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Absolute blockchain strength? Evidence from the ABS market in China

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Abstract

Blockchain, a type of distributed ledger technology, has become a buzzword in the past decade. Its potential to challenge current business practices such as financial transactions has been touted or criticised by numerous researchers and practitioners. Nonetheless, academic literature thus far has provided little empirical evidence on how financial services benefit from such new technology. We exploit the emerging asset-backed security (ABS) market in China and its rapid adoption of blockchain technology. We examine whether blockchain-based ABS products enjoy better pricing than those not based on blockchain after controlling potential endogeneity with coarsened exact matching. Analysing approximately 5,000 ABS products issued between 2015 and 2020, we show that the adoption of blockchain technology indeed reduces the yield spread by approximately 25 basis points and that this benefit is heterogeneous across the different underlying asset classes and institutional arrangements. Interestingly, we find that social factors such as familiarity among key ABS parties may increase or decrease the benefit of adopting blockchain in ABS products depending on the asset classes and regulatory environments. Our study makes a timely contribution to the debate surrounding blockchain technology and its implication for the financial sector.

Keywords: asset-backed security, blockchain, financial technology, social embeddedness, technology adoption.

JEL classification: G30, G32, M40, O33.

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1. Introduction

The use of blockchain technology has grown rapidly over the past decade along the rise of crypto assets. There has been a great deal of excitement as well as scepticism regarding the impact of adopting blockchain in business operations, particularly in financial services. Although the technology is still far from fulfilling ambitious goals such as currency creation or person-to-person payments, the adoption of permissioned blockchain has become prevalent in trade finance, clearing and settlement due to increased transaction efficiency and transparency. For example, the Australian Securities Exchange collaborated with Digital Asset to develop a blockchain-based post-trade clearing and settlement system. Five leading commercial banks including Hong Kong and Shanghai Banking Corporation and Standard Chartered Bank in Hong Kong SAR also adopted a blockchain platform developed by Ping An Technology to streamline credit loan applications among the banks.

While the adoption of blockchain technology by the financial sector is promising, little has been discussed, let alone empirically examined, whether the novel technology ushers in a new risk arising from the potentially overrated sense of security. Indeed, both economics and legal literatures have suggested that permissioned blockchain may be subject to potential collusion among participants and in extreme cases, encourage such behaviour with a better cover than before. For example, accounting professionals worry that potential fraudsters could exploit the illusory reliability of blockchain in terms of data collection and verification to collude with confederate "third" parties.

In this paper, we analyse two sides of the same coin, namely, whether the adoption of blockchain technology improves efficiency and transparency of financial transactions; more importantly, whether the potential weak governance in terms of social interactions among participants generates an illusionary sense of reliability; and finally, if the market is efficient, whether the market can understand such complexity and price it in. Our study builds upon several streams of literature: the narrowly defined ABS literature, the literature on tech adoption in finance, and the literature on the sociological view of economic transactions.

This paper focuses on the application of blockchain on asset-backed securities (ABS). Blockchain ABS has the potential to be the next hit, given the significant scale of the ABS market and the lack of transparency in its data disclosure, where blockchain technology is expected to bring additional benefits. Indeed, the ABS market has already adopted this technology. In China, blockchain has been used at various stages in the securitisation process since 2017. In the United States, the first securitisation backed by loans originated, serviced, financed and sold on blockchain was completed in March 2020. We study how blockchain ABS products compare with traditional ABS products, and whether differences in the design and governance of permissioned blockchain, as well as the relationship among participants in the issuance of ABS, affect the valuation and performance of ABS products.

Analysing approximately 5,000 ABS deals or 14,000 tranches launched between 2015 and mid-2020 in China, our study shows that adopting blockchain technology helps improve the ABS issuance cost about 0.1% or 25 bps. This estimation is robust to several tests such as primary vs secondary trading or a coarsened exact matching (CEM) scheme. Overall, adopting blockchain appears to be beneficial in terms of improving the efficiency and transparency of ABS trading in China. However, such benefit is heterogeneous across different institutional arrangements and asset classes. Blockchain adoption seems more valuable for China Securities Regulatory Commission (CSRC)-regulated ABS products, such as consumer loan or account receivable. It is aligned with an information asymmetry explanation: relatively speaking, CSRC-regulated ABS products are less standardised and potentially more opaque than, for example, residential mortgage-backed securities (RMBS).

Surprisingly, our study also reveals that social mechanism or familiarity among key players interacts with blockchain adoption in a subtle way. Prior shared experience (PSE) among key parties interacts positively with blockchain adoption under China Banking Regulatory Commission (CBRC) regulation. In contrast, PSE exhibits a negative interaction with blockchain adoption under CSRC regulation. These results imply that the market participants appreciate the influence of PSE in the adoption of blockchain even more under CBRC regulation but become dubious toward the combination under CSRC regulation.

First, our research is related to the literature on the relationship among key parties associated with securitisation and the pricing of structured finance products. Credit rating agencies were criticised for their poor performance in rating structured finance products prior to the 2008 Global Financial Crisis (GFC). He et al (2012, 2016) argue that some investors question the quality of such ratings and look for independent information. They show that investors may price the risk that large issuers received more inflated ratings than small ones. They also find evidence that investors in the riskier segment of the market (below AAA rating) partially priced the risk of rating shopping into yields. Cong and He (2019) show that blockchain in smart contracts can mitigate informational asymmetry and improve welfare through enhanced entry and competition, but that the irreducible distribution of information during consensus generation may encourage greater collusion. Similarly, we argue that blockchain is not a magic cure, and shrewd investors may require premium compensating for risks associated with potential collusion for blockchain with lower-quality governance.

Second, our research is related to how technology interweaves with social governance to enact market transactions. Economical sociology scholars contend that economic transactions are embedded in social interactions. Therefore, financial or economic actions are subtly influenced by social relationship among players. For example, Baker (1984) finds that interaction among traders at a major stock option exchange exhibited distinct social structural patterns that affected the direction and magnitude of option price volatility. The pattern was dramatically different from what conventional economic theories predicted. Our research therefore contributes to the economic sociology literature and provides a holistic explanation on the blockchain adoption process in the financial market.

Last, this paper contributes to the emerging literature on the consequences of fintech. It is a small yet fast growing literature that examines the dynamics and consequences of various fintech business models or technologies such as robo-advisory or cryptocurrency. Nonetheless, researchers have thus far primarily adopted modelling techniques or simulations. For example, Auer et al (2021) conduct an economic analysis of permissioned distributed ledge technology in a monetary economy. They observe that, while blockchain technology involves updating the ledger through a decentralised consensus on the unique truth, the robustness of the equilibrium that supports this consensus depends on who has access to the ledger and how it can be updated. Using a global game technique in an exchange economy with credit, they solve for the optimal design of a ledger that balances three objectives of decentralisation, security (a robust consensus) and scale (the efficient volume of transactions), and show that, depending on dynamic incentives, either decentralised or centralised designs can be optimal. However, few studies have empirically tested their hypotheses using a large-scale data from a financial sector. Our study confers valuable insights to fintech practitioners and related policy makers from an empirical angle.

The rest of the paper is organised as the following. Section 2 gives an overview of the ABS market in China and its blockchain adoption. Section 3 presents the main hypotheses. Section 4 explains data and empirical design. Section 5 provides the main empirical results, while section 6 concludes.

2. The ABS market and blockchain adoption in China

2.1 The ABS market

An asset-backed security (ABS) is a type of financial instrument that is created by pooling assets together – usually ones that generate a cash flow from debt, such as consumer loans, mortgage loans or accounts receivable – and issuing new securities that are structured into different tranches. ABS markets are well developed in countries such as the United States. Mortgage-backed securities (MBS), a major ABS product, have a total value of more than USD11 trillion and an average daily trading volume of USD300 billion in 2021.[2] In fact, the ABS market grew rapidly and was considered by many observers as one of the main drivers of the 2008 GFC. Despite the clever design of pooling many pieces of individual assets (eg mortgage or consumer loans) and converting

[2] These figures are from SIFMA and include both commercial and residential MBS.

them into several tranches with different levels of risk, ABS products such as MBS later suffered from several major problems such as bundling inferior assets, lack of proper diversification and, more prominently, inflated ratings from virtually all major rating agencies.

China planned to develop its own ABS market prior to the GFC with a few guideline policies and trials. However, the severity of the GFC delayed its introduction for a few years until 2014. With the rising consumer financing popularised by e-commerce and payment technologies (eg Alibaba and Alipay), China finally launched its ABS products with consumer loans or mortgage loans as the underlying assets. The entire market grew exponentially after 2015 from almost negligible to as much as the total issuance volume of CNY2.9 trillion in 2020.[3]

As in the United States, an ABS is issued in China with coordination and negotiation among several key parties. The asset owner (or the originator), such as a commercial bank that underwrites thousands of mortgage loans or an e-commerce platform that issues thousands of consumer loans, sets up a special purpose vehicle (SPV) as the issuer. The originator sells the assets to the SPV, who then works with an underwriter such as a securities firm to issue and sell the ABS to qualified investors.[4] Before an ABS product is launched, the issuer and the underwriter need to coordinate and negotiate with several other parties such as rating agencies for credit rating reports, auditing firms for audit reports and finally financial regulators for approval.

In our research setting, ABS products are issued under the regulation by several regulatory agencies, but mainly by two: CBRC[5] and CSRC. Those ABS products issued by banks are regulated by CBRC. CBRC has followed the international standards to regulate banks using on-site examinations, off-site reviews, prudential meetings[6] and other supervisory measures, with a view to pre-empting any financial risks. In contrast, CSRC, like other securities regulators, focuses on enhancing market efficiency and investor protection. Mandatory disclosure is a dominant technique of securities regulation, mainly to address information asymmetry and agency problems. Given the different regulatory principles, CBRC-regulated ABS products may be more standardised and transparent than the CSRC-regulated ones. This is especially the case for RMBS, because mortgages in China are predominantly plain vanilla with either equal amortisation or equal principal payment over time.

[3] Moody's Analytics (2021).

[4] Thus far, only institutional investors or qualified individuals have been allowed to purchase ABS products in China.

[5] In 2018, CBRC and China Insurance Regulatory Commission (CIRC) were merged into China Banking and Insurance Regulatory Commission (CBIRC).

[6] An annual off-site review of a bank by the supervisor is usually followed by a prudential meeting with the senior management of the bank to discuss prudential issues identified during the review.

2.2 Blockchain adoption

Blockchain, a type of distributed ledger technology, is a ledger or database that is shared and controlled by a group of nodes in the network. The emergence of Bitcoin increased the popularity of the technology by proving a use case to millions of users, either individuals or institutions. Despite the general distrust of cryptocurrency or Bitcoin, institutions such as central banks or major banks often consider the underlying blockchain technology as a solution to address several issues plaguing operations in the financial sector. Blockchain is commonly believed to have superiority due to its shared ownership, immutable data and traceability of data on the long chain of blocks.

One key difference between blockchain adopted by the Bitcoin community and that adopted by most business establishments is whether the block is permissionless or permissioned. From a governance perspective, a permissionless blockchain allows anyone (anonymous or not) with internet access to join the data approval and writing (ie consensus making) process. A classic example is Bitcoin in which millions of users from anywhere in the world in theory can join the mining and win a chance to write data into blocks. In contrast, a permissioned blockchain allows only qualified nodes to approve data editing or consensus making. In a typical financial transaction such as the issuance of an ABS, only parties such as the issuer, the rating agency, the auditing firm and the regulator have the rights to collectively approve data written and stored into blocks.

Blockchain technology can be beneficial to the ABS market for several reasons. First, blockchain is clearly a digital technology. Key information such as the underlying assets and their changes, audit reports, rating reports and other relevant information can be stored in a more structured format. Unlike paper-based disclosure which is often limited in terms of the scope of information provided (eg, only a summary of reports is provided), blockchain adoption allows relevant parties, especially buyers, to access a wide range of information.

Second, blockchain data often involve simultaneous approval by multiple parties. Writing data to a permissioned blockchain is often associated with signing with their own encrypted keys (or passwords). This simultaneity does not only fit into the typical procedure but also reduces room for errors or human manipulation. The entire approval process is recorded digitally with time stamps and becomes visible to relevant parties.

The most touted benefit of blockchain is the immutability and traceability of data (Moody's Investors Service (2019)). After all, digitalisation and simultaneous approval by multiple parties can be achieved without blockchain. The real beauty of blockchain technology lies in its long chain of blocks (or datasets) with one block connecting to the next with relational changes in a temporal manner. The distributed governance and this longitudinal storage significantly reduce the chances for any party to "backdate" old data, which is commonly found in many financial frauds.

Besides, buyers or other parties of an ABS product can easily track the entire history of the product such as the initial rating report and subsequent changes to the underlying assets. Therefore, blockchain technology can significantly boost the buyers' confidence in data fidelity and their ability to analyse historical data.

In our research setting, leading technology firms in China such as Alibaba, Baidu and Tencent all developed their own blockchain platforms and actively promoted their platforms among firms and relevant organisations. Financial operations such as settlement or securitisation are major markets for those blockchain platforms. For example, Figure 1 shows that one major auto maker, Chang An Xin Sheng (长安新生 in Chinese), as the originator launched an ABS product that bundled thousands of its auto loans on a blockchain platform developed by Baidu in 2017. With encouragement from regulators, more blockchain-based ABS deals have been launched since then.

3. Hypotheses

Before we introduce the empirical approach, this section explains how we develop three main hypotheses on the impact of blockchain adoption on the cost of issuing ABS in China. In particular, these hypotheses are developed in the context of efficiency gains and digital governance on blockchain ABS.

The use of blockchain is perceived to increase efficiency in multiple phases of the securitisation process, such as the servicing, financing and structuring (ie tranching) phases. For example, in the securitisation process, a smart contract can automate a cash flow waterfall, reducing operational and third-party costs and improving asset transparency and settlement certainty. However, the implementation of blockchain technology in securitisation has been partial. For example, underlying loans in most cases are originated in traditional, non-digital ways, and the loans need to be digitised or tokenised to become part of the blockchain.

As a digital governance structure, blockchain can serve as a novel coordination and governance mechanism among a set of related stakeholders. In financial transactions, such stakeholders are often buyers, sellers, brokers, settlement agencies, legal parties and regulators. In a conventional setting, the key governance responsibilities often rest on the regulators and impartial agents such as accounting firms. For example, equity issuance will place the securities regulator as the key monitoring party which oversees compliance and communicates with sellers and their representatives such as corporate lawyers.

By contrast, private blockchain increases dependence on central administration as a kind of gatekeeper (Moody's Investors Service (2019)). A single administrator or a consortium controls the blockchain system, vets on participating parties and their rights, and makes decisions on information validation and recording on the chain. Absent good governance, information misrepresentation on blockchain or collusive agreement on a subchain is possible. Such risk is even higher when members of the administrative consortium have had repeated interactions (say, in previous ABS deals).

When blockchain is introduced to an ABS transaction, we expect that part of the governance responsibilities will shift to the platform for a few reasons. First, when blockchain is used, data disclosure will be made on a nearly real time basis and subject to several intermediaries' approval. This speedy processing will allow the parties to improve efficiency of transactions, which is arguably the largest benefit of introducing blockchain. In equity trading, the introduction of an electronic communication network (ECN), particularly after introducing tighter information disclosure policies, significantly improved liquidity and reduced transaction cost (Huang (2002)). In corporate bond trading, a similar effect was found after the adoption of electronic display of trade information among all market participants in recent years (O'Hara and Zhou (2021)). Timely disclosure is also found to reduce trading costs in the municipal bond market in the United States (Chalmers et al (2021)).

Second, when blockchain is used, the monitoring role of regulators can be partially lifted or shouldered by the platform. When key information such as sellers' submission documents, past records and updates become visible to all key stakeholders on the blockchain platform, the single party governance de facto becomes a multi-party governance. That is, any party has the right to analyse the data and detect anomalies. This effect is also consistent with the existing studies which show that multiple sources of monitoring such as analyst coverage add a new layer of monitoring mechanism such that firms with more analyst coverage often produce higher-quality financial reports (Irani and Oesch (2013)). Given the ample evidence that rating agencies become reliant on their corporate clients for revenue and soften their ratings accordingly (Daines et al (2010), Kedia et al (2014), Dimitrov et al (2015)), such alliance-based governance will play a key role in monitoring information disclosure and providing accurate estimates.

Given the blockchain's benefit of improving transparency and monitoring and enhancing efficiency, we aim to test the following first hypothesis:

Hypothesis 1: *Market participants understand the benefits of blockchain, so that yield spreads at issuance are lower for blockchain-based ABS deals than for those not based on blockchain, holding other things equal.*

The effect of blockchain adoption also depends on the characteristics of underlying assets that formulate an ABS deal. In other words, the value of blockchain adoption can be heterogeneous across different asset classes. If the information asymmetry story from the ABS and other finance literatures holds, we expect to see a higher value added from blockchain adoption to those deals whose underlying assets are less standardised or less transparent.

As stated earlier, the ABS market, or broadly speaking the financial market, is rife with information asymmetry issues. For example, Piskorski et al (2015) find that some originators and underwriters did not disclose second liens for mortgage loans, so that investors were provided biased information regarding residential MBS (RMBS) deals. Quite a few finance studies also find that originators are more inclined to bundle low-quality assets than high-quality ones in the MBS market (eg, Downing et al (2009), Jiang et al (2014)).

The adoption of technology, however, could mitigate the information asymmetry problem. For example, O'Hara and Zhou (2021) find that electronic request for quotes affects bond dealers' trading such that it can reduce transaction cost compared to voice trading. A few studies on the adoption of electronic trading for securities markets also corroborate the finding that better information disclosure, particularly with the help of internet or IT technology, not only improves efficiency of human actions but more importantly mitigates information asymmetry and agency problems (Huang (2002), Venkataraman (2001)).

In China's ABS market, different types of asset exhibit different levels of room for data manipulation or reconciliation. For example, MBS in China is often regarded as being subject to tight control and scrutiny under CBRC regulation. Investors in China typically understand mortgage loans well because they are mainly plain vanilla, have standard terms and comparable parameters and are important for the overall economy. In contrast, other types of asset are quite novel and opaque to investors. With the rapid rise of e-commerce and mobile payments in China, millions of individual users not only purchase items quickly from e-commerce portals but also have easy access to consumer credit issued by e-commerce platforms such as Alibaba or JD. Although these consumer loans are typically small in amount, credit history of the borrowers is often missing or hard to evaluate. An ABS deal with consumer loans as the underlying assets, therefore, is more difficult to understand and analyse. Such opacity of information may lead to amplified concerns over information asymmetry between the originators and the buyers. Similarly, corporate bonds or other forms of debt are often shrouded in a web of corporate structure and inter-firm obligation networks. Often the parameters in ABS deals based on corporate debt are neither standardised nor easy to interpret, even with a large bundle.

Given that the demand for information disclosure and accuracy varies across different types of asset, blockchain can significantly boost the readability and consistency of certain assets such as consumer loans and mitigate the degree of information asymmetry. These assets therefore will benefit more from the adoption of blockchain technology, which motivates us to test the following second hypothesis:

Hypothesis 2: *Other things being equal, market participants value the benefits of adopting blockchain technology more for certain types of asset. In particular, blockchain-based ABS products whose underlying assets are consumer loans or accounts receivable enjoy lower yield spreads than those products whose underlying assets are mortgage loans or auto loans.*

Economic sociologists find that economic actions are often embedded in specific social structures, institutional arrangements and even interpersonal interactions (Granovetter (1985)). Their studies add another layer of explanation to the behaviour of financial market participants. For example, researchers have documented how traders exhibit special pricing behaviour when they form groups on trading floors (Baker (1984)). In addition, the interaction between regulators and financial firms can lead to a unique regulatory outcome even when different countries faced similar financial innovations designed to evade regulations around the same time (Thiemann and Lepoutre (2017)).

One social mechanism that we examine in this paper is the interaction among firms or players. Sociologists often term it "embeddedness" or familiarity among players. Embeddedness plays a significant role in many seemingly well-established financial or economic decisions (Hochberg et al (2010)). Besides the aforementioned studies, researchers also find that commercial banks often make lending decisions partly based upon their embeddedness with the borrowers (Uzzi (1999), Uzzi and Lancaster (2003)). Simply put, borrowers familiar to lenders via frequent prior interactions often obtain more favourable loan rates, even after controlling for all seemingly rational factors such as borrowers' credit scores and financial performance.

Embeddedness or familiarity among players may have negative impacts on asset prices. In a typical financial transaction, familiarity among key parties could signal potential collusion or even breed a scandal. For example, the well-planned benefits of distributed ledger or governance are premised on the assumption that different parties will work independently without considering the feedback from other parties. However, if the parties have had social interactions or become familiar with each other, such familiarity could lower the possibility of independent monitoring or reporting. As such, the adoption of blockchain technology can strengthen independence among players because the technology enables simultaneous approvals and significantly reduces human interaction and thus decreases room for possible collusion or a scandal arising from familiarity among players.

We conjecture that the benefit of blockchain adoption will be more prominent for ABS deals with familiar parties, which leads us to the following third hypothesis:

Hypothesis 3: *Market participants value the benefits of blockchain adoption in ABS deals with familiar parties more than those in ABS deals with unfamiliar parties, all other things being equal.*

4. Data and empirical design

4.1 Data

The first Blockchain ABS deal made a debut in China in 2017. Our sample of ABS deals is downloaded from WIND, and includes deals issued between 2015 and mid-2020.

There are over 20 types of ABS in China in terms of the category of the underlying assets, and the following six types have seen blockchain ABS deals: RMBS, commercial MBS, auto loan ABS, consumer loan ABS, supply chain finance ABS and account receivable ABS. In terms of the amount outstanding, these six types account for over 70% of all ABS products in China.

In our empirical analysis, we consider only the following four types of ABS product where blockchain technology has been used for a fair comparison of the effect of blockchain adoption: RMBS, auto loan ABS, consumer loan ABS and account receivable ABS. In total, we gathered approximately 5,000 ABS deals with more than 14,000 tranches. The total market value of those ABS deals exceeds CNY8 trillion. Blockchain-based ABS products account for around 5% of all ABS products in terms of the number of deals, spreading across several underlying asset classes such as mortgage loans and consumer loans.

We consider the following dependent and key explanatory variables in our empirical analyses.

Yield spread. Our key dependent or outcome variable is the yield spread, expressed as the difference between the coupon rate of one ABS tranche and a benchmark rate, which is the Chinese government bond yield with a similar duration. This measure is compatible with the ABS literature and the market practice (He et al (2012)). The smaller the difference, the better the ABS pricing. Since the differences vary drastically across ABS deals, we take a natural log of such percentage difference to minimise the impact of skewed distribution. In fact, our key findings remain roughly unchanged when we use the percentage difference instead.

Blockchain. We construct a dummy variable which takes value 1 when an ABS is issued based on blockchain technology, and zero otherwise. We gather qualitative evidence from various sources to determine whether a focal ABS is blockchain-based or not. We first comb the data downloaded from WIND to identify names of the originators and underwriters. We then search keywords such as blockchain and ABS in search engines such as Baidu and Google. Once we have related news, we then search various sources such as corporate websites, annual reports, white papers and other sources to further validate whether the focal ABS deal is blockchain-based or not. We also contacted a few informants who held key executive or technology positions at leading technology firms such as PingAn or Tencent to help us verify the data accuracy. We also conducted a robustness test with only those deals that survived our additional verification process. The main results remain roughly the same as the ones reported.[7] Nonetheless, we caution the readers of the possibility of further changes in our sample data.

Prior shared experience (PSE). We measure PSE using a relational dyadic network approach. In particular, we consider all possible dyads consisting of

[7] For example, we replicate the same analyses as shown in Table 3 and 4 by excluding those unverified deals and obtain similar results. The results are provided in the appendix as Tables A1 and A2.

two parties among N parties in an ABS deal (eg, issuer, auditor, rating agency, etc), count the number of prior joint transactions for each dyad and calculate the average number of transactions across all dyads, which is the PSE score (Zheng et al (2016)). Figure 2 provides a visual representation of how we calculate the PSE score. As an example, if an ABS deal involves five parties, we have 10 possible dyads or links. If issuer I and auditor J have jointly worked on three transactions before, we code T_{ij} as 3. If auditor J and rating agency K have jointly worked on two transactions before, we code T_{jk} as 2. We sum up all T's across all 10 dyads in the entire group, which is 5. Then, the PSE score is 5/10 = 0.5.

Asset class dummies. We create a few representative asset class dummies to capture the heterogeneous effect of blockchain adoption. Each dummy indicates whether the underlying asset belongs to one specific type of the following four: residential mortgage, auto loan, consumer loan or account receivable. While the first two are subject to CBRC regulation, the last two to CSRC regulation.

We also consider the following six control variables in the regressions.

Rating score. We calculate the average credit rating of an ABS tranche. In particular, we convert a letter scale into a numerical scale by setting AAA = 1, AA+ = 1.67, AA = 2, AA– = 2.33 and so on, following He et al (2012).

Tranche principal. We calculate the principal amount of each ABS tranche either at issuance or as the remaining principal amount on a later date. We log it to reduce the impact of skewed distribution.

Number of tranches. This variable records the number of tranches in each ABS deal.

Average life. This variable measures the remaining time (in years) to maturity for each tranche.

Fixed interest. This dummy variable takes value 1 if an ABS deal makes a fixed interest payment, and zero otherwise.

CSRC as regulator. This dummy variable takes value 1 if an ABS deal is subject to CSRC regulation, and zero if it is subject to CBRC regulation. This dummy variable is closely related to the four asset class dummy variables because residential mortgages and auto loans are subject to CBRC regulation, while consumer loans and accounts receivable to CSRC regulation.

Table 1 provides descriptive statistics of the aforementioned variables from one sample used in our estimation.[8] Even after logged, the yield spread of ABS deals exhibits relatively large dispersion. As expected, the yield spread is positively correlated with the rating score, which implies that higher-rated ABS deals enjoy lower issuance costs. A majority of deals are under CSRC regulation. The share of blockchain-based deals in this sample is 10%, higher than that in raw data primarily because coarsened exact matching drops many

[8] The sample used in Table 1 is from coarsened exact matching and primary trading, both of which are explained in section 4.2.

irrelevant observations in the control group, that is, many non-blockchain-based deals.

4.2 Regression specifications

In order to test the three hypotheses explained in section 3, we use the following three specifications for empirical analysis:

$$log(Yield\ spread) = \beta_0 + \beta_1 blockchain + \gamma X + \alpha_{year} + \varepsilon;$$

$$\log\ (Yield\ spread) = \beta_0 + \beta_1 blockchain + \beta_2 blockchain \times asset\ class\ + \gamma X + \alpha_{year} + \varepsilon; \text{ and}$$

$$log(Yield\ spread) = \beta_0 + \beta_1 blockchain + \beta_3 blockchain \times PSE\ + \gamma X + \alpha_{year} + \varepsilon.$$

The key estimator is β_1, while β_2 and β_3 are the key interaction estimators to assess how blockchain adoption interacts with asset class or *PSE*. X is a vector of variables, including the six control variables (Rating score, Tranche principal, Number of tranches, Average life, Fixed interest, and CSRC as regulator), *PSE* and the four asset class dummies (Residential mortgage, Auto loan, Consumer loan and Account receivable). α_{year} captures year-fixed effects. We expect β_1 to be negative, which indicates a positive effect of blockchain adoption on ABS pricing.

Our estimation may be subject to an endogeneity problem because the selection of certain ABS deals into blockchain might be correlated with the outcome variable, yield spread. For example, issuers may engage in more active promotion of their blockchain-based deals toward potential buyers. Issuers may also adopt other practices to make their new products more attractive to buyers such as a smaller pool with higher-quality loans.[9] If this is the case, we may overestimate the positive effect of blockchain adoption.

To address this endogeneity, we adopt a coarsened exact matching (CEM) approach to filter our sample observations. CEM is a matching method to deal with endogeneity commonly observed in archive-based studies. It provides researchers with more accurate estimates and simpler implementation than many other matching methods such as propensity score matching (Iacus et al (2019)). CEM essentially matches each treatment observation (ie a blockchain ABS deal) with one or more comparable control observations (ie a non-blockchain ABS deal) on several key visible dimensions such as the total amount of principal, the amount of underlying assets and the date of issuance. CEM therefore drops those observations that are less valuable and keep only those key observations to accomplish a stronger inference.

In ABS trading, we also separately consider trading in the primary market and that in the secondary market. Like IPO in stock markets, an ABS deal is

[9] Interestingly, blockchain reduces the possibility that issuers bundle "inferior assets" because blockchain makes information disclosure more detailed, longitudinal and immutable.

often traded more actively at issuance or in primary trading. If buyers are influenced by the promotion or "halo effect" of blockchain adoption, they may regress to the mean and behave differently later or in secondary trading.

5. Estimation results

We first test Hypothesis 1 and estimate the baseline effect of blockchain adoption with primary trading data but without CEM. Table 2 shows the estimation results, which are largely compatible with both conventional wisdom and our prediction. In particular, columns 1 and 2 show that the coefficients on most control variables have the expected sign: the larger the principal amount of a tranche, the lower the yield spread; the higher the number of tranches, the higher the yield spread; and the longer the remaining maturity, the higher the spread. In addition, the control variable, "CSRC as the regulator", in column 2 exhibits a negative impact on ABS pricing (ie, increase the yield spread), which is compatible with the view that CSRC often regulates more opaque and riskier assets. A further examination corroborates this conjecture. Column 3 shows that residential mortgages and auto loans, two types of asset under CBRC regulation, exhibit better ABS pricing (ie lower yield spread) than the other two types of asset regulated by CSRC. Finally, the coefficient on PSE is positive, but only marginally statistically significant (column 4).

Blockchain adoption exhibits an overall positive and significant effect on ABS pricing (Table 2, column 5). The magnitude of this effect is non-trivial. On average, blockchain adoption boosts ABS pricing (ie lowers the yield spread) in primary trading by 0.18% or around 39 bps, compared to non-blockchain ABS. Extreme or dubious cases may bias our estimates. For example, we have one underwriter, "Debang Securities" (德邦证券 in Chinese), which underwrote a large number of ABS deals. The blockchain adoption effect, however, remains robust to the exclusion of the largest originator (column 6) or underwriter (column 7) from the sample.

We further examine the baseline blockchain adoption effect by addressing endogeneity concerns. Table 3 replicates the estimation in Table 2 by using a CEM method. As we discussed earlier, CEM can improve inference by dropping irrelevant observations and thus using a more comparable and focused sample. Indeed, we obtain a smaller effect of blockchain adoption of 0.12% but it is still economically and statistically significant. Other variables exhibit similar patterns as in Table 2. When we instead consider PSE (column 4), the coefficient on PSE is now negative but statistically insignificant.

We also examine whether the blockchain adoption effect persists in secondary trading. Table 4 shows that, only with a negligible decrease (from 0.12% to 0.11%), blockchain adoption appears to be beneficial even in secondary trading. Together, our conservative estimate is that adopting blockchain overall boosts ABS pricing by approximately 0.1% or 25bps, lending strong support to our first hypothesis. Finally, when we consider secondary trading, the coefficient on PSE is negative and statistically significant (columns 4 to 7), but the magnitude of the coefficient is very small.

Using the secondary market data and the CEM sample, we test how the blockchain adoption effects vary across different assets or familiarity among key parties (Hypothesis 2 and Hypothesis 3, respectively). The results reported in Table 5 are both assuring and surprising. The coefficient on the interaction term between blockchain adoption and residential mortgages is negative and significant (−0.12, column 4), suggesting a positive interaction effect between blockchain adoption and RMBS under CBRC regulation. However, blockchain appears to be less valuable to those deals with auto loans as the underlying assets (0.07, column 4) under the same CBRC regulation, although the coefficient is not statistically significant. The insignificant estimates may be explained by the relatively smaller asset size and shorter life span of auto loans than those of residential mortgages. Another possible explanation is that auto loans are originated not only by banks but also by auto finance companies or other third-party financial institutions.[10] Under CSRC regulation, blockchain adoption seem to be valuable for both types of asset: consumer loan and account receivable (−0.24 and −0.16, respectively, column 5). In terms of the magnitude of the effect, blockchain adoption enhances ABS pricing more for CSRC regulated deals than for CBRC regulated deals.

Finally, in Table 5 we find that PSE, the variable indicative of familiarity among key parties, exhibits the opposite interaction effects with blockchain adoption under the two different regulators. As in Hypothesis 3, the coefficient on the interaction term of PSE and blockchain is negative and significant (−0.004, column 6), indicating a positive interaction between PSE and blockchain adoption for those deals under CBRC regulation which are easier to understand and analyse. In contrast, the coefficient on the interaction term becomes positive and significant (0.004, column 7) for those deals under CSRC regulation. This contrasts with Hypothesis 3 that blockchain adoption will reduce potential frauds arising from familiar parties. There are several possible explanations. For example, market participants may not totally trust the structure of the blockchain platform, especially regarding who exactly authorise data writing and falsification in a permissioned blockchain. In other words, opaqueness in blockchain itself could be compounded with opaqueness of assets. Relatedly, market participants may perceive the use of blockchain as a smoke gun or gimmick played by familiar parties instead of an independent governance mechanism. A further examination is required to elaborate how exactly market participants view the social relationship among key parties and adoption of a novel technology.

[10] As of 2019, most other third-party auto finance institutions were not regulated by the CBIRC. As a result, they were not subject to auto loan-related regulatory guidelines and thus had a more liberal product strategy, more creative origination and underwriting practices, and greater flexibility in choosing customers. For details, see S&P Global (2019).

6. Conclusions

Blockchain technology has dominated headline news in the past decade. Numerous businesses started their own blockchain projects or collaborated with other parties on blockchain development and adoption. In some rosy reports or news, blockchain technology is portrayed as a panacea for numerous business issues such as lack of efficiency or abundant frauds. Despite the hype toward blockchain, academic research is still at an early, conceptualisation stage or at a case study stage. Questions such as whether blockchain is indeed beneficial and how exactly blockchain is beneficial in real business operations remain largely unanswered.

Our study is a timely response to such a call in that we empirically examine whether the adoption of blockchain technology is valuable in a trillion-dollar market, China's emerging ABS market. We borrow insights from finance and economic sociology literatures and carefully develop hypotheses regarding the effect of blockchain adoption on ABS pricing.

Our study finds that overall blockchain adoption improves ABS pricing significantly. This effect is robust to several model specifications. Moreover, the blockchain effect is heterogeneous across different institutional arrangements and asset classes. It becomes more valuable under CSRC regulation for those opaque assets. Interestingly, social embeddedness or familiarity among key parties involved with an ABS deal plays a subtle role: when combined with blockchain adoption, such familiarity becomes more beneficial to less opaque ABS deals which are subject to CBRC regulation but more costly to more opaque deals under CSRC regulation. This dual effect of social embeddedness and exactly how key parties negotiate and coordinate on issuing and pricing blockchain-based ABS are worth further exploration.

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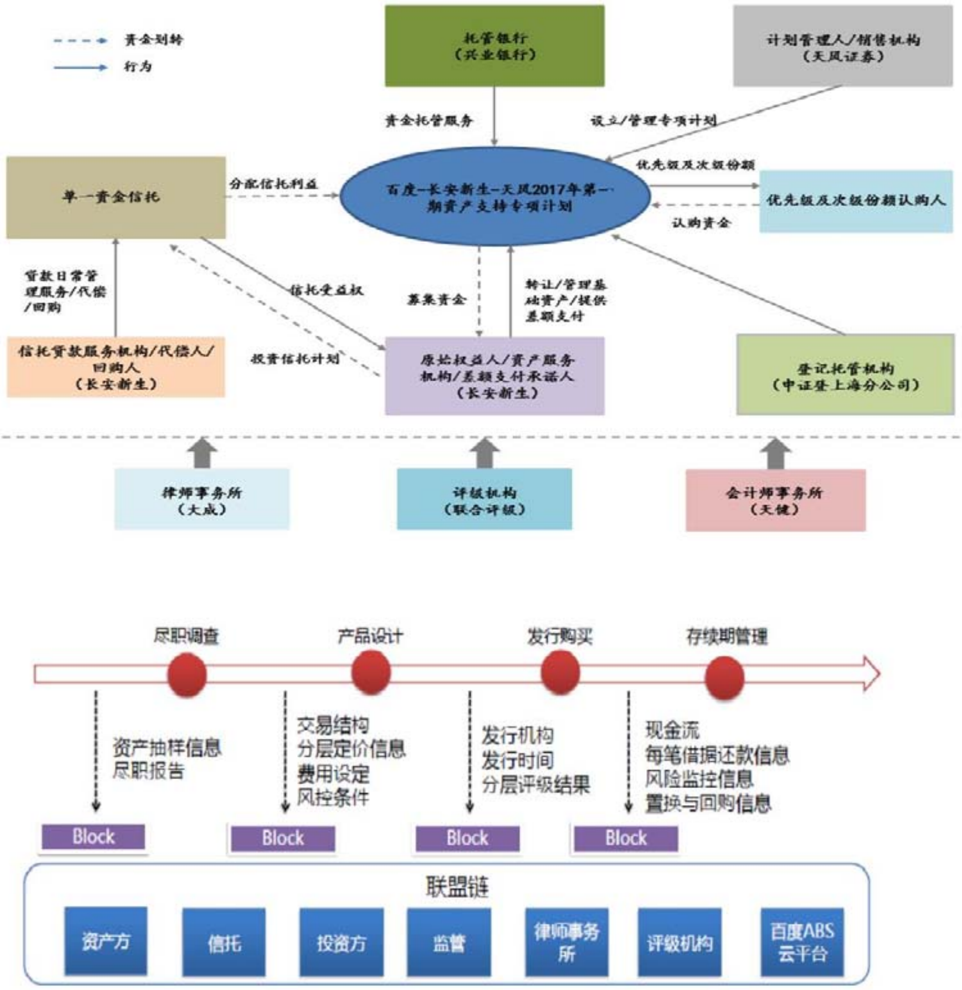
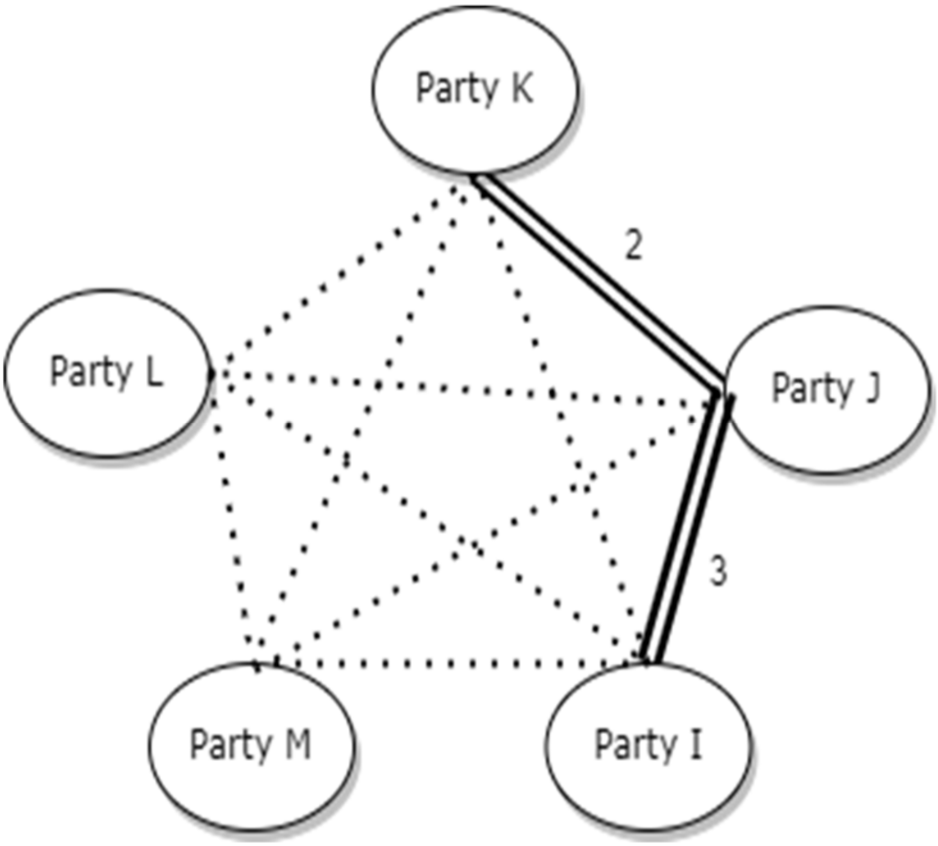
Figure 1: An illustrative example of a blockchain-based ABS



Source: PKU Case, “区块链在百度 ABS 业务中的应用”, 2021.

Figure 2: An illustrative example of PSE measurement



Notes: Assuming that an ABS deal involves five parties (ie *I*, *J*, *K*, *L* and *M*), we have 10 dyads or links. In this example the dyad ***I-J*** has three prior transactions, the dyad ***J-K*** two prior transactions and the other dyads zero prior transactions. Then, the PSE score, a measure of familiarity for this group of parties, is (3+2)/10=0.5.

Table 1: Descriptive statistics

Variables	Mean	S.D.	Min	Max												
Yield Spread (primary)	0.76	0.57	-3.51	2.54												
Rating Score	1.75	2.46	1	12.33	0.05											
Amount of Principal	4.68	1.43	0	8.53	-0.44	-0.07										
Number of Tranches	4.92	4.02	1	31	0.19	-0.02	-0.43									
Average Life	2.08	2.52	0.01	28.35	-0.01	-0.03	0.07	0.15								
Fixed Interest	0.83	0.38	0	1	0.20	0.10	-0.27	-0.01	0.16							
Blockchain	0.10	0.30	0	1	-0.20	0.07	0.17	-0.16	0.12	-0.01						
Residential Mortgage	0.06	0.24	0	1	-0.33	-0.04	0.37	-0.09	-0.15	-0.46	0.10					
Auto Loan	0.05	0.21	0	1	-0.23	-0.06	0.19	-0.09	-0.08	-0.06	0.05	-0.06				
Consumer Loan	0.06	0.24	0	1	-0.03	0.01	0.06	-0.12	-0.04	0.12	-0.04	-0.07	-0.06			
Account Receivable	0.22	0.42	0	1	0.03	0.04	0.03	-0.22	0.40	0.20	0.18	-0.14	-0.12	-0.14		
CSRC as Regulator	0.71	0.45	0	1	0.38	-0.04	-0.40	0.24	0.31	0.36	-0.01	-0.40	-0.35	0.17	0.21	
Prior Shared Experience	0.88	1.79	0	15.1	0.03	0	0	0	-0.01	-0.03	-0.02	0.03	-0.01	-0.02	-0.05	-0.08

Notes: this table is based on the CEM sample, primary trading only.

Table 2: Estimation of the blockchain adoption effect with primary trading and without CEM

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	Primary: controls only	Primary: add CSRC	Primary: add assets	Primary: add pse	Primary: add blockchain	Remove Largest Originator	Remove Largest Underwriter
Rating Score	0.01+	0.00	0.01+	0.01+	0.01*	0.01*	0.01+
	(1.65)	(1.03)	(1.76)	(1.65)	(2.12)	(2.20)	(1.79)
Tranche Principal	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**	-0.01**
	(-20.37)	(-14.26)	(-16.21)	(-20.38)	(-12.54)	(-11.62)	(-11.98)
Number of Tranches	0.01**	0.01**	0.01**	0.01**	0.00**	0.00**	0.01**
	(8.89)	(5.39)	(7.05)	(8.91)	(2.71)	(3.09)	(4.34)
Average Life	0.02**	0.01*	0.02**	0.02**	0.01*	0.01*	0.01**
	(6.14)	(2.52)	(5.79)	(6.17)	(2.53)	(2.39)	(3.81)
Fixed Interest	0.19**	0.01	0.05**	0.19**	-0.02	-0.02	-0.00
	(10.19)	(0.72)	(2.68)	(10.32)	(-1.09)	(-1.26)	(-0.12)
CSRC as Regulator		0.50**			0.41**	0.41**	0.36**
		(26.84)			(19.76)	(19.63)	(15.88)
Residential Mortgage			-0.59**		-0.34**	-0.35**	-0.37**
			(-19.91)		(-11.33)	(-11.41)	(-10.03)
Auto Loan			-0.53**		-0.25**	-0.25**	-0.24**
			(-18.33)		(-8.23)	(-8.18)	(-5.96)
Consumer Loan			-0.12**		-0.22**	0.23**	-0.18**
			(-7.16)		(-12.28)	(3.45)	(-10.07)
Account Receivable			0.00		-0.06**	-0.06**	-0.05**
			(0.06)		(-3.36)	(-3.71)	(-2.99)
Prior Shared Experience				0.00+	0.00**	0.00**	0.00**
				(1.87)	(3.17)	(2.78)	(3.48)
Blockchain					-0.18**	-0.19**	-0.16**
					(-7.34)	(-7.54)	(-5.63)
Observations	7028	7028	7028	7028	7028	6596	6095
R-squared	0.25	0.33	0.32	0.25	0.36	0.36	0.33

Notes: +, * and ** mean statistical significance at the 10%, 5% and 1% levels, respectively.

Table 3: Estimation of the blockchain adoption effect with primary trading and CEM

VARIABLES	(1) Primary: controls only	(2) Primary: add CSRC	(3) Primary: add assets	(4) Primary: add pse	(5) Primary: add blockchain	(6) Remove Largest Originator	(7) Remove Largest Underwriter
Rating Score	-0.01	-0.01*	-0.01	-0.01	-0.01	-0.01+	-0.01+
	(-1.28)	(-2.24)	(-1.53)	(-1.29)	(-1.63)	(-1.69)	(-1.84)
Tranche Principal	-0.03**	-0.02**	-0.02**	-0.03**	-0.01**	-0.01**	-0.02**
	(-17.46)	(-14.73)	(-10.70)	(-17.44)	(-9.54)	(-8.12)	(-10.71)
Number of Tranches	0.02**	0.02**	0.03**	0.02**	0.02**	0.02**	0.02*
	(4.04)	(3.93)	(5.53)	(4.04)	(2.81)	(2.91)	(2.33)
Average Life	0.05**	0.03**	0.05**	0.05**	0.04**	0.04**	0.04**
	(6.21)	(4.14)	(5.80)	(6.15)	(4.77)	(4.65)	(5.38)
Fixed Interest	0.28**	0.04	0.05	0.28**	-0.05	-0.05	-0.05
	(8.13)	(1.30)	(1.45)	(8.08)	(-1.46)	(-1.56)	(-1.54)
CSRC as Regulator		0.50**			0.39**	0.40**	0.37**
		(19.20)			(12.67)	(12.75)	(10.84)
Residential Mortgage			-0.86**		-0.58**	-0.61**	-0.57**
			(-16.49)		(-10.70)	(-10.78)	(-9.06)
Auto Loan			-0.60**		-0.29**	-0.30**	-0.27**
			(-14.12)		(-6.19)	(-6.24)	(-4.55)
Consumer Loan			-0.22**		-0.31**	-0.04	-0.30**
			(-10.42)		(-13.82)	(-1.21)	(-13.28)
Account Receivable			0.03		-0.05+	-0.05*	-0.04+
			(1.18)		(-1.87)	(-2.08)	(-1.74)
Prior Shared Experience				-0.004	-0.003	-0.003	0.003
				(-1.36)	(-0.28)	(-0.48)	(0.09)
Blockchain					-0.12**	-0.14**	-0.11**
					(-4.74)	(-5.01)	(-3.77)
Observations	3232	3232	3232	3232	3232	2998	2753
R-squared	0.30	0.37	0.38	0.30	0.41	0.40	0.38

Notes: +, * and ** mean statistical significance at the 10%, 5% and 1% levels, respectively.

Table 4: Estimation of the blockchain adoption effect with secondary trading and CEM

VARIABLES	(1) Primary: controls only	(2) Primary: add CSRC	(3) Primary: add assets	(4) Primary: add pse	(5) Primary: add blockchain	(6) Remove Largest Originator	(7) Remove Largest Underwriter
Rating Score	0.02**	0.01**	0.02**	0.02**	0.01**	0.01**	0.02**
	(13.38)	(6.09)	(8.78)	(13.27)	(7.80)	(8.03)	(7.41)
Tranche Principal	-0.02**	-0.02**	-0.01**	-0.02**	-0.01**	-0.01**	-0.01**
	(-69.67)	(-54.05)	(-42.74)	(-69.64)	(-38.59)	(-31.67)	(-39.29)
Number of Tranches	0.04**	0.02**	0.03**	0.04**	0.01**	0.01**	0.01**
	(35.22)	(16.93)	(29.76)	(35.44)	(10.42)	(12.05)	(6.51)
Average Life	0.06**	0.04**	0.06**	0.06**	0.04**	0.04**	0.05**
	(30.70)	(21.56)	(28.16)	(30.64)	(22.43)	(21.04)	(21.76)
Fixed Interest	0.32**	0.02**	0.09**	0.32**	-0.03**	-0.03**	-0.02**
	(55.06)	(4.16)	(15.85)	(55.08)	(-5.19)	(-5.56)	(-3.62)
CSRC as Regulator		0.61**			0.51**	0.51**	0.50**
		(114.61)			(79.44)	(79.07)	(67.76)
Residential Mortgage			-0.76**		-0.42**	-0.45**	-0.39**
			(-77.80)		(-42.43)	(-43.81)	(-30.66)
Auto Loan			-0.54**		-0.15**	-0.16**	-0.12**
			(-73.22)		(-18.83)	(-19.39)	(-11.15)
Consumer Loan			-0.14**		-0.25**	-0.02	-0.24**
			(-23.72)		(-42.11)	(-1.45)	(-39.07)
Account Receivable			0.07**		-0.02**	-0.03**	-0.02**
			(12.79)		(-4.69)	(-5.52)	(-2.99)
Prior Shared Experience				-0.00**	-0.00**	-0.00**	-0.00**
				(-13.06)	(-8.67)	(-10.40)	(-7.68)
Blockchain					-0.11**	-0.11**	-0.09**
					(-18.36)	(-18.19)	(-12.97)
Observations	53920	53920	53920	53920	53920	50662	46587
R-squared	0.33	0.48	0.46	0.33	0.52	0.52	0.46

Notes: +, * and ** mean statistical significance at the 10%, 5% and 1% levels, respectively.

Table 5: Estimation of the interaction effects with secondary trading and CEM

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	add blockchain	under CBRC	Under CSRC	CBRC asset interaction	CSRC asset interaction	CBRC pse interaction	CSRC pse interaction
Rating Score	0.01**	0.06**	0.01**	0.06**	0.01**	0.06**	0.01**
	(7.80)	(4.04)	(6.38)	(3.85)	(6.91)	(4.00)	(6.46)
Tranche Principal	-0.01**	-0.01**	-0.02**	-0.01**	-0.02**	-0.01**	-0.02**
	(-38.59)	(-18.30)	(-46.31)	(-18.26)	(-46.28)	(-18.30)	(-46.29)
Number of Tranches	0.01**	-0.01+	0.01**	-0.01	0.01**	-0.01+	0.01**
	(10.42)	(-1.84)	(6.46)	(-1.49)	(5.20)	(-1.65)	(6.21)
Average Life	0.04**	0.05**	0.04**	0.05**	0.04**	0.05**	0.04**
	(22.43)	(23.39)	(15.91)	(22.70)	(15.12)	(23.43)	(15.90)
Fixed Interest	-0.03**	0.02**	-0.06**	0.02**	-0.06**	0.02**	-0.06**
	(-5.19)	(3.24)	(-8.86)	(3.28)	(-8.51)	(3.34)	(-9.06)
Residential Mortgage	-0.42**	-0.43**		-0.44**		-0.43**	
	(-42.43)	(-40.27)		(-40.14)		(-40.30)	
Auto Loan	-0.15**	-0.14**		-0.14**		-0.15**	
	(-18.83)	(-17.41)		(-16.74)		(-17.52)	
Consumer Loan	-0.25**		-0.22**		-0.21**		-0.22**
	(-42.11)		(-36.65)		(-34.33)		(-36.67)
Account Receivable	-0.02**		-0.02**		-0.00		-0.02**
	(-4.69)		(-3.76)		(-0.18)		(-3.80)
Prior Shared Experience (PSE)	-0.00**	-0.00	-0.00**	-0.00	-0.00**	0.00	-0.00**
	(-8.67)	(-1.05)	(-7.12)	(-1.05)	(-7.34)	(0.46)	(-9.54)
Blockchain	-0.11**	-0.06**	-0.11**	-0.16**	-0.02**	-0.04**	-0.13**
	(-18.36)	(-4.98)	(-16.60)	(-4.04)	(-2.94)	(-3.05)	(-17.72)
Residential Mortgage X Blockchain				-0.12**			
				(3.35)			
Auto Loan X Blockchain				0.07			
				(1.58)			
Consumer Loan X Blockchain					-0.24**		
					(-12.30)		
Account Receivable X Blockchain					-0.16**		
					(-11.97)		
PSE X Blockchain						-0.004**	0.004**
						(-3.65)	(9.70)
Observations	53920	11195	42725	11195	42725	11195	42725
R-squared	0.52	0.43	0.22	0.43	0.22	0.43	0.22

Notes: +, * and ** mean statistical significance at the 10%, 5% and 1% levels, respectively.

Appendix

Table A1: Estimation of the blockchain adoption effect with primary trading and CEM (additionally verified blockchain ABS deals only)

VARIABLES	(1) Primary: controls only	(2) Primary: add CSRC	(3) Primary: add assets	(4) Primary: add pse	(5) Primary: add blockchain	(6) Remove Largest Originator	(7) Remove Largest Underwriter
Rating Score	-0.01	-0.01*	-0.01+	-0.01	-0.01+	-0.01+	-0.01*
	(-1.41)	(-2.40)	(-1.71)	(-1.41)	(-1.84)	(-1.84)	(-2.03)
Tranche Principal	-0.26**	-0.21**	-0.17**	-0.26**	-0.16**	-0.16**	-0.17**
	(-18.80)	(-16.78)	(-13.23)	(-18.78)	(-12.13)	(-10.55)	(-12.18)
Number of Tranches	0.01	0.01	0.02**	0.01	0.01	0.01	0.00
	(0.89)	(1.19)	(3.48)	(0.89)	(0.98)	(0.96)	(0.55)
Average Life	0.03**	0.02**	0.04**	0.03**	0.03**	0.03**	0.04**
	(5.16)	(3.22)	(5.80)	(5.08)	(4.71)	(4.68)	(5.49)
Fixed Interest	0.33**	0.06+	0.06+	0.33**	-0.04	-0.04	-0.05
	(10.00)	(1.79)	(1.70)	(9.87)	(-1.28)	(-1.38)	(-1.37)
CSRC as Regulator		0.53**			0.40**	0.40**	0.37**
		(20.36)			(12.54)	(12.58)	(10.77)
Residential Mortgage			-0.89**		-0.61**	-0.62**	-0.64**
			(-18.44)		(-11.70)	(-11.45)	(-11.02)
Auto Loan			-0.61**		-0.30**	-0.30**	-0.30**
			(-14.60)		(-6.29)	(-6.24)	(-4.91)
Consumer Loan			-0.26**		-0.34**	-0.03	-0.33**
			(-11.77)		(-15.08)	(-1.38)	(-14.54)
Account Receivable			0.04+		-0.03	-0.04	-0.03
			(1.79)		(-1.33)	(-1.55)	(-1.13)
Prior Shared Experience				-0.01	-0.00	-0.00	-0.00
				(-1.58)	(-0.38)	(-0.45)	(-0.25)
Blockchain					-0.12**	-0.13**	-0.11**
					(-4.51)	(-4.63)	(-3.66)
Observations	3,136	3,136	3,136	3,136	3,136	2,908	2,672
R-squared	0.3	0.37	0.39	0.3	0.42	0.42	0.39

Notes: +, * and ** mean statistical significance at the 10%, 5% and 1% levels, respectively.

Table A2: Estimation of the blockchain adoption effect with secondary trading and CEM (additionally verified blockchain ABS deals only)

VARIABLES	(1) Primary: controls only	(2) Primary: add CSRC	(3) Primary: add assets	(4) Primary: add pse	(5) Primary: add blockchain	(6) Remove Largest Originator	(7) Remove Largest Underwriter
Rating Score	0.02**	0.01**	0.02**	0.02**	0.01**	0.01**	0.02**
	(13.22)	(6.06)	(8.71)	(13.12)	(7.71)	(7.91)	(7.13)
Tranche Principal	-0.02**	-0.02**	-0.01**	-0.02**	-0.01**	-0.01**	-0.01**
	(-68.57)	(-53.25)	(-42.32)	(-68.53)	(-38.20)	(-31.40)	(-38.67)
Number of Tranches	0.04**	0.02**	0.03**	0.04**	0.01**	0.01**	0.01**
	(34.39)	(16.42)	(29.02)	(34.58)	(10.01)	(11.62)	(6.12)
Average Life	0.06**	0.04**	0.06**	0.06**	0.04**	0.04**	0.05**
	(30.07)	(21.19)	(27.66)	(30.01)	(22.12)	(20.74)	(21.47)
Fixed Interest	0.32**	0.02**	0.09**	0.32**	-0.03**	-0.03**	-0.02**
	(54.12)	(4.17)	(15.53)	(54.13)	(-5.11)	(-5.49)	(-3.49)
CSRC as Regulator		0.61**			0.51**	0.51**	0.50**
		(112.31)			(77.87)	(77.54)	(66.44)
Residential Mortgage			-0.76**		-0.43**	-0.45**	-0.39**
			(-76.31)		(-41.75)	(-43.11)	(-30.09)
Auto Loan			-0.53**		-0.15**	-0.16**	-0.12**
			(-71.79)		(-18.48)	(-19.05)	(-10.93)
Consumer Loan			-0.14**		-0.25**	-0.03+	-0.24**
			(-23.51)		(-41.57)	(-1.69)	(-38.64)
Account Receivable			0.07**		-0.02**	-0.03**	-0.02**
			(12.74)		(-4.38)	(-5.20)	(-2.75)
Prior Shared Experience				-0.00**	-0.00**	-0.00**	-0.00**
				(-12.55)	(-8.26)	(-10.04)	(-7.35)
Blockchain					-0.11**	-0.11**	-0.09**
					(-18.38)	(-18.18)	(-12.95)
Observations	52,307	52,307	52,307	52,307	52,307	49,135	45,191
R-squared	0.33	0.480	0.46	0.33	0.52	0.52	0.47

Notes: +, * and ** mean statistical significance at the 10%, 5% and 1% levels, respectively.

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