroom/speeches-statements/statement-stein-xbrl-062818` . Accessed November 28, 2025.

[7]See `https://www.sec.gov/comments/s7-03-17/s70317-1753547-151970.pdf`.

[8]Source: `https://www.sec.gov/data-research/sec-markets-data/edgar-log-file-data-sets`

[9]The earliest iXBRL filing in our data occurs on July 1, 2016, reflecting early voluntary adoption. The SEC later mandated iXBRL in a staggered manner: large accelerated filers for fiscal periods ending on or after June 15, 2019; accelerated filers on or after June 15, 2020; and all remaining filers on or after June 15, 2021 (SEC Open Meeting, June 28, 2018).

XBRL analysis, we identify each borrower's earliest iXBRL filing and exclude always-treated firms. The earliest effective adoption date in the estimation sample is October 20, 2017. Unlike the initial XBRL rollout, voluntary iXBRL adoption reached substantial scale even before the mandate. Panel B of Table A.6 shows that firms participating in the voluntary phase from 2016 to 2019 account for 20.0% of total adopters. Mandatory adoption begins in 2019, which also marks the year with the largest number of new adopters, corresponding to the first phase of the staggered iXBRL mandate.

Table A.8 reports the results. Across all three measures—*Nonbank*, *Log(1+NumNonbanks)*, and *Nonbank%*—the coefficient on *iXBRL* is positive and statistically significant.[10] Because iXBRL improves the technical quality of machine-readable disclosures, it provides complementary variation in the effectiveness of machine readability rather than the introduction of machine readability itself. The increase in nonbank participation following iXBRL adoption therefore reinforces our interpretation that further reductions in the cost of processing public information disproportionately benefit nonbank participants, amplifying the effects documented in the main analysis.

[10]The results are robust to an untabulated specification that restricts the sample to the pre–June 15, 2019 period, corresponding to the voluntary iXBRL adoption phase; the estimated effect of *iXBRL* remains positive and statistically significant.

**Figure A.3**

Coverage of Matched Syndicated Loans

The upper panel plots the total number of U.S. syndicated loan facilities in DealScan (solid line) and the subset that can be matched to Compustat firms using the linking table from Chava and Roberts (2008) (dashed line) over 1990–2019. The lower panel plots the corresponding coverage ratio, defined as matched facilities divided by total facilities in DealScan.

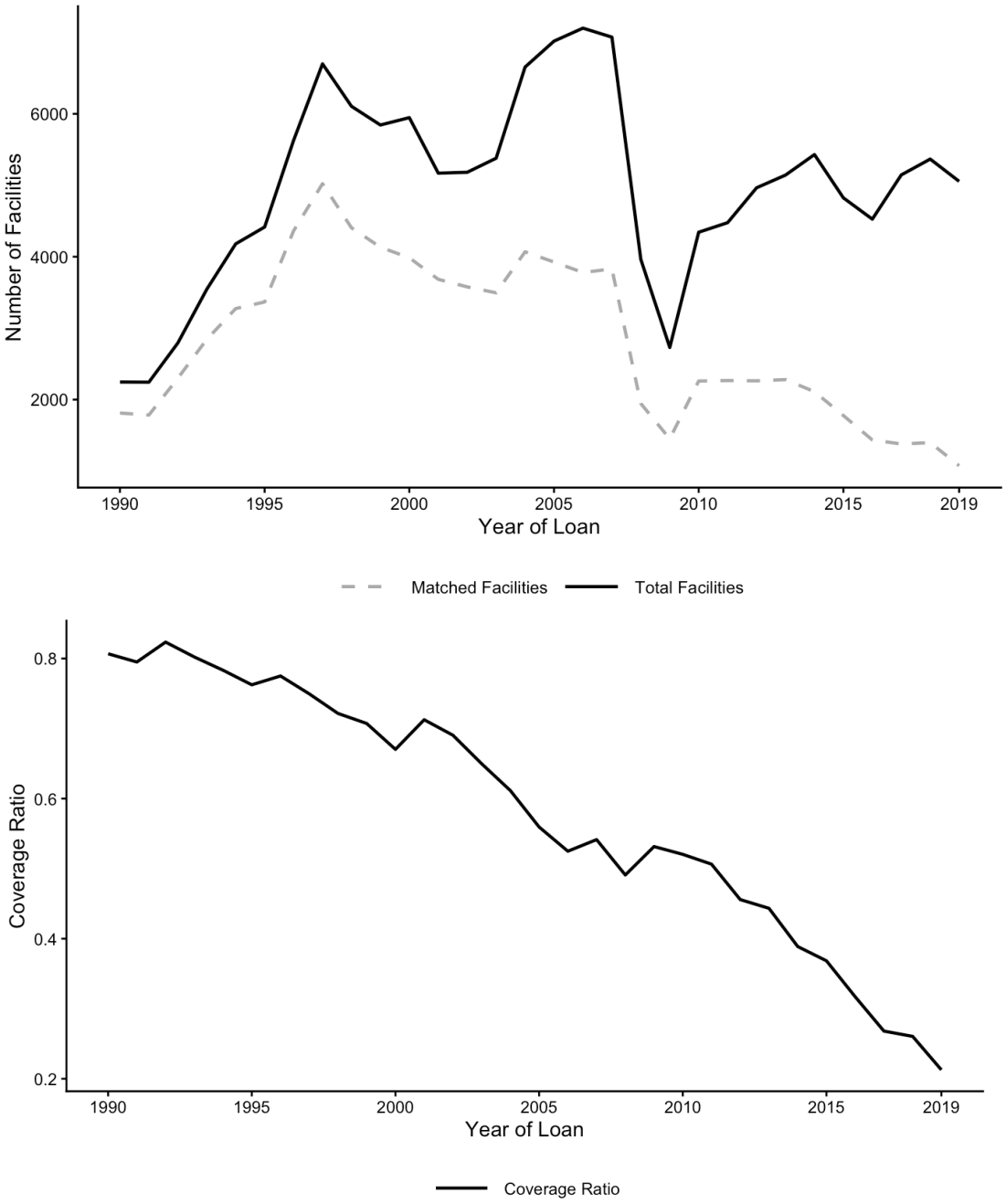


**Table A.6**

XBRL and Inline XBRL Adopters by Year

This table reports the annual distribution of firms adopting XBRL (Panel A) and Inline XBRL (Panel B) filing programs, covering both the voluntary and mandatory phases. The sample consists of borrowing firms with a valid Central Index Key (CIK) that obtained syndicated loans between 1982 and July 2020.

**Panel A: XBRL Adopters by Year**

| Year | Program | No. of Firms | Cumulative (%) |
|---|---|---|---|
| 2005 | Voluntary | 2 | 0.1 |
| 2006 | Voluntary | 3 | 0.1 |
| 2007 | Voluntary | 3 | 0.2 |
| 2008 | Voluntary | 6 | 0.4 |
| 2009 | Voluntary | 20 | 1.0 |
| 2009 | Mandatory | 411 | 13.3 |
| 2010 | Mandatory | 844 | 38.5 |
| 2011 | Mandatory | 1,934 | 96.2 |
| 2012 | Mandatory | 126 | 100.0 |
| Total | – | 3,349 | – |

**Panel B: Inline XBRL Adopters by Year**

| Year | Program | No. of Firms | Cumulative (%) |
|---|---|---|---|
| 2016 | Voluntary | 13 | 0.6 |
| 2017 | Voluntary | 43 | 2.4 |
| 2018 | Voluntary | 120 | 7.7 |
| 2019 | Voluntary | 284 | 20.0 |
| 2019 | Mandatory | 1,338 | 78.3 |
| 2020 | Mandatory | 499 | 100.0 |
| Total | – | 2,297 | – |

**Table A.7**

The Effect of Voluntary versus Mandatory XBRL Adoption on Nonbank Participation

This table reports estimates of the effect of XBRL adoption on nonbank participation in the syndicated loan market, distinguishing between voluntary and mandatory adoption regimes. Columns (1), (3), and (5) restrict the sample to loan facilities obtained by voluntary XBRL adopters from 2005 through June 14, 2009. Columns (2), (4), and (6) use the full sample of syndicated loans from 2005 to 2012. *Mandate* equals one for loans issued on or after June 15, 2009, the start of mandatory XBRL reporting, and zero otherwise. All other variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

| | *Nonbank* | | *Log(1+NumNonbanks)* | | *Nonbank%* | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *XBRL* × *Mandate* | | 0.252* | | 0.202 | | 0.050* |
| | | (0.151) | | (0.198) | | (0.027) |
| *XBRL* | -0.103 | -0.142 | -0.034 | -0.081 | -0.009 | -0.024 |
| | (0.157) | (0.148) | (0.212) | (0.196) | (0.033) | (0.026) |
| *Mandate* | | 0.009 | | -0.011 | | -0.023 |
| | | (0.059) | | (0.066) | | (0.020) |
| Borrower Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| Borrower FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 4,354 | 6,287 | 4,354 | 6,287 | 4,354 | 6,287 |
| Adjusted $R^2$ | 0.469 | 0.391 | 0.467 | 0.416 | 0.507 | 0.457 |

**Table A.8**

The Effect of Inline XBRL (iXBRL) Adoption on Nonbank Participation

This table reports estimates of the effect of Inline XBRL (iXBRL) adoption on nonbank participation in the syndicated loan market. The sample consists of facility-level observations for U.S. syndicated loans from 2016 through March 31, 2020. *iXBRL* is an indicator equal to one if the loan is issued in or after the borrower's iXBRL adoption year, and zero otherwise. All other variables are defined in Table 1. Robust standard errors clustered at the borrower level are reported in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

| | *Nonbank* | *Log(1+NumNonbanks)* | *Nonbank%* |
|---|---|---|---|
| | (1) | (2) | (3) |
| *iXBRL* | 0.420*** | 0.312*** | 0.083** |
| | (0.134) | (0.110) | (0.034) |
| Borrower Controls | Yes | Yes | Yes |
| Loan Controls | Yes | Yes | Yes |
| Borrower FE | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes |
| Loan Type FE | Yes | Yes | Yes |
| Loan Purpose FE | Yes | Yes | Yes |
| Observations | 1,040 | 1,040 | 1,040 |
| Adjusted $R^2$ | 0.651 | 0.679 | 0.695 |