Market Discipline and Regulatory Arbitrage: Evidence from ABCP Liquidity Guarantors

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Abstract

We investigate whether the U.S. stock market disciplines asset-backed commercial paper (ABCP) liquidity guarantors who exploit a regulatory loophole that exempts at least 90% of the risk capital charge. We find that the market reduces liquidity guarantors' franchise value when a short ABCP maturity causes the conduit credit losses to remain with guarantors rather than being transferred to investors. Banks with franchise value more sensitive to the ABCP guarantee cost maintain a higher risk capital buffer. We interpret our findings as evidence that market discipline—complexity of the shadow banking system notwithstanding—alleviates the consequence of regulatory arbitrage.

Keywords: Capital Regulation; Market Discipline; Regulatory Arbitrage; Bank Risk Capital.

JEL classification: G01, G21, G28

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1 Introduction

Market discipline, as per Bliss and Flannery (2002), includes two distinct components: market *monitoring* and market *influence*. Market monitoring, based on the semi-strong form of the efficient market hypothesis, means a bank's franchise value incorporates all relevant public information. Market influence means a change in franchise value would influence the bank's subsequent behavior. The Basel Committee on Banking Supervision (BCBS) designates market discipline, along with the minimum capital requirements and supervisory review, as the "three pillars" of the Basel Accords. In nations such as the United States, where bank funding structure is complex, loopholes in the minimum capital requirement can be obscure enough to remain for an extended period. Loophole-exploiting banks took excessive risks beyond regulatory presumption and played a critical role in the Financial Crisis of 2007 - 2009. How effective is market discipline, in terms of market monitoring and market influence, against banks participating in regulatory arbitrage? Answering this question will deepen our insights on the "three pillars" framework of the Basel Accords.[1]

We examine the effect of market discipline on U.S. bank holding companies (BHCs) that exploit a risk-capital regulatory loophole regarding the asset-backed commercial paper (ABCP) conduit, an off-balance-sheet financing facility that gained popularity in the early 2000s. A BHC can unload on-balance-sheet long-term risky assets to an ABCP conduit and finance it by issuing guaranteed ABCPs. To ensure that the ABCP facility obtains the highest credit rating and low-cost financing, the BHC usually offers either a full-fledged *credit guarantee* or and a weaker *liquidity guarantee*. BHCs that offer liquidity guarantees, hereby *liquidity guarantors*, presumably transfer the assets' credit risk to ABCP investors. Therefore, prior to 2010, liquidity guarantors have enjoyed a regulatory exemption that lowers their regulatory risk capital requirement toward the guarantee obligation by at least 90%. It is widely believed that the risk capital exemption, also called "ABCP exclusion," is a regulatory loophole that closely links to the boom and bust of ABCP market in

[1] Many studies focus on how to refine capital requirements by focusing on macroprudential regulation and countercyclical capital buffer (Hanson, Kashyap, and Stein, 2011; Repullo and Suarez, 2012; Jiménez, Ongena, Peydró, and Saurina, 2017), bank liquidity management and regulation (Berger and Bouwman, 2009; Cornett, McNutt, Strahan, and Tehranian, 2011; Loutskina, 2011; Acharya and Naqvi, 2012), and stable funding measures (Brunnermeier and Pedersen, 2008), among others. Nevertheless, studies on the effectiveness of market discipline under the presence of capital requirement loophole is limited.

the 2000s (Financial Crisis Inquiry Commission, 2011; Covitz, Liang, and Suarez, 2013).

We exploit the ABCP exclusion to understand the effectiveness of market discipline, the third pillar of the Basel Accords. Specifically, we examine whether the U.S. stock market is efficient enough to lower the franchise value of a guarantor who suffers losses from its regulatory arbitrage activities while still meeting the risk capital requirement. We also investigate whether the loophole-exploiting banks increase their risk capital buffer without explicit regulatory intervention when facing effective market monitoring.

To do so, we first develop a theoretical model to analyze ABCP conduits with credit or liquidity guarantee.[2] The model highlights that, when ABCP maturity is short enough, the credit losses from a liquidity-guaranteed ABCP conduit will not be transferred to outside investors, but will instead remain with the liquidity guarantor, as if the guarantor has provided a full-fledged credit guarantee. Hence, the ABCP exclusion, which provides a minimum 90% reduction in the risk capital requirement even under a distressed market when investors flock to ABCP with overnight maturity, is a regulatory loophole. More importantly, the theoretical model confirms that ABCP maturity variations, which affect the liquidity guarantee cost but are not concerned by capital regulations, create a testbed to investigate market monitoring on regulatory arbitrage. Subsequently, we evaluate the effectiveness of market influence by studying whether the liquidity guarantor, with its franchise value pressed by the market, maintains a higher capital ratio above the minimum requirement.

Using Moody's panel data on the universe of ABCP conduits from April 2001 to September 2009, we obtain the outstanding ABCPs guaranteed by U.S. BHCs and the type of guarantees that they provide. About 18% of the sample BHCs are liquidity guarantors, thereby have exploited the ABCP exclusion. They also tend to be larger, with more cash and fewer real estate loans on their balance sheets. The difference raises a concern that the observed equity returns and capital ratios of BHCs that do not take advantage of ABCP exclusion might not be the counterfactual observations of their loophole-exploiting counterparties' returns and capital ratios. To address this

[2] The dynamic capital structure model literature includes Leland (1994b), Leland and Toft (1996), Leland (1994a), and Decamps, Rochet, and Roger (2004). The fair value of deposit insurance is related to Merton (1977) and Merton (1978), which study the pricing of insurance under dynamic settings.

concern, we match the loophole-exploiting BHCs with the rest of the sample BHCs on size and balance sheet characters using the propensity score method of Rosenbaum and Rubin (1983) and the Mahalanobis matching of Abadie and Imbens (2016).

We find evidence of market monitoring among loophole-exploiting BHCs, as their franchise value drops when a short ABCP maturity hampers risk transfer from ABCP conduits to investors. Specifically, when facing an average mortgage delinquency rate and one standard deviation increase of the percentage share of the ABCP maturing overnight, the franchise value of an ABCP guarantor with an average liquidity guarantee exposure drops about 0.77% by propensity score weighted regression, and 0.62% by Mahalanobis matching estimates. The changes in franchise value are unlikely to be driven by latent factors, as the changes do not vary with the interaction between credit guarantee exposure and ABCP maturity. Market monitoring is stronger among liquidity guarantors with below-average Tier-1 risk capital and persists even during the ABCP market boom, suggesting the market concerns about the potential risk capital shortfall caused by the loophole-exploiting guarantors suffering the increased cost of the guarantee. Our findings indicate that the market prices in the losses associated with the regulatory arbitrage activities, despite the complexity of shadow bank financing.

Turning to the market influence, we find that although BHCs using ABCP shadow bank financing tend to have lower capital ratios, the loophole-exploiting BHCs maintain higher Tier-1 capital ratios after controlling for BHC characteristics. The higher capital ratio persists even after adjusting for the reduced total risk-weighted assets allowed by the ABCP exclusion. The propensity-score-weighted estimates suggest that loophole-exploiting BHCs have a 1.22% to 1.74% higher Tier-1 capital ratio, with or without the adjustment, whereas Mahalanobis matching estimates suggest a 2.15% to 2.64% higher Tier-1 capital ratio. Moreover, the Tier-1 capital ratio is higher among BHCs whose equity returns are more sensitive to ABCP losses. These findings suggest that market influence may be able to mitigate the negative effects of regulatory arbitrage on bank capital adequacy.

Our paper belongs to the literature on market discipline. Flannery and James (1984) show that bank stock returns fluctuate with interest rates because the market notices the difference in maturity between bank assets and liabilities. Martinez Peria and Schmukler (2001) as well as Demirgüç-Kunt and Huizinga (2004) present market discipline by depositors as bank creditors. Subordinated notes and debentures can also serve as a market disciplinary tool (Avery, Belton, and Goldberg, 1988; Gorton and Santomero, 1990; Ashcraft, 2008). This paper, to the best of our knowledge, is the first to show the effectiveness of equity market discipline against regulatory arbitrage, notwithstanding the complexity of off-balance-sheet financing.[3]

Our paper also contributes to two additional strands of literature. The empirical finding on the high capital ratio of the loophole-exploiting BHCs extends the literature on optimal bank capital structure. Extant literature on optimal bank capital structure suggests that, contrary to conventional belief, BHCs do not simply leverage up to the minimum capital requirement but maintain an optimal capital buffer above the regulatory minimum (Flannery, 1994; Myers and Rajan, 1998; Diamond and Rajan, 2000; Calomiris and Wilson, 2004; Allen, Carletti, and Marquez, 2011). Empirical studies confirm that banks maintain a capital buffer above the minimum requirement (Berger, DeYoung, Flannery, Lee, and Öztekin, 2008; Gropp and Heider, 2010).[4] This article reveals that loophole-exploiting BHCs adjust their risk capital level when faced with the pressure of market discipline.

Furthermore, this study adds to the literature of shadow bank financing (Brunnermeier, 2008; Krishnamurthy, 2009; Acharya, Gale, and Yorulmazer, 2011; He and Xiong, 2012b; Martin, Skeie, and von Thadden, 2014), as well as the related capital regulation and regulatory arbitrage (Covitz et al., 2013; Kisin and Manela, 2016). The model explains how risk capital exemption in ABCP exclusion gave opportunities for guarantors to take excess risk before 2010 (Acharya, Schnabl, and Suarez, 2012). Therefore, the model supports the belief that regulatory arbitrage is the primary driving force behind the growth of ABCP (Pozsar, Adrian, Ashcraft, and Boesky, 2010; Adrian and Ashcraft, 2012; Ordonez, 2018). As the seminal paper by Acharya et al. (2012) illustrates regulatory arbitrage among ABCP guarantors, our paper shows that regulatory-arbitraging BHCs are

[3]Our paper does not intend to argue whether the regulators are aware of the existence of the ABCP loophole. Policy change and implementation in the United States must follow rules of procedure, which usually takes an extended period. Hence, a regulatory loophole may remain when regulatory bodies are aware of its existence.

[4]Flannery and Rangan (2008) find that regulatory innovations in the early 1990s weakened conjectural government guarantees and enhanced bank counterparties' incentive to monitor and price default risk.

monitored by the stock market. This paper also relates to studies of regulatory arbitrage in multiple areas of financial markets, including mortgage-backed securities (Demyanyk and Loutskina, 2016), trust-preferred securities (Boyson, Fahlenbrach, and Stulz, 2016), and international banking activity due to cross-country differences in banking regulation (Houston, Lin, and Ma, 2012; Ongena, Popov, and Udell, 2013; Karolyi and Taboada, 2015; Frame, Mihov, and Sanz, 2020).

2 Institutional background

Before presenting the research analysis, we describe the necessary institutional details, particularly regarding the changes in capital requirements of liquidity guarantee.

2.1 ABCPs and credit versus liquidity guarantee

In the 2000s, ABCP was a major U.S. money market instrument whose total outstanding peaked at $1.21 trillion in 2007, which was approximately 12.3% of the country's commercial bank liability volume. An *ABCP conduit* is a shadow banking funding facility that allows a bank to finance long-term assets off-balance-sheet by rolling over short-term ABCPs with the highest credit rating. The conduit's assets value may fall below a pre-set threshold, at which point the conduit is considered default and forced into a costly liquidation. Nevertheless, the short maturity of ABCPs might allow investors to close their position before the deteriorating conduit reaches the default threshold. Institutional investors of ABCPs, mostly money market funds (MMFs), demand *rollover support* to ensure they can unwind their positions swiftly.[5] Additionally, the investors may also demand *wind-down support*, that is, payment when the ABCP conduit defaults.

Each ABCP conduit has a guarantor bank, also known as the sponsor, to provide the support that investors demand. In many cases, the guarantor is the same bank that creates the ABCP conduit by moving its risky assets off the balance sheet. We focus on such cases in our study.

[5]Under SEC Rule 2a-7, MMFs may only hold the highest rated debt and must maintain an overall portfolio weighted average maturity of 60 days or less. According to the Federal Reserve Financial Accounts of the United States, MMFs had aggregate assets up to 2.69 trillion USD by the end of 2008. The large size of MMFs leads to lower transaction costs of ABCP in the secondary market.

There are two distinct types of guarantees that sponsors can offer—credit guarantee and liquidity guarantee—with different levels of support to investors and distinct regulatory capital consequences. Both guarantees feature rollover support when the conduit has not reached the default threshold: when investors with maturing ABCPs no longer want to reinvest or "rollover" the commercial paper, the guarantor pays the ABCP's principal amount back to the investors.[6]

A credit guarantee offers better *wind-down support*. When the underlying conduit is deemed to be in default, ABCP investors with a credit guarantee receive the full principal from the sponsor, whereas ABCP investors with a liquidity guarantee only recover the remaining collateral value of the conduit's underlying assets.[7]

Figure 1 illustrates the similarities and differences between the credit and liquidity guarantees, and compares their risk capital charge, which we discuss below.[8]

2.2 Capital requirements and the growth of ABCP

A BHC can sponsor multiple ABCP facilities with different types of guarantees, while facing risk capital charges against each guarantee obligations. Since the credit risks of credit-guaranteed ABCP facility remain with its sponsor, U.S. regulators consistently impose a strict capital requirement that demands the sponsor to hold capital against the full amount covered by the guarantee. However, before 2010, BHCs that sponsor liquidity-guaranteed ABCP conduits—named liquidity guarantors—enjoyed an exemption known as *ABCP exclusion* whereby they were only required to prepare risk capital for at most 10% of the guaranteed ABCP outstanding.[9] The changes in capital requirements of liquidity guarantee obligations coincide with the growth of ABCP outstandings in

[6]Usually, the bank then reissues the ABCP at a discounted price.

[7]Although the conduits typically have some credit enhancement measures, such as a subordinate or overcollateralization tranche as the first group to absorb the loss of default, ABCP investors are still subject to credit risk once the credit enhancement is depleted. The size of program credit enhancement is small, often covering less than 15% of conduit assets.

[8]Our definitions of credit and liquidity guarantee are consistent with the definitions in Acharya et al. (2012), as well as in Kisin and Manela (2016). There are other alternative structures and supports in ABCP conduit, including but not limited to collateralized debt obligations, repurchase agreeements, and total return swaps. We do not include these alternative structures in our sample and analysis.

[9]A liquidity guarantor might also sponsor credit-guaranteed ABCP conduits: it just cannot save risk capital charge through its credit guarantee positions.

Figure 1: **Credit vs. liquidity guarantee**
The figure illustrates the similarities and differences between a credit guarantee and a liquidity guarantee. When an investor with maturing ABCP no longer wants to reinvest or "rollover" her commercial paper, the sponsor bank pays the commercial paper's principal amount back to the investor regardless of the type of guarantee. When the investor's ABCP is deemed default, that is, under the wind-down trigger, the investor can receive the principal of ABCP only if the paper has credit guarantee. Investors of liquidity-guaranteed ABCP incur losses since they can only obtain the market value (sales proceedings) of the conduit assets. Finally, before 2010 when ABCP exclusion was effective, sponsors of ABCP liquidity guarantee were only required to prepare risk-capital against 0% to 10% of ABCP outstanding.

<table>
<tr><th></th><th>Credit guarantee</th><th>Liquidity guarantee</th></tr>
<tr><td>When ABCP matures:</td><td colspan="2">- No payments to investors if they rollover.
- Pays investors ABCP face value (rollover support), then re-issues ABCP, if investors leave.</td></tr>
<tr><td>When ABCP conduit winds-down:</td><td>Pays investors the ABCP face value.</td><td>Pays investors the fair market value of underlying assets.</td></tr>
<tr><td>Capital requirement under ABCP exclusion:</td><td>Sponsor needs to prepare risk capital for 100% of the ABCP conduit assets.</td><td>Sponsor needs to prepare risk capital for only 0% to 10% of ABCP conduit assets.</td></tr>
</table>

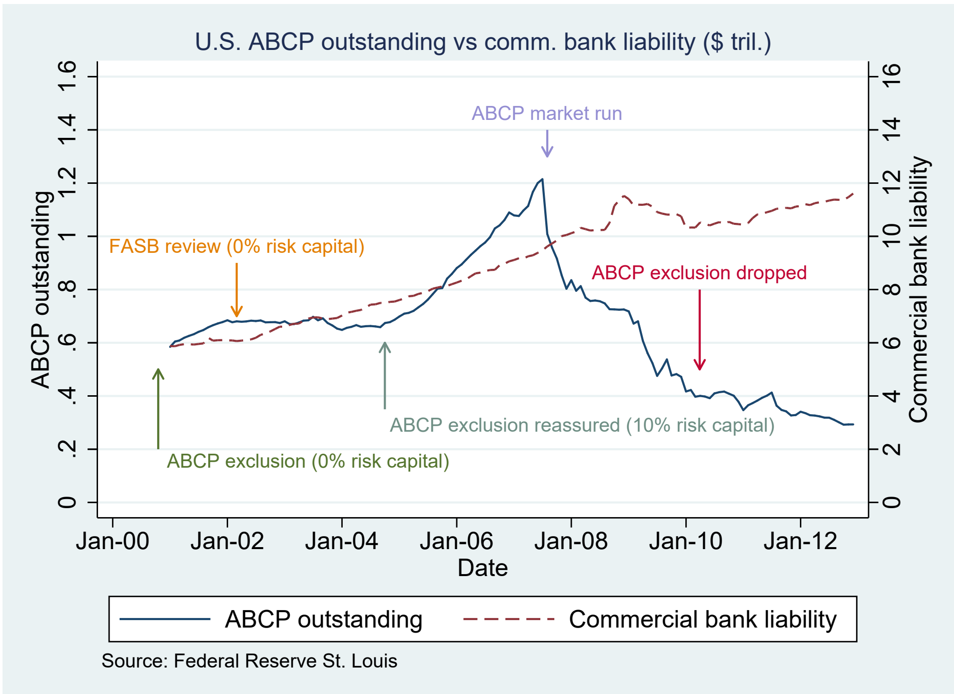
the United States, as shown in Figure 2 as well as our discussion below.

In September 2000, the Financial Accounting Standards Board (FASB) introduced Financial Accounting Standards (FAS) 140, which allowed a bank that establishes a liquidity-guaranteed ABCP conduit to book the assets as being "sold" to the conduit and to avoid the costly risk capital requirement altogether, effective after March 31, 2001.[10] ABCP financing was adopted widely under FAS 140, and by mid-2002, the ABCP outstanding was \$0.67 trillion, which was approximately 11% of the total commercial bank liabilities (\$6.1 trillion).

Nevertheless, in mid-2002, the FASB proposed consolidating ABCP conduits on guarantor's balance sheet in response to the scandal of Enron, which had used off-balance-sheet facilities similar to ABCP conduits to conceal the firm's leverage. Although the FAS 140 was still in effect, FASB's

[10]Specifically, FAS 140 deems an ABCP conduit achieves a "qualifying SPE" status because first, the financial assets are isolated from the bank after the transfer and, second, the limited activities of the conduit are entirely specified in the legal documents. Third, the conduit holds only passive financial assets that were transferred in, guarantees, and servicing rights. Finally, the sale or disposal of the conduit assets must be specified in the legal documents and exercised by a party that puts the holders' beneficial interests back to the SPE. Hence, the sponsor can claim the conduit is a "qualified SPE" and book the transfer of risky assets to the conduit as a "true sale," even though the sponsor still needs to provide a liquidity guarantee in the future.

Figure 2: **U.S. ABCP outstanding vs. commercial bank liability**
This figure shows the total U.S. ABCP outstanding (left y-axis) and U.S. commercial bank liabilities (right y-axis, scaled ten times compared to the left y-axis), both in trillion USD. The ABCP exclusion was introduced in 2000 through FAS 140, and later under FASB review since mid-2002. In September 2004, U.S. regulators reassured the ABCP exclusion, led to a rapid ABCP market expansion until the market collapsed in August 2007. U.S. regulators announced the elimination of ABCP exclusion on January 28, 2010.



consolidation proposal generated considerable concerns among ABCP sponsors.[11] As a result, the growth of ABCP outstanding stalled.

Regulators reassured the ABCP exclusion in September 2004: although FASB required banks to consolidate ABCP conduits to balance sheets, regulators permitted banks to hold risk capital at a conversion factor of 10% against the size of liquidity-guaranteed ABCP facilities into their risk-weighted assets.[12] ABCP began growing again as sponsors could avoid 90% of the risk capital

[11]See FASB's July 2002 news release on the proposition of consolidation principles for SPEs at `https://www.fasb.org/news/nr070102.shtml`. In response, Moody's Investors Service (2002) argued that the consolidation would cause guarantors to violate their regulatory capital requirements.

[12]Effective since September 2004, the Office of the Comptroller of the Currency (OCC), Board of Governors of the Federal Reserve System (FRB), Federal Deposit Insurance Corporation (FDIC), and Office of Thrift Supervision (OTS) collectively permitted sponsoring banks to exclude those assets in ABCP programs that were consolidated as a result of FASB Interpretation 46(R) from their risk-weight asset base. For more details, please refer to Risk-based capital gudelines; capital adequacy guidelines; capital maintenance: consolidation of asset-backed commercial paper programs and other issues, 69 Fed. Reg. 44,908 (July 28, 2004), (to be codified at 12 C.F.R. pt. 3; 12 C.F.R. pts. 208, 225; 12 C.F.R. pt. 325; 12 C.F.R. pt. 567). These guidelines are responses to FASB Interpretation 46(R), which required banks to consolidate SPE assets to its balance sheet.

charge on their liquidity guarantee obligations. From September 2004 to July 2007, the ABCP outstanding registered an 83% growth from \$0.66 to \$1.21 trillion, much larger than the 26% growth in the total commercial bank liabilities.

The ABCP market experienced a shadow bank run in August 2007, when investors' confidence in ABCP as a safe asset faltered due to the deterioration of underlying mortgage-backed securities (MBS). In September 2008, commercial paper investors suffered another major loss triggered by the Lehman bankruptcy.[13] On September 15, 2009, the OCC, FRB, FDIC, and OTS (collectively, the agencies) requested comment on a proposal to eliminate the ABCP exclusion, that is, to require liquidity guarantors to count 100% of the conduit assets in their risk-weighted assets.[14] Finally, on January 28, 2010, the agencies announced the abolition of ABCP exclusion.[15] The ABCP outstanding rapidly declined since August 2007, and dropped further after the Lehman crisis and capital requirement change.

In response to the financial crisis, the Federal Reserve swiftly cut the target Fed fund rate by 325 basis points over seven Federal Open Market Committee (FOMC) meetings from September 2007 to April 2008. It also carried out a massive MBS purchase program, as part of the Quantitative Easing (QE), since November 25, 2008. Notably, the Federal Reserve—for the first time in its history—provided Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF) to directly help ABCP guarantors to fulfill their guarantee obligations to Money Market Mutual Funds (MMMFs), major ABCP investors who rapidly reduced the holdings of commercial papers after the shocks.[16] By early January 2009, the Federal Reserve owned commercial papers worth of \$357 billion, or 22.4% of the market (Cecchetti, 2009; Kacperczyk and Schnabl, 2010). Although AMLF stabilized asset outflows from MMMFs and reduced ABCP yields significantly (Duygan-Bump, Parkinson, Rosengren, Suarez, and Willen, 2013), the ABCP outstanding has remained low.

[13] For instance, the default of Lehman Brothers caused the share value of Reserve Primary Fund—a \$65 billion MMF with \$785 million of Lehman's commercial paper—to drop below the conventional \$1 mark.

[14] See Federal Register, Vol. 74, No. 177 at `https://www.govinfo.gov/content/pkg/FR-2009-09-15/pdf/E9-21497.pdf`.

[15] See Federal Register, Vol. 75, No. 18 at `https://www.occ.gov/news-issuances/federal-register/2010/75fr4636.pdf`.

[16] See `https://www.federalreserve.gov/monetarypolicy/abcpmmmf.htm` for more details about AMLF.

2.3 Liquidity guarantors and regulatory arbitrage

After the financial crisis, the Financial Crisis Inquiry Commission (2011) (hereafter *FCIC report*) investigated regulatory arbitrage activities and provided more detailed anecdotal evidence of U.S. BHCs avoiding risk capital charges by moving unsold assets and securities from their balance sheets to ABCP conduits. For instance, from 2003 to 2006, as Citigroup sought to become the top-ranked producer of collateralized debt obligations (CDOs), it dumped $25 billion of unsold subprime-related CDO tranches to ABCP conduits and issued liquidity-guaranteed commercial papers.[17] The FCIC report conclude:[18]

> Commercial banks used (asset-backed) commercial paper, in part, for regulatory arbitrage.

We provide further evidence of changes in capital requirements driving the growth of *bank-level* liquidity-guaranteed ABCP outstanding in Table A.2 of Appendix A.3.1. Similar to the growth pattern in total ABCP outstanding in Figure 2, we find the liquidity-guaranteed ABCP financing at the *bank-level* also grew rapidly after regulatory support since 2000 and reassurance in 2004, and remained flat amid the FASB review period. Acharya et al. (2012) also show that most guarantees are capital-reducing liquidity guarantees, and most guarantors are commercial banks, subject to the most stringent capital requirements.[19] In summary, the close connection between the regulatory changes and growth in ABCP outstanding in both aggregate and bank levels suggests that U.S. BHCs set up liquidity-guaranteed ABCP facilities partly to exploit regulatory loopholes.

We then further investigate the market's response to BHCs' regulatory arbitrage activities. To do so, it is important to determine how an efficient market *should* value loophole-exploiting banks facing varying market conditions. The theoretical model describes how credit and liquidity guarantee costs vary with ABCP market conditions and underlying assets quality, then develops empirical hypotheses.

[17] See the Financial Crisis Inquiry Commission (2011), page 138-139, available at `https://www.govinfo.gov/content/pkg/GPO-FCIC/pdf/GPO-FCIC.pdf`.

[18] See the Financial Crisis Inquiry Commission (2011), page 114.

[19] Subsequently, Kisin and Manela (2016) estimated loophole-exploiting BHCs' shadow cost of capital requirements.

3 Theory

We start with a parsimonious model of an ABCP guarantor subject to a regulatory capital constraint. Consider a continuous time risk-neutral economy with time $t \in [0, +\infty)$ and riskless interest rate $r > 0$. The economy contains a bank with initial equity capital E, deposit D, and ABCP guarantee obligation G. We focus on the analysis of the off-balance-sheet financing and let deposit D remain constant over t. There is also one unit of risky long-term project which, after an initial investment, pays risky cash flow following a geometric Brownian motion $dy_t = \mu y_t dt + \sigma y_t dW_t$, where W_t is a standard Brownian motion and $0 < \mu < r$. Hence, the project has an intrinsic value $V(y_t) = y_t / (r - \mu)$ as the risk-neutral expectation of cash flow. The initial investment to set up the project is $V(y_0) = y_0 / (r - \mu)$. At $t = 0$, the bank raises capital $V(y_0)$ for the risky project by setting up an off-balance-sheet ABCP conduit that issues and then rolls bank-guaranteed ABCP. The ABCP pays a fixed coupon k such that the paper is originated at par.

We let the ABCP guarantor issues commercial paper with a maturity that matches the investors' idiosyncratic shock of liquidity requirement.[20] In a similar vein as He and Xiong (2012a), we assume that the ABCP maturity $\tau \in (0, +\infty)$ follows an exponential distribution with probability density function $f(x) = me^{-mx}$ with parameter $m > 0$. Hence, m fraction of the outstanding paper will mature within the next time unit, and the expected remaining time-to-maturity of ABCP is $1/m$.

The bank offers an ABCP guarantee $G(y_t, m)$, which refers to either a credit guarantee $G^C(y_t, m)$ or a liquidity guarantee $G^L(y_t, m)$. Under both types of guarantee, the guarantor bank offers *rollover support* that pays investors the face value of their maturing ABCP if they choose not to roll over the paper. The bank then reissues the paper at the market price $A(y_t, m)$. The guarantee lasts until the ABCP conduit winds down, which is triggered by the conduit asset cash flow y_t hitting the wind-down threshold y_w. The bank then pays investors of credit guaranteed ABCP investors the face value of the paper, and investors of liquidity guaranteed ABCP investor the market value of conduit assets. Panels (a) and (b) of Figure 3 demonstrate the timing of events for a credit

[20] We choose not to model the consumption problem specifically for it is not the focus of our paper. In the standard financial intermediary theory literature, investors face idiosyncratic uncertainty about her preference type as an early or late consumer (Bencivenga and Smith, 1991; Allen and Gale, 2004b,a). Investors facing such uncertainty will adjust the maturity of investment accordingly.

guaranteed ABCP conduit and liquidity guaranteed ABCP conduit, respectively.

We assume that the initial bank capital E is large enough to cover the cost of credit or liquidity guarantee, such that $E + G(y_t, m) \geq 0$ for all $y_t > y_w$. The assumption is consistent with the fact that no ABCP conduit has ever experienced guarantor default even during the crisis period: ABCP is a vital funding facility for the sponsoring bank such that defaulting on the guarantee obligation leads to severe reputational damage.

Following the essence of BCBS definition, we let a bank's capital ratio $K(y_t)$ to be the value of equity capital over bank assets, with the ABCP guarantee cost explicitly included in both the capital and assets to highlight the impact of the guarantee to the capital ratio.[21] Hence, $K(y_t) \equiv \frac{E+G(y_t,m)}{D+E+G(y_t,m)+\beta V(y_t)}$, where β is the conversion ratio for the risk capital charge against a bank's ABCP guarantee obligation. For a sponsor of liquidity-guaranteed ABCP, $\beta = 0$ before December 2003, and $\beta = 0.1$ afterwards and until the ABCP exclusion was eliminated. Whereas for a sponsor of credit-guaranteed ABCP, $\beta = 1$. We also assume the sponsor of liquidity guarantee has a significant involvement in off-balance-sheet financing such that $V(y_w) \geq \sqrt{\beta} D$. Finally, we let the bank maintain its capital ratio $K(y_t)$ no less than the minimum requirement $\underline{K}$ or face a regulatory penalty.[22]

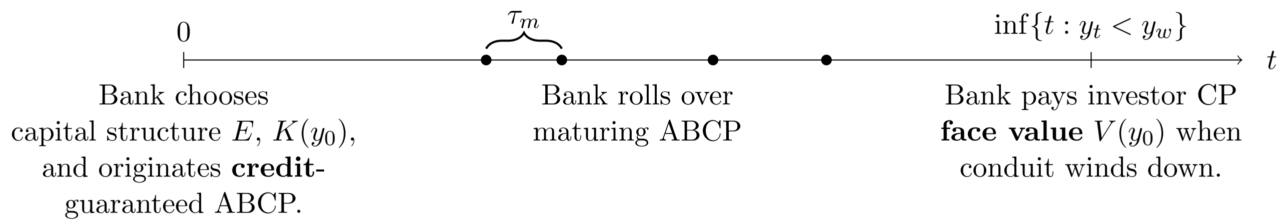
3.1 Market monitoring: ABCP maturity and risk transfer

In this section, we develop the empirical hypotheses for testing effective market monitoring of ABCP liquidity guarantors, that is, whether a liquidity guarantor's market value varies depending on its regulatory arbitrage activities. To do so, we start with the comparative statics of the sponsor's cost of credit and liquidity guarantees to ABCPs with different maturities.

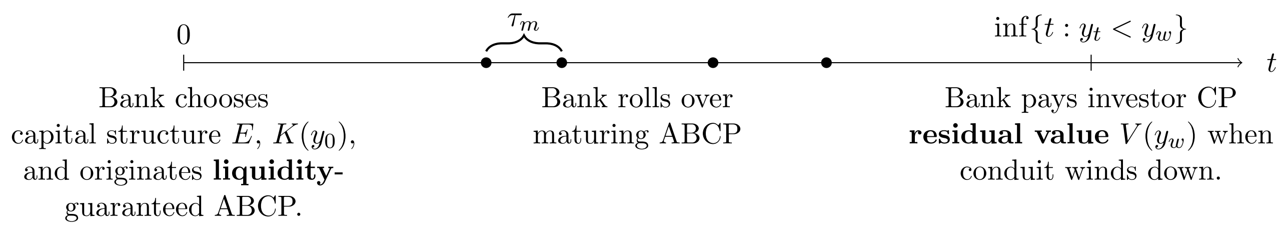
[21]To focus on off-balance-sheet ABCP facility, our measure of capital ratio abstracts away the risk-weighting for on-balance-sheet assets and assume they have a risk weight of 100%. As a result, our capital ratio uses equity capital with guarantee cost as the numerator (risk capital) of the capital ratio, and uses the value of debt and equity—the book value of assets—plus the guarantee cost and off-balance-sheet assets as the denominator.

[22]Once a bank fails to maintain the capital ratio above the minimum requirement, it can continue to operate under the regulatory forbearance, which leads to more stringent regulatory oversight and higher operating costs. The bank may also be forced to replenish capital through other means such as fire selling high quality assets or raising equity when the share price is subdued.

Figure 3: **Model timeline.**
Panels (a) and (b) present timelines for credit and liquidity guarantees in the model respectively. There are multiple events of rolling over maturing ABCP, marked by black dots. The ABCP maturity follows an exponential distribution with parameter m, so $\tau_m \sim Exp(m)$. When incumbent ABCP matures, the bank needs to rollover the commercial paper under the cash flow y_t. Since the cash flow y_t may not be as high as y_0, the new commercial paper may be issued at a discount since the investor may demand a higher return. In this case, the bank equity holder has to post the margin and will suffer a loss. Once the ABCP conduit wind-down gets triggered, investors of credit guaranteed ABCP receive the face value of the commercial paper from the bank, whereas investors of liquidity guaranted ABCP receive the residual value of underlying assets.



(a) **Credit guaranteed ABCP**



(b) **Liquidity guaranteed ABCP**

ABCP maturity has two opposing effects on the cost of guarantees. First, as with many fixed-income securities with credit risk, ABCPs with shorter maturity trade at a (weakly) higher price level, since credit events are less likely to occur before the maturity date. Hence, when an investor is no longer willing to roll over his ABCP, the guarantor—obligated to buy back the discounted paper at par—incurs a lower cost when the paper maturity is shorter. However, under an ABCP market exodus, a shorter ABCP maturity means the bank has to buy back discount papers at par more frequently. Does the high rollover frequency dominate the low cost of rollover—a lower ABCP maturity leads to a higher liquidity guarantee cost—or not? To shed light on the comparative statics of guarantee cost, we first derive the value functions of credit- and liquidity-guaranteed ABCPs and study how they vary with ABCP maturities.

Proposition 1. *The value of ABCP under a credit guarantee does not vary with the maturity* $1/m$. *Specifically,* $A^C(y_t, m) = V(y_0)$.

Proposition 2. *The value of ABCP with a liquidity guarantee* $A^L(y_t, m) = \mathbf{1}_{\{y_t \geq y_0\}} A_h^L(y_t, m) + \mathbf{1}_{\{y_t < y_0\}} A_l^L(y_t, m)$*, where*

$$\begin{aligned} A_h^L(y_t, m) &= \frac{k}{r} V(y_0) + C_h(m)\phi(y_t; y_w), \\ A_l^L(y_t, m) &= \frac{k+m}{m+r} V(y_0)(1 - \psi(y_t; y_w)) + V(y_w)\psi(y_t; y_w) - C_l(m)\left(\psi(y_t; y_w) - \bar{\psi}(y_t; y_w)\right), \end{aligned}$$

in which $\phi(y_t; y_w) = \left(\frac{y_t}{y_w}\right)^H$*,* $\psi(y_t; y_w) = \left(\frac{y_t}{y_w}\right)^G$*, and* $\bar{\psi}(y_t; y_w) = \left(\frac{y_t}{y_w}\right)^{\bar{G}}$*. Further,* $H = \frac{1}{2} - \frac{\mu}{\sigma^2} - \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} < 0$*,* $G = \frac{1}{2} - \frac{\mu}{\sigma^2} - \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2(r+m)}{\sigma^2}} < 0$ *and* $\bar{G} = \frac{1}{2} - \frac{\mu}{\sigma^2} + \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2(r+m)}{\sigma^2}} > 0$*. Finally,* $C_h(m)$*,* $C_l(m)$*, and* k *satisfy the smooth pasting conditions at* $A_h^L(y_t, m) = A_l^L(y_t, m) = V(y_0)$ *and* $\frac{\partial}{\partial y} A_h^L(y_t, m) = \frac{\partial}{\partial y} A_l^L(y_t, m)$ *at* $y_t = y_0$*.*

Despite the complicated value function of an ABCP with a liquidity guarantee, Propositions 1 and 2 show that the value of liquidity guaranteed ABCP varies with the ABCP maturity $1/m$, whereas the value of credit guaranteed ABCP does not. Panel (a) of Figure 4 shows that when the ABCP maturity gets shorter, the value of a discounted ABCP (whose underlying asset value $y_t < y_0$) increases as the paper receives liquidity support sooner. Subsequently, the liquidity guarantor incurs a higher cost as it provides more frequent support to investors:

Proposition 3. *When the ABCP maturity* $1/m$ *decreases, the liquidity support value function* $G^L(y_t, m)$ *becomes more negative whereas the credit support value function* $G^C(y_t)$ *remains unchanged given* y_t*. Moreover, we have* $G^C(y_t) < G^L(y_t, m) < 0$ *and* $\lim_{m \to \infty} G^L(y_t, m) = G^C(y_t)$ *for* $\forall y_t > y_w$*.*

Proposition 3 shows a crucial difference between the costs of credit and liquidity guarantees:[23] The cost of credit guarantee remains constant as the ABCP maturity $1/m$ decreases, whereas the cost of liquidity guarantee rises as the ABCP maturity decreases, despite being lower than the cost of credit guarantee.[24] Moreover, when the ABCP maturity decreases further, the cost of liquidity guarantee converges to the cost of credit-guarantee (illustrated in Panel (b) of Figure 4). In other

[23] As both types of guarantee have negative value, and $G^C(y_t) < G^L(y_t, m) < 0$, both types of guarantee are costly for the guarantor to provide.

[24] Hence, Proposition 3 answers the question at the beginning of the section: the effect of high rollover frequency dominates the low cost of rollover.

words, liquidity-guaranteed conduits transfer credit losses to investors *only when the average ABCP maturity is long enough.* When the ABCP maturity approaches zero, the credit losses in liquidity-guaranteed conduit no longer transfers to investors, but to remain with the guarantor.

Although normally less than 10% of the originated ABCP maturing overnight due to heterogeneous liquidity preferences of investors (Bate, Bushweller, and Rutan, 2003), ABCP investors flock to overnight ABCP when their confidence in conduit asset quality decline, causing a liquidity guarantor to essentially offer a full-fledged credit guarantee (Covitz et al., 2013). Hence, Proposition 3 offers a theoretical explanation to the phenomenon of *securitization without risk transfer* depicted in the empirical analysis of Acharya et al. (2012), who show that credit losses from ABCP conduit remained with the liquidity guarantor instead of ABCP investors during the ABCP run in 2007.

Proposition 3 highlights that the liquidity guarantee cost would rise as a result of the *interaction* between the shortened ABCP maturity and the loss of the underlying ABCP conduit asset value, as the guarantor bears the burden of the conduit asset loss due to the short ABCP maturity. Further, if the market monitoring is effective, we project that the market value of the guarantor bank would drop as the market realizes the increased cost of the bank's liquidity guarantee:

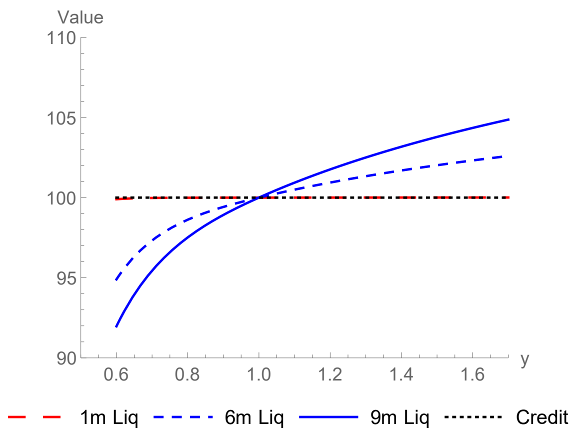
H1: Under effective market monitoring, the interaction term between a shortened ABCP maturity and the deteriorating liquidity-guaranteed conduit asset would lower the guarantor's value, as the drop in ABCP maturity impedes the credit loss transfer from the liquidity-guaranteed ABCP conduit to investors.

The difference between the credit and liquidity guarantee highlighted by Proposition 3 leads to the second hypothesis regarding market monitoring and credit guarantee obligations:

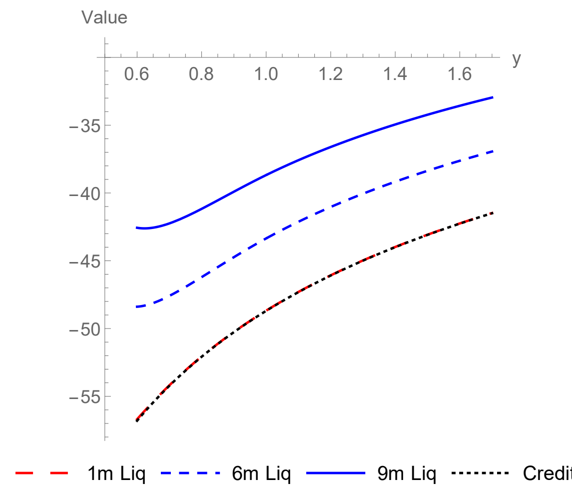
H2: Under effective market monitoring, the interaction term between the maturity and the change in credit-guaranteed conduit asset value would not significantly affect the guarantor's market value, as the change in ABCP maturity does not affect the credit loss transfer from the credit-guaranteed ABCP conduit to investors.

Finally, Proposition 3 reveals the mechanism of regulatory arbitrage. The ABCP exclusion became a regulatory loophole because it disregards how ABCP maturity affects the cost of liquidity

Figure 4: **Value functions by ABCP maturity and guarantee type**
Panel (a) shows the value functions of credit guaranteed ABCP (dotted line), liquidity guaranteed ABCP with 1m maturity (long dashed line), liquidity guaranteed ABCP with 6m maturity (short dashed line) and liquidity guaranteed ABCP with 9m maturity (solid line). Panel (b) shows the value functions of credit guarantee (dotted line), liquidity guarantee for 1m ABCP (long dashed line), liquidity guarantee for 6m ABCP (short dashed line), and liquidity guarantee for 9m ABCP (solid line). Parameters are $r = 0.04$, $\mu = 0.03$, $\sigma = 0.5$, $y_w = 0.3$, and $y_0 = 1$.



(a) **Value functions of ABCP**



(b) **Value functions of credit vs. liquidity guarantee**

guarantee, particularly in the extreme situation of the ABCP market run. More importantly, the empirical tests on H1 and H2 can shed light on whether the market monitoring can reveal the loophole-exploiting banks, and allow us to further study whether these banks might adjust their leverages while facing the market pressure.

It is worth noting that the market monitoring of liquidity guarantee cost does not contradict the regulatory arbitrage literature, which claims that banks can increase their market value upon engaging in regulatory arbitrage activities (Boyson et al., 2016). Engaging in regulatory arbitrage allows banks to increase its leverage and volatility of assets value, which might increase the value of bank equity as a call option on the bank assets (Flannery 1994; Diamond Rajan 2000; Calomiris and Wilson 2004). In this paper, we focus on the BHCs that have already engaged in regulatory arbitrage activities facing increased *cost* of liquidity guarantee, and a lower bank value, due to higher credit losses from the conduit assets.

3.2 Market influence: Equilibrium capital ratios

Would a loophole-exploiting bank prepare more risk capital, conditional on an effective market monitoring? Specifically, would the bank be concerned whether its $K(y_t)$, driven by the market value of the equity capital and bank assets, can stay above the minimum requirement $\underline{K}$? How would such a concern affect the bank's choice of initial capital ratio $K(y_0)$?

To address these questions and highlight the difference between liquidity guarantee and credit guarantee, we consider two banks: a bank L that sponsors only liquidity guarantee, and a bank C that sponsors only credit guarantee. We then compare the dynamics of $K^L(y_t)$ and $K^C(y_t)$:

Proposition 4. *When the ABCP maturity $1/m$ approaches zero, bank L—whose initial capital ratio is the same as bank C—has its capital ratio $K^L(y_t)$ that is more sensitive to the shock in the underlying asset value than $K^C(y_t)$ when $y_t < y_0$, or $\frac{dK^L(y_t)}{dy_t} > \frac{dK^C(y_t)}{dy_t}$. Subsequently, bank L is more likely to violate the minimum capital requirement under any realized path of y_t.*

Hence, if both banks L and C have the same initial capital ratio, bank L would violate the minimum requirement $\underline{\kappa}$ *sooner*. Since banks manage their capital level by weighting the inefficiency of holding more capital in normal times and the cost of failing to meet the minimum capital requirement $\underline{K}$ during adverse times (Flannery, 1994; Myers and Rajan, 1998; Diamond and Rajan, 2000; Allen et al., 2011), Proposition 4 suggests that banks choose to use liquidity guaranteed ABCP financing—therefore exploiting the regulatory loophole—should maintain a higher level of equilibrium *initial* capital ratio, or the book-value based capital ratio, than those ABCP guarantor banks not exploiting the regulatory loophole.[25] We present the following hypothesis to test the effectiveness of market influence.

H3: Banks that use liquidity guaranteed ABCP financing, therefore exploiting the loophole of ABCP exclusion, tend to keep a higher capital ratio under an effective market influence.

We test the empirical hypotheses in the following sections.

[25]Standard results in stochastic optimization theory suggest that the bank should set the equilibrium initial capital ratio, be it $K^L(y_0)$ or $K^C(y_0)$, by keeping an optimal distance from the threshold level $\underline{K}$. This is also the intuition in the dynamic capital structure (Leland, 1994a; He and Xiong, 2012b)

4 Data and summary statistics

We combine the following six data sources for the empirical analysis: ABCP maturity and outstanding summary from the Federal Reserve, the financial statement information of U.S. BHCs from the Federal Reserve Board's FR Y-9C forms, ABCP conduit information from Moody's Investor Service, residential mortgage performance information from ABSNet, bank daily equity returns from Compustat and the Center for Research in Security Prices (CRSP), and general macroeconomic data from Federal Reserve Economic Data (FRED).

We start with the FR Y-9C quarterly data for publicly traded BHCs from April 2001, when FAS 140 became effective, to September 2009, when regulators proposed to eliminate the ABCP exclusion.[26] We also follow the Federal Reserve's convention by dropping BHCs with total assets less than \$10 billion during our sample period, since they face much less stringent regulations.[27] This renders 2,671 bank-quarter observations from 100 publicly traded U.S. BHCs, further referred to as the *full sample*.

We obtain the quarterly outstanding amount of ABCP conduits, conduit guarantee types, and the guarantor institution details from Moody's Investors Service, then manually match each guarantor with BHCs in the FR Y-9C quarterly data. We aggregage each guarantor's quarterly outstanding principal amounts across sponsored ABCP conduits by guarantee type.[28] A BHC is

[26] We believe the proposal of eliminating ABCP exclusion—published on Federal Register Vol. 74, No. 177 on September 15, 2009 jointly by the OCC, Federal Reserve, FDIC, and OTS—might have alerted liquidity guarantors, causing them to adjust their adoption of ABCP financing during 2009 Q4. Therefore, we do not include 2009 Q4 in our sample, even though the abortion of ABCP exclusion is officially announced on January 28, 2010.

[27] The Federal Reserve treats BHCs with \$10 billion or less in assets as small bank or community bank. See, e.g., Board of Governors of the Federal Reserve System, Community Banking, at `http://www.federalreserve.gov/bankinforeg/topics/community_banking.htm`. An alternative threshold is \$1 billion in assets, followed by the Office of the Comptroller of the Currency (OCC). See, e.g., Office of the Comptroller of the Currency (OCC), Community Bank Supervision: Comptroller's Handbook, January 2010, at `http://www.occ.treas.gov/publications/publications-by-type/comptrollers-handbook/cbs.pdf`. We choose the \$10 billion threshold over \$1 billion because ABCP guarantors are usually large BHCs with total assets greater than \$100 billion, so non-guarantor BHCs with book assets in the range of \$10 to \$1 billion are less comparable BHCs in the control group in our sample.

[28] We choose not to include the balance of alternative conduits, including Collateralized Debt Obligations (CDO), Asset Backed Securities (ABS), repurchase agreements, total return swaps, and mortgage warehouses. CDO and ABS are more complex structures in which some senior tranches are structured as ABCP. Some ABCP conduits have full credit guarantees as a repurchase agreement or a total return swap, which covers 100% of the ABCP balance. We drop these records because the repo and total return swap protection sellers, instead of BHCs, carry the credit risk. Some mortgage lenders use ABCP conduits as mortgage

Table 1: **List of loophole-exploiting BHCs**
This table lists all sample BHCs that have ever used liquidity guaranteed ABCP financing facilities during our sample period from April 2001 to September 2009. The total assets (FR Y-9C item BHCK2170) and liquidity guarantee are time-series averages by BHCs, in billions of U.S. dollar. The ratio is the size of liquidity guarantee outstanding relative to total assets in percentage.

	Total assets (Bil.)	Liquidity Gurantee (Bil.)	Ratio (%)
Bank of America Corp.	1366.928	23.788	1.935
Bank of New York Mellon Co.	273.862	0.48	0.219
Bank One Corp	281.227	39.543	14.144
Capital One Financial Corp.	102.454	1.235	1.307
Citigroup, Inc.	1665.629	54.488	3.519
Compass Bancshares	27.190	1.394	5.205
Fifth Third	96.820	2.361	2.496
First Union Corp.	249.445	8.553	3.429
FleetBoston Financial Corp.	197.608	2.732	1.388
J. P. Morgan Chase & Co	741.875	17.558	2.379
Keycorp	85.249	0.613	0.73
Mellon Financial Corp.	37.973	1.75	4.447
National City Corp.	102.232	2.463	2.46
PNC Financial Services Group	165.753	3.744	2.984
State Street Corp.	130.651	7.075	6.198
Suntrust Banks Inc.	156.201	3.249	2.075
U.S. Bankcorp	200.152	7.514	4.125
Wachovia Corporation	406.111	4.003	1.051
Zions Bancorporation	37.891	3.391	9.963

noted as a liquidity guarantor exploiting the ABCP exclusion regulatory loophole in a quarter if any conduit receiving the BHC's liquidity guarantee shows a positive outstanding amount of ABCP (Acharya et al., 2012; Kisin and Manela, 2016). Within the sample period, there are 18 liquidity guarantors, resulting in 396 bank-quarter observations of regulatory arbitrage activities. Table 1 lists their names, total assets, and the absolute and relative size of liquidity guarantee outstanding.

Table 2 reports summary statistics of the quarterly balance sheet information of our sample BHCs. Column (1) covers the full sample of publicly-traded U.S. BHCs with total assets greater than \$10 billion. Column (2) shows the respective summary statistics of 18 loophole-exploiting liquidity guarantors, while Column (3) summarizes the remaining BHCs.[29] Finally, Column (4)

warehouses to provide the working capital and fund the newly originated mortgage loans that have not yet been moved into a mortgage pool for securitization. The mortgage lenders, as sponsors, are in many ways different from regular BHCs. Naturally, we also skip other conduits with non-BHC guarantors.

[29]Notice that eight BHCs started to use liquidity-guaranteed ABCP conduits later than April 2001, so they appear as non-liquidity guarantors in the earlier periods and as liquidity guarantors later. Hence, the sum of the numbers of BHCs reported in Columns (2) and (3) is greater than the number of BHCs reported

shows the difference in means, as well as the standard error of the difference, between liquidity guarantors and others.[30] Consistent with the findings of Covitz et al. (2013), liquidity guarantors are significantly larger and hold more cash or cash equivalents but fewer real estate loans. The matching procedure followed later in the study is designed to address the significant differences.

To study how market discipline affects the franchise value of BHCs as the daily ABCP market condition and ABCP conduit qualities change, we construct a BHC-day panel data set that includes sample BHCs' daily stock price and market value from CRSP. More importantly, to test hypotheses H1 and H2, we construct daily U.S. ABCP maturity measures and BHCs' guarantee exposure to the deterioration of guaranteed ABCP conduits, as shown below.

4.1 ABCP maturity

Although U.S. ABCP maturity ranges from overnight to 270 days, Covitz et al. (2013) highlight that ABCP investors tend to gravitate toward the shortest maturity paper when they start to be concerned about the ABCP market condition. Hence, Covitz et al. (2013) use the relative amount of ABCP outstanding with *overnight* maturity—the shortest possible maturity that allows investors to close positions quickly if necessary while remaining invested otherwise—to the total ABCP outstanding as a measure of average ABCP maturity because it better reflects the investors' perceptions of the ABCP market than other maturities. Therefore, we follow Covitz et al. (2013) and calculate our ABCP maturity measure OVN_t as:

$$\mathrm{OVN}_t = \left[\frac{\text{Outstanding of ABCPs that are maturing overnight}}{\text{Total ABCP outstanding}}\right]_t . \qquad (1)$$

A higher overnight share OVN_t implies that ABCP investors demand more guarantee support on day t.[31] On average, 7.4% of the outstanding ABCPs mature overnight, whereas the ratio peaks at 21.68% during the ABCP run. Figure 5 displays the daily fractions of ABCP maturing overnight

in Column (1), whereas the sum of bank-quarter observations in two subsamples equals the total number of bank-quarter observations.

[30] The definitions of balance sheet variables are provided in Table A.1 in Appendix.

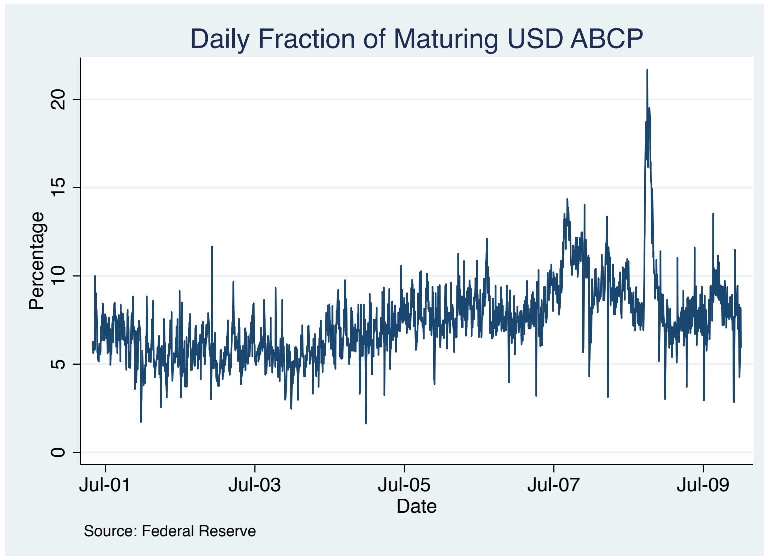
[31] We calculate the total ABCP outstanding and the outstanding of ABCP maturing overnight using the daily amount of newly issued U.S. ABCP with the highest credit rating by maturities from Federal Reserve at `https://www.federalreserve.gov/datadownload/choose.aspx?rel=CP`.

Table 2: **Summary statistics of BHCs**

The sample consists of all publicly-traded U.S. BHCs, including ABCP liquidity guarantors, with more than $10 billion total assets from April 2001 to September 2009. Column (1) shows the sample means and standard deviations. Column (2) shows the means and standard deviations of variables for BHCs that exploited the ABCP exclusion through liquidity-guaranteed ABCP conduits, whereas Column (3) shows the means and standard deviations for the remaining sample BHCs. Column (4) shows the differences in means between two subsamples and the corresponding standard errors. The balance sheet variable definitions are provided in the Appendix. Notice that eight BHCs started to use liquidity-guaranteed ABCP conduits later than April 2001, so they appear as non-liquidity-guarantors in the earlier periods and as liquidity guarantors later. Hence, the sum of the numbers of BHCs reported in Columns (2) and (3) is greater than the number of BHCs reported in Column (1), whereas the sum of bank-quarter observations in two subsamples equals the total number of bank-quarter observations. Standard deviations are in parentheses and standard errors are in brackets. Significance: $^{*}\, p < 0.10$; $^{**}\, p < 0.05$; $^{***}\, p < 0.01$.

	All	Liquidity Guarantor	Other	Diff.
	(1)	(2)	(3)	(4)
Total Assets (Bil.)	119.27	318.69	79.39	239.30***
	(265.79)	(434.86)	(197.89)	[64.91]
Liquidity guarantee (Bil.)	1.81	10.88	0.00	10.88***
	(8.14)	(17.68)	(0.00)	[1.83]
Credit guarantee (Bil.)	0.53	2.42	0.15	2.27***
	(2.25)	(4.28)	(1.31)	[0.54]
Cash Ratio	0.05	0.07	0.04	0.03***
	(0.05)	(0.08)	(0.04)	[0.01]
Loan to assets	0.60	0.53	0.61	-0.07
	(0.18)	(0.21)	(0.18)	[0.05]
RE loan to assets	0.36	0.25	0.38	-0.13***
	(0.17)	(0.15)	(0.17)	[0.04]
Security to assets	0.21	0.19	0.22	-0.03
	(0.12)	(0.09)	(0.13)	[0.03]
FS security to assets	0.18	0.18	0.18	0.00
	(0.09)	(0.09)	(0.09)	[0.02]
Deposit to assets	0.63	0.59	0.64	-0.05
	(0.18)	(0.09)	(0.19)	[0.05]
ROA (%)	0.26	0.28	0.25	0.03
	(0.35)	(0.15)	(0.38)	[0.09]
EPS	0.52	0.64	0.50	0.14
	(0.73)	(0.36)	(0.78)	[0.19]
N. of Banks	100	18	90	
Obs.	2671	396	2275	

Figure 5: **USD ABCP maturing overnight**
The daily time series of outstanding ABCP with overnight maturity. The maturity of ABCP shortened during the 2007 ABCP market freeze.



during the sample period.

4.2 BHCs' exposure to ABCP collateral delinquency

To measure each BHC's exposure to the potential losses of guaranteed ABCP conduits, we need the BHC's guarantee obligation outstanding and, ideally, the credit performance of collateral in each ABCP conduit . Unfortunately, it is hard to obtain the credit performance by ABCP conduit due to the opaqueness of off-balance-sheet financing. Nevertheless, Acharya et al. (2012) and Covitz et al. (2013) show that the deteriorating subprime mortgage was the major reason for the 2007 ABCP market run. Furthermore, Ben Bernanke also pointed out in 2007 that, when subprime mortgage delinquency started to rise, "*the problems in the mortgage-related sector reverberated throughout the financial system and particularly in the market for asset-backed commercial paper.*"[32] These sources suggest that the increase in subprime mortgage delinquency and default closely relates to the marginal credit loss of ABCP collateral assets.

A typical ABCP conduit's collateral is usually well-diversified, containing billions of dollars in

[32]See Fed Chairman Ben Bernanke's speech "The Recent Financial Turmoil and its Economic and Policy Consequences" in October 2007, available at `https://www.federalreserve.gov/newsevents/speech/bernanke20071015a.htm`.

diversified mortgage loans, or subprime mortgage related CDO tranches (Financial Crisis Inquiry Commission, 2011).[33] Therefore, we use the nation-wide average monthly subprime mortgage performance, as in Demyanyk and Van Hemert (2011), as the proxy for expected future credit losses in ABCP conduits. We follow Fuster and Willen (2017) and use the aggregate monthly balance of over 60-day delinquent loans over total balance of U.S. subprime mortgage as proxy of the marginal credit loss of conduit assets as the measure of mortgage performances, calculated using the following formula:[34]

$$\text{Mortgage Delq}_t = \left[\frac{\text{Balance of over 60-day delinquent subprime mortgages}}{\text{Balance of subprime mortgages}}\right]_t \tag{2}$$

Figure 6 presents the delinquency ratio during the sample period.[35] Table A.4 in Appendix A.3.4 validates the connection between mortgage delinquency and the overall ABCP market condition.

Aside from the loss in the ABCP conduits, each BHCs' ABCP guarantee exposure is also determined by the credit and liquidity guarantees outstanding relative to the BHC's size. Hence, we construct date t BHC-specific relative exposure to delinquent conduit assets as the product of the BHC's total outstanding liquidity-guaranteed conduits and the percentage of over 60-day subprime mortgage delinquent ratios, normalized by the BHC's book value:

$$\text{LG Delq. Exposure}_{i,t} = \frac{\text{Outstanding of liquidity-guarantee}_{i,t} \times \text{Mortgage Delq}_t}{\text{Book value}_{i,t}}. \tag{3}$$

Furthermore, we construct the CG Delq. Exposure$_{i,t}$ in a similar fashion using bank i's outstanding amount of credit guarantee at date t.

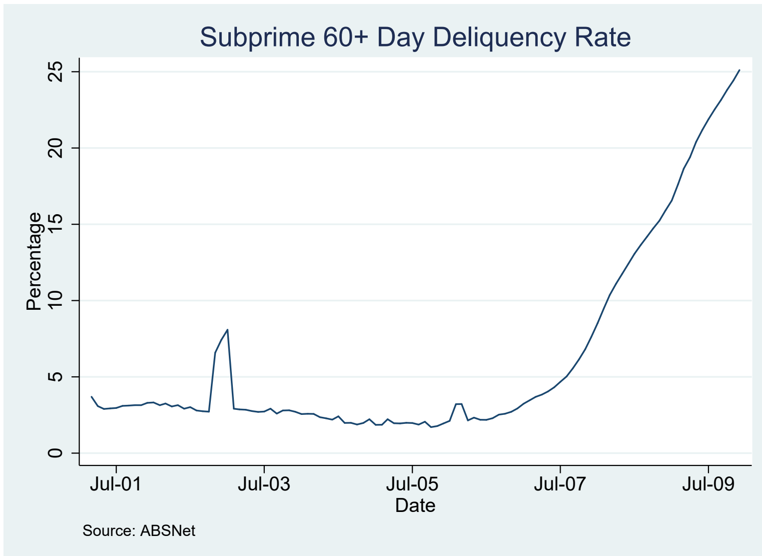
The three aforementioned datasets—BHCs' daily equity value, ABCP market condition OVN$_t$, guarantors' delinquency exposures LG Delq. Exposure$_{i,t}$ and CG Delq. Exposure$_{i,t}$—are then merged with each BHC's balance sheet information of the most recent quarter-end to construct a BHC-day

[33] CDO tranches are further diversified as each of the tranches is a securitized product backed by a diversified pool of assets including mortgages.

[34] Hayre, Saraf, Young, and Chen (2008) highlight the importance of the 60-day delinquency rate as borrowers who are over 60 days delinquent typically do not return to current.

[35] Although the delinquency ratio presents a clear upward trend during the sample period, the trend is unlikely to lead to spurious regression estimates since we use the *change* in ABCP conduit credit risk, which is the product of the delinquency ratio and the bank's relative conduit exposure, as our regression variable.

Figure 6: **Subprime mortgage 60+ day delinquency ratio**
The delinquency status of U.S. subprime mortgage loans. We aggregate the monthly balance of over 60-day delinquent subprime mortgage loans and normalize it with the monthly total current balance of subprime mortgage loans. The delinquency rate fluctuated but remained stable before mid-2006, then started to pick up as the U.S. housing market softened. By the end of 2009, about 25% of the subprime loans are over 60 days delinquent.



panel using the CRSP-FRB linking file from the Federal Reserve of New York.[36] We also augment the panel with common market and macroeconomic factors, including U.S. GDP, the change in target Fed Fund rate, and the magnitude of QE.[37]

5 Empirical analysis

5.1 Matching

The summary statistics for the sample BHCs in Table 2 show that the loophole-exploiting BHCs are larger and have a different capital structure than the rest of the sample BHCs. These differences imply that the control group's observed franchise values or risk capital ratios may not be the counterfactual outcomes to the regulatory-arbitraging BHCs. To address such empirical challenges, we use two different matching methods: propensity score weights and Mahalanobis matching.

[36]See `https://www.newyorkfed.org/research/banking_research/datasets.html`

[37]The GDP data are from Macroeconomic Advisers LLC, and the QE data are from the weekly MBS purchase amount published by the Federal Reserve.

5.1.1 Propensity score method

We construct the propensity score measure of Rosenbaum and Rubin (1983) by investigating the determinants of regulatory arbitrage and provide insights into a suitable control model for subsequent analysis. Specifically, we estimate the following logit model for the full sample:

$$\log \frac{p_{i,q}}{1 - p_{i,q}} = \alpha_q + \beta \mathbf{X}_{i,q} + \epsilon_{i,q}, \tag{4}$$

where $p_{i,q}$ is the probability of bank i providing a liquidity guarantee to an ABCP conduit in quarter q. We include the quarter fixed effects, α_q to control for the economy-wide factors, including the development of the ABCP market, which can make the ABCP financing facility more accessible.

The matrix $\mathbf{X}_{i,q}$ contains the selected characteristics for bank i in quarter q. Besides the log of book assets, we also include the bank's cash ratio since the guarantors are expected to provide liquidity when the commercial paper rollover fails. Furthermore, Covitz et al. (2013) prove that banks set up ABCP conduits as an alternative financing channel that allows them to move assets, in particular mortgages, off their balance sheets. Therefore, we focus on the share of loans, particularly real estate loans, as they can affect the bank's decision regarding the use of ABCP liquidity financing. We also control the share of on-balance-sheet securities, particularly securities that are marked as "for sale," which are more likely to be moved to ABCP conduits. Finally, following the standard bank capital structure literature (Gropp and Heider, 2010), we add additional controls, including the deposit-to-asset ratio to control for the bank liability mix, as well as return on assets (ROA) and earnings per share (EPS) to control for bank profitability.[38]

Columns (1) and (2) of Table 3 present the results from regression (4), without and with the quarter fixed effects, respectively. We observe that the BHCs' likelihood of exploiting the ABCP exclusion is positively associated with the bank size, loan-to-assets ratio, and security-to-assets ratio, which is consistent with the findings of Covitz et al. (2013). In addition, we find that ABCP guarantors have fewer real estate loans on balance sheet, likely due to the fact that real-estate loans are a popular choice of long-term assets to be financed by the ABCP financing facility. Our

[38] We choose not to include banks' capital ratios because doing so defies our analysis of market influence, in which we study how U.S. stock market influences a liquidity guarantor's choice of risk capital adequacy.

analysis shows the decision to exploit the ABCP exclusion varies systematically with the potential benefit of regulatory arbitrage (Boyson et al., 2016). We use the propensity weighting calculated from the regression with quarter fixed effects, reported in Column (2) of Table 3, in the subsequent empirical tests of market discipline.

5.1.2 Mahalanobis matching

We also construct a matched control group for loophole-exploiting BHCs following Abadie and Imbens (2016). First, following the analysis presented in Section 5.1.1, which discusses how balance sheet characters and bank performance indicators might affect the bank's regulatory arbitrage decision, we calculate the Mahalanobis distance between the balance sheet characters of each liquidity guarantor in their *first* year of exploiting the ABCP exclusion and the remaining BHCs in the same period. Next, we match each liquidity guarantor with the smallest Mahalanobis distance counterparty without replacement. The resulting Mahalanobis matched sample contains 18 liquidity guarantors and 18 matched non-liquidity-guarantors.

Table 4 reports the summary statistics of the matched sample, in a structure similar to Table 2. Column (1) shows the summary statistics of the entire matched sample. Columns (2) and (3) show the summary statistics of the loophole-exploiting BHCs and the Mahalanobis matched control group, respectively. Column (4) shows the differences in mean, as well as the standard error of the difference, between the two matched subsamples. In constrast to the significant differences in sizes and capital structure shown in Table 2 between loophole-exploiting BHCs and the control group, the Mahalanobis matched control group no longer differs significantly from the loophole-exploiting BHCs. Therefore, using the matched sample alleviates the concern that loophole-exploiting BHCs are larger and have different capital structure.[39]

Abadie and Imbens (2016) argue that the Mahalanobis matching is more robust than the propensity score method. Nevertheless, the propensity score method is more flexible allows banks to have time-varying weights according to the estimated propensity, whereas the one-to-one Mahalanobis

[39]To provide further evidence on the matching quality, we show the comparable distributions between loophole-exploiting BHCs and their Mahalanobis-matched counterparties in Appendix A.3.3.

Table 3: **Logit regression**
The table provides the logit estimates of a BHC's probability of exploiting the ABCP exclusion in a quarter, using the quarterly data from April 2001 to September 2009 for all publicly-traded U.S. BHCs with $10B+ total assets. Column (1) presents the estimates without time fixed effects, whereas Column (2) shows the estimates with the time fixed effects. Bank balance sheet variable definitions are provided in the Appendix. Standard errors are reported in parentheses. Significance: $^{*}\,p < 0.10$; $^{**}\,p < 0.05$; $^{***}\,p < 0.01$.

	Logit	
	(1)	(2)
log(Total assets)	1.51***	1.62***
	(0.08)	(0.09)
Cash ratio	9.04***	10.30***
	(1.53)	(1.55)
Loan to assets	8.12***	8.59***
	(1.10)	(1.14)
RE loan to assets	-5.51***	-5.31***
	(0.82)	(0.86)
Security to assets	3.59*	4.19**
	(1.89)	(1.93)
FS security to assets	6.10***	6.11***
	(1.87)	(1.91)
Deposit to assets	3.28***	3.37***
	(0.68)	(0.69)
ROA (%)	0.56*	0.03
	(0.33)	(0.39)
EPS	-0.04	-0.02
	(0.13)	(0.16)
Quarter FE	No	Yes
Obs.	2671	2671
Pesudo R^2	0.41	0.43
χ^2	913.57	953.99

Table 4: **Summary statistics of Mahalanobis matched sample**

The sample consists of all publicly-traded U.S. ABCP liquidity guarantors and the counterparties, among the remaining full sample of banks, with the smallest Mahalanobis distance by balance sheet characters. The matched balance sheet characters including asset size, cash ratio, loan to assets ratio, real estate loan to asset ratio, security to assets ratio, for-sale security to asset ratio, deposit to assets ratio, as well as bank performance information including return on equity and return on assets. Specifically, Column (1) shows the sample mean and standard deviations of the matched sample. Column (2) shows the means and standard deviations of variables for liquidity guarantors. Column (3) shows the means and standard deviations for the matched other BHCs. Column (4) shows the differences in means between two subsamples and the corresponding standard errors. Bank balance sheet variable definitions are provided in the Appendix. Standard deviations are in parentheses and standard errors are in brackets. Significance: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

	All (1)	Liquidity guarantor (2)	Matched other BHCs (3)	Diff. (4)
Total Assets (Bil.)	247.55	318.69	176.40	142.29
	(363.36)	(434.86)	(268.35)	[120.44]
Liquidity guarantee (Bil.)	5.44	10.88	0.00	10.88**
	(13.50)	(17.68)	(0.00)	[4.17]
Credit guarantee (Bil.)	1.21	2.42	0.00	2.42**
	(3.22)	(4.28)	(0.00)	[1.01]
Cash Ratio	0.06	0.07	0.06	0.02
	(0.07)	(0.08)	(0.06)	[0.02]
Loan to assets	0.55	0.53	0.56	-0.03
	(0.23)	(0.21)	(0.25)	[0.08]
RE loan to assets	0.28	0.25	0.32	-0.07
	(0.17)	(0.15)	(0.18)	[0.05]
Security to assets	0.18	0.19	0.17	0.02
	(0.10)	(0.09)	(0.11)	[0.03]
FS security to assets	0.17	0.18	0.16	0.02
	(0.10)	(0.09)	(0.11)	[0.03]
Deposit to assets	0.59	0.59	0.59	-0.00
	(0.19)	(0.09)	(0.26)	[0.06]
ROA (%)	0.29	0.28	0.29	-0.02
	(0.18)	(0.15)	(0.22)	[0.06]
EPS	0.81	0.64	0.97	-0.34
	(0.94)	(0.36)	(1.28)	[0.31]
N. of Banks	36	18	18	
Obs.	823	396	427	

matching lasts throughout the sample period. Hence, we adopt both methods in the analysis to ensure that the empirical results are not the consequence of a particular matching method choice.

5.2 Market monitoring

We now investigate whether the capital market monitors loophole-exploiting BHCs. We begin by testing our first main hypothesis (H1) developed in Section 3.1, that is, whether the U.S. stock market notices that a drop in ABCP maturity causes ABCP conduit credit losses to remain with liquidity guarantor.

Specifically, we measure the bank franchise value using Tobin's q (Keeley, 1990; Demsetz, Saidenberg, and Strahan, 1996; Gonzalez, 2005; Park and Peristiani, 2007). We follow the details in Keeley (1990) and Demsetz et al. (1996) and construct Tobin's q, $q_{i,t}$, for BHC i on date t, using the daily bank stock price and the book value of assets and equity in the most recent quarter end. We then regress the date t change in BHC i's franchise value, $\Delta q_{i,t}$, with the *interaction* of change in ABCP maturity $\Delta \mathrm{OVN}_t$ and the BHC's liquidity guarantee exposure ΔLG Delq. Exposure$_{i,t}$, developed in Sections 4.1 and 4.2, respectively.

Admittedly, one could argue that some market- or economy-wide latent factors, such as financial crisis or business cycle, might also lower BHCs' franchise value, cause ABCP investors to flock to short maturity papers, lead to a higher subprime mortgage deliquency ratio, and elevate guarantor's deliquency exposure simultaneously. Nevertheless, these latent factors are unlikely to cause market responses to the sponsors' liquidity guarantee obligations to differ from their credit guarantee obligations.[40] Therefore, investigating a bank's credit guarantee obligation would help to alleviate the concern about latent factors, since Proposition 3 suggests that the credit guarantee is unaffected by the interactions between ABCP maturity and underlying conduit loss. In other words, if the bank franchise value varies with the interaction of ABCP maturity and liquidity guaranteed ABCP conduit exposure, but not with credit-guaranteed ABCP conduit exposure, then the bank franchise value change is more likely to be driven by market monitoring.

[40] In particular, notice that a higher subprime mortgage deliquency ratio would increase both LG Delq. Exposure$_{i,t}$ and CG Delq. Exposure$_{i,t}$.

In summary, we test our hypotheses using the following model

$$\begin{aligned}\Delta q_{i,t} &= \alpha_i + \beta_0 \times \Delta\text{OVN}_t \\ &+\beta_1 \times \Delta\text{LG Delq. Exposure}_{i,t} + \beta_2 \times \Delta\text{OVN}_t \times \Delta\text{LG Delq. Exposure}_{i,t} \\ &+\beta_3 \times \Delta\text{CG Delq. Exposure}_{i,t} + \beta_4 \times \Delta\text{OVN}_t \times \Delta\text{CG Delq. Exposure}_{i,t} \\ &+\beta_5 \times \mathbf{X}_{i,t} + \beta_6 \times \mathbf{Y}_t + \varepsilon_{i,t}, \end{aligned} \tag{5}$$

under both the full sample using the propensity weight estimated using Equation (4) and the Mahalanobis matched sample. The main coefficients of interest are β_2 and β_4, which corresponds to our empirical hypothesis H1 and H2, respectively. Bank balance sheet variables $\mathbf{X}_{i,t}$ contain the same set of bank characteristics we have used in the matching process in Equation (4). The macroeconomic and Federal Reserve Intervention condition control variables $\mathbf{Y}_t$ include magnitude of the Federal Reserve's QE during the financial crisis, using the weekly mortgage-backed security purchase amount, the change in target Fed funds rate, and GDP growth.

Columns (1) through (3) of Table 5 show the regression results using the full sample with propensity score weighting. Consistent with effective market monitoring (H1), the interaction between maturity and the bank's liquidity guarantee risk, $\Delta\text{OVN}_t \times \Delta\text{LG Delq. Exposure}_{i,t}$, significantly affects the guarantors' franchise values. For a liquidity guarantor with average exposure (\$10.9 billion), size (\$319 billion), and facing an average monthly mortgage delinquency rate increase of 0.416%, a one standard deviation increase in percentage share of ABCPs maturing overnight (1.140%) leads to an annualized change of -0.77% in Tobin's q.[41] Columns (4) through (6) show the regression estimates using the Mahalanobis matched sample. The estimates suggest an annualized change of -0.62% in Tobin's q, very close to the estimates of propensity score weighted analysis. Moreover, consistent with H2, the interaction between maturity and the bank's credit guarantee risk does not significantly change the bank's returns. Finally, we notice the market-wide MBS purchases and target Fed fund rates cuts lead to higher bank franchise values, suggesting the Federal Reserve's intervention helped to improve the healthiness of banking sector. Nevertheless, the Federal Reserve's interventions do not affect market monitoring much, as the estimates remain

[41] Specifically, the annual change in the Tobin's q is $-13.20 \times \frac{10.9}{319} \times 0.00416 \times 0.0114 \times 360 = -0.77\%$.

stable after we control for macroeconomic condition and the intervention of the Federal Reserve.

Our empirical estimates demonstrate that the U.S. stock market is aware of the increased conduit credit losses incurred by ABCP liquidity guarantors when ABCP maturity falls, even though such scenario is not fully considered in capital regulations, which requires a fixed 10% risk capital for outstanding ABCP regardless of ABCP maturity. This finding extends the literature of market discipline beyond BHCs' on-balance-sheet activities, such as maturity mismatches (Flannery and James, 1984), deposit credits (Martinez Peria and Schmukler, 2001; Demirgüç-Kunt and Huizinga, 2004), and subordinated debentures (Avery et al., 1988; Gorton and Santomero, 1990; Ashcraft, 2008). Despite the complexity in shadow banking systems (Pozsar et al., 2010), the U.S. stock market is efficient enough to differentiate the loophole-exploiting guarantee exposure from similar credit guarantee obligations that do not facilitate regulatory arbitrage.

Our findings also relate to Acharya et al. (2012), who provide empirical evidence of regulatory arbitrage among ABCP guarantors by showing that BHCs with a high conduit exposure—more regulatory arbitrage positions—turned out to be the riskier BHCs during the ABCP run in August 2007, from August 8–10 in particular, but *not* in other months. Our paper explicitly recognizes the effect of ABCP maturity on the liquidity guarantee costs; we find that the ABCP maturity and deterioration of ABCP conduit assets jointly affect bank franchise values in our sample period, which includes both the turmoil and quiet years before the crisis.

5.2.1 Guarantor subsample and the impact of Federal Reserve's intervention

In response to the ABCP market meltdown and subsequent shock in the commercial paper market due to Lehman's bankruptcy, the Federal Reserve launched AMLF to provide short-term loans to enhance the liquidity of ABCP guarantors when the major commercial paper investors (mostly MMMFs) were liquidating their investments (Duygan-Bump et al., 2013). In this section, we focus on the ABCP liquidity guarantor subsample and evaluate the impact of the Federal Reserve's intervention—AMLF in particular—on ABCP guarantors and the effectiveness of market monitoring.[42]

[42] We thank an anonymous referee for suggesting this test.

Table 5: **Market monitoring: bank Tobin's q and guarantee exposure**

The table provides estimates for the model presented in Equation (5) using sample data from April 2001 to September 2009. Columns (1) through (3) present the propensity score weighted estimates using all publicly-traded U.S. BHCs with \$10B+ total assets. Columns (4) through (6) present the OLS estimates using the matched sample. The dependent variable is the change in bank i's Tobin's q on date t. For the explanatory variables, ΔOVN_t measures the change in the ratio of ABCP outstanding matures overnight on date t. ΔLG Delq. $\text{Exposure}_{i,t}$ and ΔCG Delq. $\text{Exposure}_{i,t}$ are the products of the change in subprime mortgage delinquency rate on date t, multiplies the principal of liquidity guaranteed ABCP conduit and credit guaranteed ABCP conduit respectively, normalized by the bank's book value. Bank balance sheet variable definitions are provided in the Appendix. BHC and time-period clustered standard errors are reported in parentheses. Significance: $^{*}\, p < 0.10$; $^{**}\, p < 0.05$; $^{***}\, p < 0.01$.

Variable	Δ Tobin's q					
	Propensity score weighted			Matched		
	(1)	(2)	(3)	(4)	(5)	(6)
Δ OVN × Δ LG Delq. Exposure	-13.52***	-13.32***	-13.20**	-10.98***	-10.72***	-10.59**
	(5.10)	(5.09)	(5.18)	(4.15)	(4.14)	(4.18)
Δ OVN × Δ CG Delq. Exposure	-11.79	-11.76	-11.83	-9.40	-9.16	-9.28
	(16.94)	(16.90)	(16.76)	(16.39)	(16.37)	(16.29)
Δ LG Delq. Exposure	-0.01	0.00	-0.00	0.01	0.02	0.01
	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)
Δ CG Delq. Exposure	0.18	0.19	0.14	0.16	0.20	0.16
	(0.15)	(0.16)	(0.16)	(0.14)	(0.15)	(0.15)
Δ OVN	-0.42**	-0.42**	-0.53***	-0.32**	-0.32**	-0.38***
	(0.17)	(0.17)	(0.17)	(0.15)	(0.15)	(0.15)
log(Total assets)		-0.03***	-0.04***		-0.03***	-0.04***
		(0.01)	(0.01)		(0.01)	(0.01)
Cash ratio		0.10	0.06		0.09	0.06
		(0.18)	(0.18)		(0.12)	(0.12)
Loan to assets		0.00	-0.02		-0.04	-0.07
		(0.09)	(0.09)		(0.12)	(0.12)
RE loan to assets		0.14**	0.16***		0.09	0.10
		(0.06)	(0.06)		(0.08)	(0.08)
Security to assets		0.20**	0.20**		0.07	0.07
		(0.09)	(0.09)		(0.11)	(0.11)
FS security to assets		-0.01	-0.02		0.06	0.05
		(0.06)	(0.06)		(0.08)	(0.08)
Deposit to assets		0.09*	0.08*		0.04	0.03
		(0.05)	(0.05)		(0.06)	(0.06)
ROA (%)		-0.02	-0.02		-0.00	-0.00
		(0.03)	(0.03)		(0.02)	(0.02)
EPS		0.01	0.01		0.00	0.00
		(0.01)	(0.01)		(0.01)	(0.01)
Fed MBS Purchase			0.97***			0.75***
			(0.15)			(0.17)
Δ Fed Fund Rate			-0.28***			-0.17***
			(0.03)			(0.03)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	No	No	Yes	No	No	Yes
Obs.	177530	177530	177530	59461	59461	59461
Adj. R^2	0.000303	0.000661	0.00289	0.000506	0.001000	0.00342
F-Statistics	3.172	3.973	9.868	2.629	2.934	5.240

Using the Federal Reserve's AMLF transaction data, each guarantor's daily amount of net funding obtained from the facility is calculated and normalized by the guarantor's size.[43] We then re-run regression (5) using the liquidity guarantors subsample, with the change in outstanding AMLF borrowings as an additional BHC-specific control, along with the existing controls of the Fed funds rate and Fed MBS purchases. Using the liquidity guarantors subsample also helps to alleviate the concern that the empirical results in Table 5 are driven by the inclusion of non-guarantor BHCs through the matched samples.

Column (1) of Table 6 reports the panel regression estimate of our baseline specification in Equation (5), using liquidity guarantor-only sample. The estimated effect of market monitoring among liquidity guarantors is very close to the estimate in Table 5. We then add the control for guarantor's participation in Federal Reserve's AMLF program and present the results in Column (2). Unlike the market-wide MBS purchase and target Fed fund rate cuts, which result in higher bank franchise values, AMLF had no significant impact on participants' franchise values, most likely because banks suffered higher loss from their ABCP guarantee obligation were more likely to borrow from AMLF. More importantly, when the BHC-specific AMLF usage is included, the effect of market monitoring remains unchanged, indicating that the AMLF does not interfere with market monitoring.

5.2.2 Low-capitalized banks and regulatory arbitrage

Our interpretation of the evidence presented so far is that the U.S. stock market is aware of the increase in liquidity guarantee costs when shortened ABCP maturity causes the conduit credit losses to remain with the guarantor. Additionally, the value of BHC franchises drops due to the liquidity guarantee obligations rather than economy-wide latent factors, which is evident from the market's differential responses toward a BHC's liquidity- versus credit-guarantee exposure. In this section, we further investigate the specific role of regulatory arbitrage, rather than any other liquidity-guarantee-related factors, in market monitoring.

For simplicity, our theoretical model focuses on the cost of guarantee obligations and does not

[43] The AMLF data are available at `https://www.federalreserve.gov/regreform/reform-amlf.htm`.

Table 6: **Market monitoring: ABCP guarantor BHCs subsample**

Column (1) presents OLS estimates for the model presented in Equation (5) using the sample data of ABCP liquidity guarantor BHCs only, from April 2001 to September 2009. The dependent variable is the change in bank i Tobin's q on date t. For the explanatory variables, ΔOVN_t measures the change in the ratio of ABCP outstanding matures overnight on date t. ΔLG Delq. $\text{Exposure}_{i,t}$ and ΔCG Delq. $\text{Exposure}_{i,t}$ are the products of the change in subprime mortgage delinquency rate on date t, multiplies the principal of liquidity guaranteed ABCP conduit and credit guaranteed ABCP conduit respectively, normalized by the bank's book value. Federal Reserve's MBS purchase refers to the net Fed purchase of MBS on date t, and ΔFed Fund Rate are the changes in effective Fed Fund Rate on date t. Column (2) presents the OLS estimates with additional control of Fed AMLF, which reflects each guarantor's borrowing from AMLF normalized by its size on date t. Bank balance sheet variable definitions are provided in the Appendix. BHC and time-period clustered standard errors are reported in parentheses. Significance: $^{*}\, p < 0.10$; $^{**}\, p < 0.05$; $^{***}\, p < 0.01$.

Variable	Δ Tobin's q	
	(1)	(2)
Δ OVN $\times$ Δ LG Delq. Exposure	-13.29***	-13.29***
	(5.14)	(5.14)
Δ OVN $\times$ Δ CG Delq. Exposure	-2.95	-2.89
	(19.09)	(19.08)
Δ LG Delq. Exposure	0.00	0.00
	(0.04)	(0.04)
Δ CG Delq. Exposure	0.17	0.18
	(0.24)	(0.24)
Δ OVN	-0.46	-0.46
	(0.30)	(0.30)
Fed AMLF		-3.30
		(5.58)
Fed MBS Purchase	0.72***	0.72***
	(0.20)	(0.20)
Δ Fed Fund Rate	-0.24***	-0.24***
	(0.06)	(0.06)
Bank FE	Yes	Yes
Balance Sheet Controls	Yes	Yes
Macro Controls	Yes	Yes
Obs.	25994	25994
Adj. R^2	0.00631	0.00636
F-Statistics	2.818	2.679

explicitly feature how bank value varies with regulatory capital. Nonetheless, the extant literature on bank capital structure suggests that an increase in the guarantee costs should more severely impair the value of a bank with lower capital, as the bank is more likely to breach the minimum capital requirements (Flannery and James, 1984; Diamond and Rajan, 2000).[44] Therefore, by investigating whether the drops in bank franchise values are more substantial on guarantors with less risk capital buffer, we can test whether the market penalizes loophole-exploiting BHCs due to the risk capital shortfall induced by the liquidity guarantee obligation.

Specifically, we measure the market monitoring across ABCP liquidity guarantors with different levels of Tier-1 capital ratios. As the summary statistics of Tier-1 capital ratios presented in Panel (a) of Table 7 shows, the average Tier-1 capital ratio among loophole-exploiting BHCs is 9.47%. We then introduce a dummy variable $\mathbf{1}_{i,t}^{\{\text{Lower Capital}\}}$ takes the value of 1 when the guarantor i's tier-1 risk capital ratio is lower than the average level of 9.47% at the closest quarter-end before date t, and 0 otherwise. Subsequently, we estimate the following OLS model:

$$\begin{aligned}
\Delta q_{i,t} \quad = \quad & \alpha_i + \beta_0 \times \mathbf{1}_{i,t}^{\{\text{Lower Capital}\}} \\
& + \beta_1 \times \Delta\text{OVN}_t + \beta_2 \times \Delta\text{LG Delq. Exposure}_{i,t} + \beta_3 \times \Delta\text{OVN}_t \times \Delta\text{LG Delq. Exposure}_{i,t} \\
& + \beta_4 \times \mathbf{1}_{i,t}^{\{\text{Lower Capital}\}} \times \Delta\text{OVN}_t + \beta_5 \times \mathbf{1}_{i,t}^{\{\text{Lower Capital}\}} \times \Delta\text{LG Delq. Exposure}_{i,t} \\
& + \beta_6 \times \mathbf{1}_{i,t}^{\{\text{Lower Capital}\}} \times \Delta\text{OVN}_t \times \Delta\text{LG Delq. Exposure}_{i,t} \\
& + \beta_7 \times \mathbf{X}_{i,t} + \beta_8 \times \mathbf{Y}_t + \varepsilon_{i,t}. \qquad (6)
\end{aligned}$$

The empirical estimates presented in Panel (b) of Table 7 show that, when faced with an average monthly mortgage delinquency rate change and a one standard deviation increase in percentage share of ABCPs maturing overnight, guarantors with average ABCP exposure but below-average Tier-1 risk capital ratio see an additional annualized drop of 1.68% in Tobin's q.[45] The empirical findings in Table 7 are consistent with the predictions of the literature on bank capital structure

[44] We thank an anonymous referee for calling our attention to this analysis.

[45] The regression coefficient −28.85 translates into a $-28.85 \times \frac{10.9}{319} \times 0.00416 \times 0.0114 \times 360 = -1.68\%$ annualized drop in the Tobin's q for a liquidity guarantor with average exposure ($10.9 billion), size ($319 billion), and facing an average delinquency rate increase of 0.416%, a one standard deviation increase in percentage share of ABCPs maturing overnight (1.140%)

(Flannery and James, 1984; Diamond and Rajan, 2000). More importantly, conditional on the increase in the liquidity guarantee cost, the U.S. market response is more sensitive to the guarantors with a lower risk capital buffer, highlighting that the drop in franchise value is due to the regulatory capital shortfall, a consequence of liquidity guarantors' regulatory arbitrage through their guarantee exposure.

5.2.3 Robustness: Sample periods

Given that the ABCP market run happened when investors started to become concerned about the housing bubble (Covitz et al., 2013), one might be concerned that the drop in guarantors' franchise value is solely driven by the financial crisis. To address this concern, we separate the regression in the periods before and after the beginning of 2006, when the housing market first showed its softness (Foote, Gerardi, and Willen, 2012). The first period observed a steady growth in the ABCP market, whereas the second period witnessed the toppling and decline of the market. Table 8 shows that the results are significant both before and after the housing market peak. Therefore, the empirical result presented using the whole sample data is not driven solely by the post-ABCP crisis period. Admittedly, similar to the stronger effect we have observed among low-capitalized banks, the market responses were also more substantial from 2006 through 2009, likely due to the increased fragility of the banking system as a result of excessive risk-taking.

A similar concern is that the low-interest environment from 2002 to 2004 may have made ABCPs appealing to yield-seeking investors who were bound to hold only high-quality assets, whereas rising interest rates after 2004 increased the likelihood of an ABCP run to be more likely. The interest rate was also one of the primary reasons behind the housing price change and MBS defaults. Hence, we run separate regressions for the periods before and after the beginning of 2005 to capture the regression under different interest rate environments. Table 9 shows that the results are robust under both interest rate environments, though the market responses were more substantial in the latter period due to increased risk-taking within the banking system.

In summary, the stock market is responsive to the BHCs' off-balance-sheet activity during the entire sample period between April 2001 and September 2009, rather than only during an earlier

Table 7: **Market monitoring: Low-capitalized ABCP guarantors**

Panel (a) presents the summary statistics of the quarterly Tier-1 risk capital ratios among ABCP liquidity guarantors. Panel (b) shows the OLS estimates of Equation (6) using the sample data of ABCP liquidity guarantor BHCs only, from April 2001 to September 2009. The dependent variable is the change in bank i's Tobin's q on date t. For the explanatory variables, ΔOVN_t measures the change in the ratio of ABCP outstanding matures overnight on date t. ΔLG Delq. Exposure$_{i,t}$ is the product of the change in subprime mortgage delinquency rate on date t, multiplies the bank's exposure to ABCP liquidity guarantee aforementioned, which is the principal of ABCP relative to the bank's book value. Lower Capital is an indicator equals 1 when the BHC's Tier-1 risk capital ratio at the closest quarter-end prior to date t is lower than 9.47%, the average quarterly Tier-1 risk capital ratio among all liquidity guarantors. Bank balance sheet variable definitions are provided in the Appendix. BHC and time-period clustered standard errors are reported in parentheses. Significance: $^{*}\,p < 0.10$; $^{**}\,p < 0.05$; $^{***}\,p < 0.01$.

(a) **Summary statistics of Tier-1 risk capital ratio among liquidity guarantors**

	mean	sd	min	max	count
Tier-1 cap. ratio (%)	9.47	2.30	6.43	20.25	396

(b) **Liquidity guarantors with below-average Tier-1 capital ratios**

Variable	Δ Tobin's q		
	(1)	(2)	(3)
Δ OVN $\times$ Δ LG Delq. Exposure $\times$ Lower Capital	-30.92***	-29.97***	-28.85**
	(11.58)	(11.58)	(11.55)
Δ OVN $\times$ Δ LG Delq. Exposure	-9.37**	-9.27**	-9.36**
	(4.64)	(4.64)	(4.63)
Δ LG Delq. Exposure $\times$ Lower Capital	0.04	0.09	0.09
	(0.10)	(0.10)	(0.10)
Δ LG Delq. Exposure	-0.01	-0.00	-0.01
	(0.03)	(0.03)	(0.03)
Δ OVN $\times$ Lower Capital	1.13**	1.11**	1.13**
	(0.45)	(0.45)	(0.45)
Lower Capital	0.01	0.01	0.01**
	(0.01)	(0.01)	(0.01)
Δ OVN	-1.08***	-1.06***	-1.16***
	(0.34)	(0.34)	(0.34)
Bank FE	Yes	Yes	Yes
Balance Sheet Controls	No	Yes	Yes
Macro & Fed Controls	No	No	Yes
Obs.	25994	25994	25994
Adj. R^2	0.00165	0.00272	0.00712
F-Statistics	4.242	3.609	9.102

Table 8: **Market monitoring by subperiods: Rapid ABCP market growth**
The table provides estimates for the model presented in Equation (5) under two subperiods. The first subperiod is from April 2001 to December 2005 when U.S. ABCP market enjoyed rapid growth. The second subperiod is from January 2006 till September 2009. Columns (1) and (2) present the propensity score weighted estimates using all publicly-traded U.S. BHCs with \$10B+ total assets under the first and second subperiods, respectively. Columns (3) and (4) present the OLS estimates using the matched sample under the first and second subperiods, respectively. The dependent variable is the change in bank i's Tobin's q on date t. For the explanatory variables, ΔOVN_t measures the change in the ratio of ABCP outstanding matures overnight on date t. ΔLG Delq. Exposure$_{i,t}$ and ΔCG Delq. Exposure$_{i,t}$ are the products of the change in subprime mortgage delinquency rate on date t, multiplies the principal of liquidity guaranteed ABCP conduit and credit guaranteed ABCP conduit respectively, normalized by the bank's book value. Bank balance sheet variable definitions are provided in the Appendix. BHC and time-period clustered standard errors are reported in parentheses. Significance: $^{*}\,p < 0.10$; $^{**}\,p < 0.05$; $^{***}\,p < 0.01$.

Variable	Δ Tobin's q			
	Propensity score weighted		Matched	
	2001-2005 (1)	2006-2009 (2)	2001-2005 (3)	2006-2009 (4)
Δ OVN $\times$ Δ LG Delq. Exposure	-6.60***	-74.62***	-4.60***	-69.56***
	(0.44)	(16.54)	(1.20)	(12.89)
Δ OVN $\times$ Δ CG Delq. Exposure	-2.68	20.99	-2.65	25.59
	(7.14)	(23.57)	(8.09)	(22.28)
Δ LG Delq. Exposure	0.00	0.11***	0.02	0.18
	(0.01)	(0.04)	(0.02)	(0.12)
Δ CG Delq. Exposure	0.38**	0.03	0.26	0.04
	(0.18)	(0.19)	(0.17)	(0.15)
Δ OVN	-0.24	-1.01***	-0.22	-0.78***
	(0.18)	(0.23)	(0.15)	(0.21)
Bank FE	Yes	Yes	Yes	Yes
Balance Sheet Controls	Yes	Yes	Yes	Yes
Macro & Fed Controls	Yes	Yes	Yes	Yes
Obs.	84235	93295	30736	28725
Adj. R^2	0.00112	0.00555	0.00111	0.0116
F-Statistics	34.50	30.92	5.474	48.83

or later period.[46]

5.2.4 Robustness: Market adjusted return as a measure of market monitoring

Following Pettway and Sinkey (1980), Pettway (1980), and Berger, Davies, and Flannery (2000) who study the market monitoring through the bank equity returns, we also use BHC daily abnormal returns as a direct measure of U.S. market monitoring, in addition to Tobin's q. Specifically, we first construct the abnormal return $r^a_{i,t}$ of for each sample BHC i on date t using the market model, then estimate sample BHCs' abnormal returns using the same empirical specification as in regression (5). Columns (1) through (3) of Table 10 present the propensity score weighted estimates: for a liquidity guarantor with average exposure (\$10.9 billion), size (\$319 billion), and facing an average monthly mortgage delinquency rate increase of 0.416%, a one standard deviation increase of percentage share of ABCPs maturing overnight (1.140%) leads to an annualized abnormal return of -4.7%.[47] OLS estimates using the Mahalanobis matched sample, presented in Columns (4) through (6) of Table 10, suggests an annualized abnormal return of -4.1%. Both results are qualitatively consistent with our analysis using Tobin's q in Table 5.

5.3 Market influence

The ABCP exclusion, together with the variation in the ABCP market condition, provides us a testbed to identify the effectiveness of the market influence. On the one hand, regulators did not set the liquidity guarantor's risk capital requirement base on ABCP maturity. On the other hand, effective market monitoring, which we demonstrated in Section 5.2, implies that the franchise value of the liquidity guarantee bank varies with the ABCP market condition. Subsequently, the theoretical model motivates our hypothesis H3, which states that a loophole-exploiting BHC under market pressure would hold more risk capital than an otherwise identical BHC that does not engage in regulatory arbitrage.

[46] We notice that, in both Tables 8 and 9, the significance of simple effects vary across time periods. As our discussion in Section 5.2, the simple effects might be driven not by market monitoring but by economy-wide latent factors, which indeed varied from the earlier to the later periods.

[47] Specifically, the annual change in the abnormal return is $-79.94 \times \frac{10.9}{319} \times 0.00416 \times 0.0114 \times 360 = -4.7\%$.

Table 9: **Regression by periods: Low mortgage rate**
The table provides estimates for the model presented in Equation (5) under two subperiods. The first subperiod is from April 2001 to December 2004 when U.S. mortgage borrower enjoyed historical low mortgage rates. The second subperiod is from January 2005 till September 2009. Columns (1) and (2) present the propensity score weighted estimates using all publicly-traded U.S. BHCs with \$10B+ total assets under the first and second subperiods, respectively. Columns (3) and (4) present the OLS estimates using the matched sample under the first and second subperiods, respectively. The dependent variable is the change in bank i's Tobin's q on date t. For the explanatory variables, ΔOVN_t measures the change in the ratio of ABCP outstanding matures overnight on date t. ΔLG Delq. $\text{Exposure}_{i,t}$ and ΔCG Delq. $\text{Exposure}_{i,t}$ are the products of the change in subprime mortgage delinquency rate on date t, multiplies the principal of liquidity guaranteed ABCP conduit and credit guaranteed ABCP conduit respectively, normalized by the bank's book value. Bank balance sheet variable definitions are provided in the Appendix. BHC and time-period clustered standard errors are reported in parentheses. Significance: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Variable	Δ Tobin's q			
	Propensity score weighted		Matched	
	2001-2004 (1)	2005-2009 (2)	2001-2004 (3)	2005-2009 (4)
Δ OVN $\times$ Δ LG Delq. Exposure	-6.50***	-57.67***	-4.83***	-58.93***
	(0.43)	(14.17)	(1.19)	(11.61)
Δ OVN $\times$ Δ CG Delq. Exposure	-4.10	15.19	-4.29	23.20
	(8.04)	(19.32)	(9.24)	(21.02)
Δ LG Delq. Exposure	0.00	0.12**	0.02	0.23*
	(0.01)	(0.05)	(0.02)	(0.12)
Δ CG Delq. Exposure	0.40**	-0.06	0.27	0.03
	(0.18)	(0.14)	(0.16)	(0.13)
Δ OVN	-0.46**	-0.70***	-0.43**	-0.51***
	(0.20)	(0.17)	(0.18)	(0.17)
Bank FE	Yes	Yes	Yes	Yes
Balance Sheet Controls	Yes	Yes	Yes	Yes
Macro & Fed Controls	Yes	Yes	Yes	Yes
Obs.	63070	114460	23701	35760
Adj. R^2	0.00106	0.00506	0.00133	0.0104
F-Statistics	35.90	22.34	6.379	21.76

Table 10: **Market monitoring: bank abnormal return**
The table provides estimates for the model presented in Equation (5) using sample data from April 2001 to September 2009. Columns (1) through (3) present the propensity score weighted estimates using all publicly-traded U.S. BHCs with \$10B+ total assets. Columns (4) through (6) present the OLS estimates using the Mahalanobis matched sample. The dependent variable, $r^a_{i,t}$, is bank i's abnormal return on date t, estimated from the market model. For the explanatory variables, ΔOVN_t measures the change in the ratio of ABCP outstanding matures overnight on date t. ΔLG Delq. $\text{Exposure}_{i,t}$ and ΔCG Delq. $\text{Exposure}_{i,t}$ are the products of the change in subprime mortgage delinquency rate on date t, multiplies the principal of liquidity guaranteed ABCP conduit and credit guaranteed ABCP conduit respectively, normalized by the bank's book value. Bank balance sheet variable definitions are provided in the Appendix. BHC and time-period clustered standard errors are reported in parentheses. Significance: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Variable	$r^a_{i,t}$ (%)					
	Propensity score weighted			Matched		
	(1)	(2)	(3)	(4)	(5)	(6)
Δ OVN $\times$ Δ LG Delq. Exposure	-83.57**	-83.28**	-79.94**	-74.15**	-72.80**	-69.49**
	(38.08)	(38.14)	(37.89)	(33.25)	(33.25)	(33.15)
Δ OVN $\times$ Δ CG Delq. Exposure	-62.84	-62.68	-61.46	-31.61	-31.93	-32.58
	(68.31)	(68.41)	(68.26)	(58.34)	(58.34)	(58.25)
Δ LG Delq. Exposure	-0.20	-0.34	-0.33	0.05	0.28	0.26
	(0.41)	(0.42)	(0.42)	(0.35)	(0.39)	(0.39)
Δ CG Delq. Exposure	-0.32	0.80	0.53	-0.31	0.37	0.24
	(0.74)	(0.77)	(0.77)	(0.68)	(0.75)	(0.76)
Δ OVN	-0.89	-0.91	-1.21	-0.25	-0.25	-0.44
	(1.02)	(1.03)	(1.01)	(0.83)	(0.83)	(0.83)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Balance Sheet Controls	No	Yes	Yes	No	Yes	Yes
Macro & Fed Controls	No	No	Yes	No	No	Yes
Obs.	177530	177530	177530	59461	59461	59461
Adj. R^2	0.000292	0.00271	0.00571	0.000124	0.00126	0.00303
F-Statistics	2.730	3.980	6.444	1.664	3.248	5.060

Specifically, we study a BHC chooses its risk capital level, based on the participation in regulatory arbitrage through ABCP liquidity guarantees. Using both the full sample with propensity score weighting and the matched sample, we analyze the bank capital ratio using the following specification:

$$K_{i,q+1} = \alpha_q + \gamma_0 \times \mathbf{1}_{i,q}^{\{\text{Liquidity guarantor}\}} + \gamma_1 \times \mathbf{1}_{i,q}^{\{\text{ABCP guarantor}\}} + \gamma_2 \times \mathbf{X}_{i,q} + \varepsilon_{i,q}, \tag{7}$$

in which $K_{i,q+1}$ is bank i's Tier-1 capital ratio at quarter $q+1$. In addition, $\mathbf{1}_{i,q}^{\{\text{Liquidity guarantor}\}}$ is the indicator variable, which takes the value of 1 if bank i is a liquidity guarantor at quarter q, and 0 otherwise. $\mathbf{1}_{i,q}^{\{\text{ABCP guarantor}\}}$ is the indicator variable equals 1 if bank i is an ABCP guarantor at quarter q, and 0 otherwise. $\mathbf{X}_{i,q}$ is the vector of control variables for bank i at quarter q. Finally, we include the time fixed effects α_q to capture the quarterly variation in the economy.[48]

Column (1) of Table 11 presents the regression estimates using the full sample with propensity score weighting. The results show that, on average, a liquidity guarantor has a 1.74% higher Tier-1 capital ratio than the rest of the ABCP guarantors. Column (2) presents similar estimates from the Mahalanobis matched sample: a loophole-exploiting guarantor has a 2.64% higher Tier-1 capital ratio. Both results support the prediction of H3.

Although liquidity guarantors have a higher capital ratio than other ABCP guarantors, ABCP guarantors collectively have lower Tier-1 capital ratios than BHCs that never use ABCP financing, after controlling for the liquidity guarantor dummy, BHC characteristics, and quarterly fixed effect. Specifically, the propensity score weighting estimates shown in Column (1) suggest that the capital ratio is 3.79% lower, whereas Mahalanobis matching estimates in Column (2) suggest 2.64%. These results are consistent with Irani, Iyer, Meisenzahl, and Peydro (2021), who show that banks with capital ratios approaching the regulatory minimum are more inclined to use shadow bank financing. Moreover, shadow bank facilities can serve purposes other than taking advantage of regulatory loopholes, including expanding funding capacity (Harris, Opp, and Opp, 2014; Plantin, 2014) or searching for yield (Martinez-Miera and Repullo, 2017).

Additionally, a higher Tier-1 capital ratio is associated with more collateral on the balance

[48]Bank fixed effects are co-linear with the two indicator variables.

Table 11: **Market influence: bank capital ratios and ABCP guarantee**
The table presents the OLS estimates of capital ratios for the model presented in Equation (7) in the sample period of April 2001 to September 2009. Columns (1) and (2) show estimates of Tier-1 capital ratio using propensity score weighted regression and the matched sample regression respectively, whereas Columns (3) and (4) show the corresponding estimates of adjusted Tier-1 capital ratio. Bank balance sheet control variables are described in Appendix. BHC and time-period clustered standard errors are reported in parentheses. Significance: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Variable	Tier-1 cap. ratio (%)		Adj. Tier-1 cap. ratio (%)	
	Propensity score weighted (1)	Matched (2)	Propensity score weighted (3)	Matched (4)
Liquidity guarantor	1.74**	2.64***	1.22*	2.15***
	(0.74)	(0.42)	(0.73)	(0.40)
ABCP guarantor	-2.09***	-3.79***	-2.15***	-3.82***
	(0.76)	(0.46)	(0.76)	(0.43)
log(Total assets)	-1.61***	-0.65***	-1.59***	-0.67***
	(0.09)	(0.08)	(0.09)	(0.07)
Cash ratio	-1.40	-1.04	-2.62	-1.74
	(2.45)	(1.60)	(2.44)	(1.32)
Loan to assets	-11.41***	1.73	-10.47***	3.19**
	(1.42)	(1.42)	(1.41)	(1.26)
RE loan to assets	0.68	-11.99***	-0.15	-12.83***
	(1.01)	(1.43)	(1.01)	(1.33)
Security to assets	-4.19***	15.94***	-3.83**	13.57***
	(1.62)	(2.61)	(1.61)	(2.08)
FS security to assets	-5.26***	-18.28***	-5.46***	-16.43***
	(1.49)	(2.49)	(1.48)	(2.10)
Deposit to assets	-11.37***	1.25	-11.58***	0.54
	(0.86)	(0.76)	(0.86)	(0.69)
ROA (%)	13.99***	1.01**	14.18***	0.94**
	(0.35)	(0.47)	(0.35)	(0.45)
EPS	-3.57***	0.02	-3.70***	0.04
	(0.17)	(0.16)	(0.17)	(0.15)
Quarter FE	Yes	Yes	Yes	Yes
Obs.	2671	855	2671	855
Adj. R^2	0.61	0.56	0.62	0.58
F-Statistics	345.8	55.7	359.9	66.0

sheet, lower asset risks, and a higher market-to-book ratio, which maps to a higher franchise value. Finally, larger BHCs with higher total assets have lower capital ratios partly because they are more likely to receive government aid under adverse scenarios.

5.3.1 Robustness: Alternative interpretation

In the theoretical and empirical analysis so far, we follow the standard assumption of bank capital structure literature that the guarantor optimizes its capital structure to maximize bank value by balancing the cost of breaching the regulatory required minimum and the benefit of high leverage (Flannery, 1994; Myers and Rajan, 1998; Diamond and Rajan, 2000; Calomiris and Wilson, 2004; Allen et al., 2011).[49] Specifically, after the ABCP facility is exempted from a liquidity guarantor's total risk-weighted assets, the bank would maintain the optimal capital ratio by reducing the Tier-1 risk capital accordingly. Hence, the ABCP exclusion by itself does not lead to an outright increase in the guarantor's capital ratio. Instead, the rise in the bank's capital ratio, as we observe, is the consequence of the bank adjusting its capital ratio according to the increased risk.

However, one could argue that the liquidity guarantor's capital ratio is not fully optimized in practice. Therefore, the lower amount of total risk-weighted assets due to the ABCP exclusion might lead to an outright increase in the guarantor's capital ratio. Such an argument offers an alternative explanation to our baseline empirical results in Table 11, and challenges whether the higher capital ratios among liquidity guarantors are indeed the consequence of market discipline.

To address such a challenge, we calculate an adjusted Tier-1 capital ratio $\tilde{K}$ as a counterfactual that adjusts away the possible increase in the capital ratio due to the reduced risk-weighted assets. In other words, given a liquidity guarantor, which enjoys the ABCP exclusion that lowers its total risk-weighted asset by a factor $x < 1$ and maintains a capital ratio K, we let the adjusted capital ratio $\tilde{K} \equiv xK \leq K$.[50] For other BHCs, $\tilde{K} = K$ since their total risk-weighted assets are unaffected by the ABCP exclusion.

[49] Berger et al. (2008) show that U.S. BHCs actively manage their capital ratios by optimally setting and rapidly adjusting their target "excess" capital levels substantially above well-capitalized regulatory minima.

[50] Specifically, using the notation in the theoretical model, we have $x \equiv \frac{D+E^L+G^L(y_t,m)+\beta V(y_t)}{D+E^L+G^L(y_t,m)+V(y_t)} \leq 1$ for liquidity guarantors since $\beta \leq 1$.

We then re-estimate the regression in Equation (4) by using the adjusted capital ratio $\tilde{K}$. Columns (3) and (4) of Table 11 report the estimates from the full sample with propensity score weighting and the Mahalanobis matched sample, respectively. Although the liquidity guarantors show lower estimates for the adjusted Tier-1 capital ratios, they still have a 1.22% higher Tier-1 capital ratio according to the propensity score weighted regression or a 2.15% higher adjusted capital ratio according to the matched sample. The results prove that liquidity guarantors still present a higher Tier-1 capital ratio, even after the impact of reduced total risk-weighted assets due to ABCP exclusion is reverted. Therefore, we can exclude the aforementioned alternative explanation and confirm that the capital ratios observed among liquidity guarantors are not driven entirely by the reduction of risk-weighted assets due to the ABCP exclusion.

5.3.2 Sensitivity of bank capital ratio and return to liquidity guarantee cost

Next, we prove that the high capital ratios observed among liquidity guarantors are driven by market influence. We investigate how liquidity guarantors adjust their risk capital buffer while facing the pressure from stock market. To construct the sensitivity of a bank's stock return to its ABCP guarantee exposure for *each* quarter q and guarantor bank i, we run *separate* regressions on market-adjusted return with the interaction of the bank's guarantee exposure and the ABCP maturity change on date t:

$$\begin{aligned} r^a_{i,q,t} &= \alpha_{i,q} + \beta_0 \times \Delta\%\text{OVN}_{q,t} + \beta_1 \times \Delta\text{LG Delq. Exposure}_{i,q,t} \\ &\quad + \beta^{ABCP}_{i,q} \times \Delta\%\text{OVN}_{q,t} \times \Delta\text{LG Delq. Exposure}_{i,q,t} + \varepsilon_{i,q,t}, \end{aligned} \tag{8}$$

where t is the trading days within quarter q.

From each regression, we obtain the coefficient $\beta^{ABCP}_{i,q}$, which represents each ABCP guarantor bank i's average stock price sensitivity to the risk from the ABCP guarantee obligation in quarter q. Panel (a) of Table 12 presents the summary statistics of $\beta^{ABCP}_{i,q}$. A more negative $\beta^{ABCP}_{i,q}$ means the daily abnormal return of guarantor bank i in quarter q is more sensitive to the cost of the guarantee, measured as an increased share of ABCP with overnight maturity and an increased

Table 12: **Market influence: bank capital ratios and β^{ABCP}**
Panel (a) presents the summary statistics of ABCP beta of liquidity guarantors in the sample period of April 2001 to September 2009, estimated from Equation (8). Panel (b) presents the OLS estimates of Equation (9) for the liquidity guarantors. Column (1) of Panel (b) presents the unweighted estimates, whereas Column (2) shows the estimates with bank size weighting. Bank balance sheet control variables are described in Appendix. BHC and time-period clustered standard errors are reported in parentheses. Significance: $^{*}\, p < 0.10$; $^{**}\, p < 0.05$; $^{***}\, p < 0.01$.

(a) **Summary statistics of β^{ABCP}**

	mean	sd	min	max	count
β^{ABCP}	-0.245	1.173	-5.419	1.835	396

(b) **Capital ratios and β^{ABCP}**

Variable	Tier-1 cap. ratio (%)	
	Unweighted (1)	Weighted (2)
β^{ABCP}	-0.14**	-0.14**
	(0.06)	(0.06)
log(Total assets)	1.25*	1.26*
	(0.66)	(0.64)
Cash ratio	17.75**	18.07**
	(6.56)	(6.78)
Loan to assets	-3.21	-3.00
	(7.85)	(7.75)
RE loan to assets	-9.53	-9.46
	(9.98)	(9.90)
Security to assets	15.06***	15.79***
	(4.80)	(4.76)
FS security to assets	-12.04	-12.74
	(8.22)	(7.90)
Deposit to assets	6.16*	6.17*
	(3.33)	(3.27)
ROA (%)	1.75	1.79
	(1.25)	(1.24)
EPS	-0.78	-0.79
	(0.54)	(0.53)
Bank FE	Yes	Yes
Quarter FE	Yes	Yes
Obs.	396	396
Adj. R^2	0.71	0.71
F-Statistics	314.5	318.3

conduit asset delinquency.

We then use the estimates of $\beta_{i,q}^{ABCP}$ to regress the guarantor's choice of Tier-1 capital ratio $K_{i,q+1}$ in the next quarter, using the panel regression specification as

$$K_{i,q+1} = \alpha_i + \alpha_q + \gamma_0 \times \beta_{i,q}^{ABCP} + \gamma_1 \times \mathbf{X}_{i,q} + \varepsilon_{i,q}, \tag{9}$$

to evaluate how the guarantor's choice of capital ratio responds to the sensitivity of its franchise value being impacted by the market monitoring.[51] As in regression (7), we control for quarter fixed effects α_q as well as the usual control variables $\mathbf{X}_{i,q}$ for bank i in quarter q. Moreover, we include the bank fixed effects α_i and run both an unweighted regression and a bank total asset weighted regression to ensure the results are not disproportionally driven by small or large BHCs.

Panel (b) of Table 12 show that liquidity guarantors that are more sensitive to the ABCP risk (more negative β^{ABCP}) tend to maintain a higher Tier-1 capital ratio in the subsequent quarter. This finding suggests, similar to the capital market's response to the financing cost of deposits (Martinez Peria and Schmukler, 2001; Demirgüç-Kunt and Huizinga, 2004) and subordinate debentures (Avery et al., 1988; Gorton and Santomero, 1990; Ashcraft, 2008), that the stock market's response to a loophole-exploiting bank's off-balance-sheet ABCP exposure also presses the bank to increase its risk capital cushion. These findings also help to understand how BHCs choose their optimal capital structure (Berger et al., 2008). As Gropp and Heider (2010) show that BHCs adjust their leverage ratios when shifting their liability structures away from deposits toward non-deposit liabilities, we provide further empirical evidence to exemplify how U.S. BHCs adjust their leverage following the stock market's response to their off-balance-sheet obligations.

[51] Alternatively, one can use an event study base on the ABCP market freeze in August 2007 to evaluate the change in bank capital ratio. However, this method has the following limitations. First, the ABCP market freeze had a profound impact on the banking system. Therefore, the change in bank capital ratio may not be a response to the ABCP market condition only. Second, the limited number of ABCP guarantor leads to a sample size that is too small to yield a robust statistical inference.

6 Conclusion

The risk capital exemption for ABCP liquidity guarantors is a regulatory loophole because a short ABCP maturity causes credit losses to remain with the liquidity guarantor rather than being transferred to outside investors. Does the stock market recognize banks that exploit regulatory loopholes through ABCP financing facilities? We find the market distinguishes the effects of liquidity and credit guarantee obligations on the franchise value of ABCP guarantors under short ABCP maturity and deteriorating conduit assets, implying that loophole-exploiting banks are monitored by the market.

Subsequently, does the pressure emanating from the stock market influence the loophole-exploiting BHCs? We find that these BHCs maintain higher Tier-1 capital ratios beyond the impact of reduced total risk-weighted assets allowed by the ABCP exclusion. Additionally, a guarantor whose franchise value is more sensitive to the risk from the ABCP guarantee obligation maintains a higher risk capital buffer.

In conclusion, we find evidence of active market monitoring and market influence on BHCs engaged in regulatory arbitrage in the United States. The impact of market discipline on the originate-to-distribute process, which is the model used by the shadow banking system in general, could be a fruitful research avenue for future studies (Bord and Santos, 2012).

A Appendix

A.1 Proof of Propositions

The non-arbitrage condition suggests that the ABCP value function $A(y_t, m)$ satisfies the differential equation

$$rA(y_t, m) = kV(y_0) + m\left(V(y_0) - A(y_t, m)\right)\mathbf{1}_{\{A(y_t,m)<V(y_0)\}} + \mu y_t \frac{\partial A(y_t, m)}{\partial y_t} + \frac{1}{2}\sigma^2 y_t^2 \frac{\partial^2 A(y_t, m)}{\partial y_t^2}, \tag{A.1}$$

in which $A(y_t, m)$ may refer to both ABCP with a credit guarantee $A^C(y_t, m)$ and a liquidity guarantee $A^L(y_t, m)$.[52] Nevertheless, $A^C(y_t, m)$ and $A^L(y_t, m)$ do not share the same boundary conditions due to their different obligations at $y_t = y_w$. Specifically, $A^C(y_w, m) = V(y_0)$ whereas $A^L(y_w, m) = V(y_w)$.[53]

Proposition 1. *The value of ABCP under a credit guarantee does not vary with the maturity* $1/m$*. Specifically,* $A^C(y_t, m) = V(y_0)$*.*

Proof. Since the maturity of ABCP is finite with probability 1, together with limited liability, we also have the boundary condition for $A^L(y_t)$ at singular point $y_t \to \infty$ as $\lim_{y_t\to\infty} \left|A^C(y_t)\right| < +\infty$.

The credit guarantee ensures that the ABCP investor will always be able to collect the coupon payment, and have no credit risk even if the conduit defaulted. Since the ABCP with a credit guarantee is a riskless investment, the par coupon, by non-arbitrage, has to be r. Therefore, the ODE in Equation (A.1) becomes

$$\left(r - m\mathbf{1}_{\{A^C(y_t,m)<V(y_0)\}}\right)\left(V(y_0) - A^C(y_t, m)\right) = \mu y_t \frac{\partial A^C(y_t, m)}{\partial y_t} + \frac{1}{2}\sigma^2 y_t^2 \frac{\partial^2 A^C(y_t, m)}{\partial y_t^2}.$$

[52] Specifically, the required return of ABCP equals the sum of the ABCP coupon payment $kV(y_0)$, the change of market value $A(y_t, m)$ with the fluctuation of underlying assets, and the value of rollover support. Incentive compatibility implies that the ABCP investor only chooses to rollover his paper when its market price $A(y_t, m)$ is no less than the face value. Hence, the value of rollover support is the difference between face value $V(y_0)$ and ABCP value $A(y_t, m)$ multiplies the maturity intensity m, controlled by the rollover condition $A(y_t, m) < V(y_0)$.

[53] There are secondary boundary conditions for $A^C(y_t, m)$ and $A^L(y_t, m)$, at $y_t \to \infty$ based on the regularity condition. We relegate the discussion of both secondary boundary conditions to the Appendix.

Together with boundary conditions at wind-down trigger $A^C(y_w) = V(y_0)$, it is easy to see this ODE has a unique solution $A^C(y_t) = V(y_0)$. $\square$

Proposition 2. *The value of ABCP with a liquidity guarantee* $A^L(y_t, m) = \mathbf{1}_{\{y_t \geq y_0\}} A_h^L(y_t, m) + \mathbf{1}_{\{y_t < y_0\}} A_l^L(y_t, m)$, *where*

$$\begin{aligned} A_h^L(y_t, m) &= \frac{k}{r} V(y_0) + C_h(m)\phi(y_t; y_w), \\ A_l^L(y_t, m) &= \frac{k+m}{m+r} V(y_0)(1 - \psi(y_t; y_w)) + V(y_w)\psi(y_t; y_w) - C_l(m)\left(\psi(y_t; y_w) - \bar{\psi}(y_t; y_w)\right), \end{aligned}$$

in which $\phi(y_t; y_w) = \left(\frac{y_t}{y_w}\right)^H$, $\psi(y_t; y_w) = \left(\frac{y_t}{y_w}\right)^G$, *and* $\bar{\psi}(y_t; y_w) = \left(\frac{y_t}{y_w}\right)^{\bar{G}}$. *Further,* $H = \frac{1}{2} - \frac{\mu}{\sigma^2} - \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} < 0$, $G = \frac{1}{2} - \frac{\mu}{\sigma^2} - \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2(r+m)}{\sigma^2}} < 0$ *and* $\bar{G} = \frac{1}{2} - \frac{\mu}{\sigma^2} + \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2(r+m)}{\sigma^2}} > 0$. *Finally,* $C_h(m)$, $C_l(m)$, *and* k *satisfy the smooth pasting conditions at* $A_h^L(y_t, m) = A_l^L(y_t, m) = V(y_0)$ *and* $\frac{\partial}{\partial y} A_h^L(y_t, m) = \frac{\partial}{\partial y} A_l^L(y_t, m)$ *at* $y_t = y_0$.

Proof. As in Section 3, the ABCP creditor's value function $A^L(y_t, m)$ satisfies the ODE

$$rA^L(y_t, m) = kV(y_0) + m\left(V(y_0) - A^L(y_t, m)\right)\mathbf{1}_{\{A^L(y_t,m) < V(y_0)\}} + \mu y_t \frac{\partial A^L(y_t, m)}{\partial y_t} + \frac{1}{2}\sigma^2 y_t^2 \frac{\partial^2 A^L(y_t, m)}{\partial y_t^2},$$

with boundary condition $A^L(y_w, m) = V_m(y_w)$.

The regularity condition under $y_t \to \infty$, when the probability of having y_t hits y_w converges to zero, gives out the second boundary condition. Since the maturity of ABCP is finite with probability 1, together with limited liability which leads to positive ABCP value, we have the boundary condition for $A^L(y_t, m)$ at singular point $y_t \to \infty$ as $\lim_{y_t \to \infty} \left|A^L(y_t, m)\right| < +\infty$.

We can write the differential equation into region l in which $y < y_0$ and region h in which $y > y_0$ as:

$$\begin{aligned} rA_h^L(y_t, m) &= kV(y_0) + \mu y_t \frac{\partial A_h^L(y_t, m)}{\partial y_t} + \frac{1}{2}\sigma^2 y_t^2 \frac{\partial^2 A_h^L(y_t, m)}{\partial y_t^2} \\ rA_l^L(y_t, m) &= kV(y_0) + m\left(V(y_0) - A_l^L(y_t, m)\right) + \mu y_t \frac{\partial A_l^L(y_t, m)}{\partial y_t} + \frac{1}{2}\sigma^2 y_t^2 \frac{\partial^2 A_l^L(y_t, m)}{\partial y_t^2}, \end{aligned}$$

in which the boundary conditions become $A_l^L(y_w, m) = V_m(y_w)$ and $\lim_{y_t \to \infty} \left|A_h^L(y_t, m)\right| < +\infty$.

Standard theorems about stochastic differential equation suggest the smooth pasting condition at $y_t = y_0$ as $A_h^L(y_t, m) = A_l^L(y_t, m)$ and $\frac{\partial}{\partial y_t} A_h^L(y_t, m) = \frac{\partial}{\partial y_t} A_l^L(y_t, m)$. We then obtain the value functions of A_h^L, A_l^L, and A^L following the standard technique for second order ODE. $\square$

With the value function of the ABCP, we are ready to model the value function of the ABCP guarantee G, being credit guarantee G^C or liquidity guarantee G^L, which satisfies

$$rG(y_t, m) = m(A(y_t, m) - V(y_0)) \mathbf{1}_{\{A(y_t,m)<V(y_0)\}} + \mu y_t \frac{\partial G(y_t, m)}{\partial y_t} + \frac{1}{2}\sigma^2 y_t^2 \frac{\partial^2 G(y_t, m)}{\partial y_t^2}, \quad \text{(A.2)}$$

in which $A(y_t, m) = A^C(y_t, m)$ for the credit guarantee case and $A(y_t, m) = A^L(y_t, m)$ otherwise.[54] Only under credit guarantee G^C does the guarantor need to provide credit protection upon the conduit wind-down. Hence, the credit guarantee has a boundary condition $G^C(y_w, m) = -V(y_0) + V(y_w) < 0$ whereas the liquidity guarantee has $G^L(y_w, m) = 0$.[55]

To prove Proposition 3, we first prove the following Lemma:

Lemma A.1. *When the ABCP maturity $1/m$ approaches zero, the liquidity guarantee ABCP value $\lim_{m\to\infty} A^L(y_t, m) = V(y_0)$ for $\forall y_t > y_w$. In other words, the value of liquidity guaranteed ABCP converges to that of credit guaranteed ABCP when the maturity $1/m$ drops.*

Proof. Following the value function of ABCP with liquidity guarantee given in Proposition 2, it is easy to see when $m \to \infty$, we have $G = \frac{1}{2} - \frac{\mu}{\sigma^2} - \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2(r+m)}{\sigma^2}} \to -\infty$, and $\bar{G} = \frac{1}{2} - \frac{\mu}{\sigma^2} + \sqrt{\left(\frac{1}{2} - \frac{\mu}{\sigma^2}\right)^2 + \frac{2(r+m)}{\sigma^2}} \to \infty$. Therefore, $\psi(y_t; y_w) = \left(\frac{y}{y_w}\right)^G \to 0$, and $\bar{\psi}(y_t; y_w) = \left(\frac{y}{y_w}\right)^{\bar{G}} \to \infty$. So the value function of ABCP, under a finite coupon k, becomes

$$\begin{aligned}
\lim_{m\to\infty} A_h^L(y_t, m) &= \frac{k}{r} V(y_0) + \lim_{m\to\infty} C_h(m)\phi(y_t; y_w), \\
\lim_{m\to\infty} A_l^L(y_t, m) &= \lim_{m\to\infty} \frac{k+m}{m+r} V(y_0) + C_l(m)\bar{\psi}(y_t; y_w) \\
&= V(y_0) + \lim_{m\to\infty} C_l(m)\bar{\psi}(y_t; y_w).
\end{aligned}$$

The smooth pasting conditions, $A_h^L(y_t, m) = A_l^L(y_t, m) = V(y_0)$ and $\frac{\partial}{\partial y} A_h^L(y_t, m) = \frac{\partial}{\partial y} A_l^L(y_t, m)$

[54] The differential equation follows the similar non-arbitrage argument used in the ABCP value functions.

[55] There are secondary boundary conditions for $G^C(y_t, m)$ and $G^L(y_t, m)$, at $y_t \to \infty$ based on the regularity condition. We relegate the discussion of the secondary boundary conditions to the Appendix.

at $y_t = y_0$, suggest that

$$\frac{k}{r}V(y_0) + \lim_{m\to\infty} C_h(m)\phi\left(y_t; y_w\right) = V(y_0) + \lim_{m\to\infty} C_l(m)\bar{\psi}\left(y_t; y_w\right) = V(y_0), \tag{A.3}$$

$$\lim_{m\to\infty} C_h(m)\frac{\partial}{\partial y}\phi\left(y_t; y_w\right) = \lim_{m\to\infty} C_l(m)\frac{\partial}{\partial y}\bar{\psi}\left(y_t; y_w\right). \tag{A.4}$$

It is then easy to see Equation (A.3) suggests that $\lim_{m\to\infty} C_l(m)\bar{\psi}\left(y_t; y_w\right) = 0$. Hence, $\lim_{m\to\infty} C_l(m) = 0$. With $\frac{\partial}{\partial y_t}\phi\left(y_t; y_w\right) = \frac{\partial}{\partial y_t}\left(\frac{y_t}{y_w}\right)^G = G\left(\frac{y_t}{y_w}\right)^{G-1} < 0$, Equation (A.4) suggests $\lim_{m\to\infty} C_h(m) = 0$ as well. Use Equation (A.3) again, with $\frac{k}{r}V(y_0) + \lim_{m\to\infty} C_h(m)\phi\left(y_t; y_w\right) = V(y_0)$ together with $\lim_{m\to\infty} C_h(m) = 0$ and $\lim_{m\to\infty}\phi\left(y_t; y_w\right) = 0$, we have $k = r$. Summarize the value of C_l, C_h, G and $\bar{G}$ under $m \to \infty$, we get $\lim_{m\to\infty} A^L\left(y_t, m\right) = V(y_0)$ for $\forall y_t \in (y_w, \infty)$. $\square$

Proposition 3. *When the ABCP maturity* $1/m$ *decreases, the liquidity support value function* $G^L\left(y_t, m\right)$ *becomes more negative whereas the credit support value function* $G^C\left(y_t\right)$ *remains unchanged given* y_t. *Moreover, we have* $G^C\left(y_t\right) < G^L\left(y_t, m\right) < 0$ *and* $\lim_{m\to\infty} G^L\left(y_t, m\right) = G^C\left(y_t\right)$ *for* $\forall y_t > y_w$.

Proof. By Equation (A.2), together with the value function of ABCP with credit guarantee $A^C = V(y_0)$, we can obtain that the value ABCP with credit guarantee, as well as the value of credit guarantee, does not vary with maturity $1/m$. Hence, we can drop the m in $G^C(y_t, m)$, and the differential equation for credit guarantee G^C is

$$rG^C\left(y_t\right) = \mu y_t \frac{\partial G^C\left(y_t\right)}{\partial y_t} + \frac{1}{2}\sigma^2 y_t^2 \frac{\partial^2 G^C\left(y_t\right)}{\partial y_t^2}, \tag{A.5}$$

with boundary condition $G^C\left(y_w\right) = -V(y_0) + V\left(y_w\right) < 0$. On the other hand, when $y_t \to \infty$, the stopping time $\tau = \inf\{t : y_t < y_w\} \to \infty$. Hence, $G^C(y_t) < 0$ and $\lim_{y_t\to\infty} G^C(y_t) = 0$.

Let $\bar{G}^L\left(y_t\right) = \lim_{m\to\infty} G^L\left(y_t, m\right)$. Starting from the differential equation for liquidity guarantee G^L

$$rG^L\left(y_t, m\right) = m\left(A^L\left(y_t, m\right) - V(y_0)\right)\mathbf{1}_{\{A^L(y_t,m)<V(y_0)\}} + \mu y_t \frac{\partial G^L\left(y_t, m\right)}{\partial y_t} + \frac{1}{2}\sigma^2 y_t^2 \frac{\partial^2 G^L\left(y_t, m\right)}{\partial y_t^2},$$

and using Lemma A.1, we have $\lim_{m\to\infty} A^L\left(y_t, m\right) = V(y_0)$ for $\forall y_t \in (y_w, \infty)$, and $A^L\left(y_w, m\right) =$

$V(y_w)$. Therefore, with $G^C(y_w) = -V(y_0) + V(y_w)$

$$r\bar{G}^L(y_t) = mG^C(y_w)\,\mathbf{1}_{\{y_t=y_w\}} + \mu y_t \frac{\partial \bar{G}^L(y_t)}{\partial y_t} + \frac{1}{2}\sigma^2 y_t^2 \frac{\partial^2 \bar{G}^L(y_t)}{\partial y_t^2}, \tag{A.6}$$

with boundary condition $\bar{G}^L(y_w) = 0$. Similar to the credit guarantee case, $\lim_{m\to\infty} \bar{G}^L(y_t) = 0$.

Clearly, the differential equations (A.5) and (A.6) share the same general solution, and the inhomogeneous term $mG^C(y_w)\,\mathbf{1}_{\{y_t=y_w\}}$ in differential equation (A.6) is a delta function on $y_t = y_w$. Following the standard Green function method, we have $G^C(y_t) = \bar{G}^L(y_t) < G^L(y_t) < 0$ for $\forall y_t \in (y_w, \infty)$. $\square$

Proposition 4. *When the ABCP maturity $1/m$ approaches zero, bank L—whose initial capital ratio is the same as bank C—has its capital ratio $K^L(y_t)$ that is more sensitive to the shock in the underlying asset value than $K^C(y_t)$ when $y_t < y_0$, or $\frac{dK^L(y_t)}{dy_t} > \frac{dK^C(y_t)}{dy_t}$. Subsequently, bank L is more likely to violate the minimum capital requirement under any realized path of y_t.*

Proof. First, let $\kappa(y_t) = \frac{E+G(y_0)}{D+\beta V(y_0)}$. It is easy to see that

$$K^C(y_t) \equiv \frac{E^C + G^C(y_t, m)}{D + E^C + G^C(y_t, m) + V(y_t)} = \frac{\kappa^C(y_t)}{1 + \kappa^C(y_t)}.$$

Notice that $K^C(y_t)$ is strictly increasing in $\kappa^C(y_t)$. Hence, using $\kappa^C(y_t) > 0$ instead of $K^C(y_t)$ does not change the behavior of a bank that is trying to maintain a capital ratio above the minimum requirement. Similar arrangement applies to $\kappa^L(y_t)$. We also let $\underline{K} \equiv \frac{\underline{\kappa}}{1+\underline{\kappa}}$.

The initial capital ratio of a credit guarantor with balance sheet equity capital E^C is $\kappa^C(y_0) = \frac{E^C+G^C(y_0)}{D+V(y_0)}$ and the initial capital ratio of a liquidity guarantor, who only needs to recognize a β fraction of ABCP exposure, to be $\kappa^L(y_0) = \frac{E^L+G^L(y_0)}{D+\beta V(y_0)}$. Hence, $\kappa^C(y_0) = \kappa^L(y_0)$ suggests that

$$\frac{E^L + G^L(y_0)}{D + \beta V(y_0)} = \frac{E^C + G^C(y_0)}{D + V(y_0)}. \tag{A.7}$$

With $\hat{G}^C(y_t) = G^C(y_t) - G^C(y_0)$ and similarly for liquidity guarantee as $\hat{G}^L(y_t) = G^L(y_t) -$

$G^L(y_0)$, we can write $\kappa^C(y_t) = \frac{E^C+G^C(y_0)+\hat{G}^C(y_t)}{D+V(y_t)}$ and $\kappa^L(y_t) = \frac{E^L+G^L(y_0)+\hat{G}^L(y_t)}{D+\beta V(y_t)}$. Subsequently,

$$\begin{aligned}\frac{d\kappa^L(y_t)}{dy_t} - \frac{d\kappa^C(y_t)}{dy_t} &= \frac{d}{dy_t}\frac{E^L+G^L(y_0)}{D+\beta V(y_t)} - \frac{d}{dy_t}\frac{E^C+G^C(y_0)}{D+V(y_t)} \\ &\quad + \frac{d}{dy_t}\frac{\hat{G}^L(y_t)}{D+\beta V(y_t)} - \frac{d}{dy_t}\frac{\hat{G}^C(y_t)}{D+V(y_t)},\end{aligned}$$

whereas

$$\begin{aligned}\frac{d}{dy_t}\frac{E^L+G^L(y_0)}{D+\beta V(y_t)} - \frac{d}{dy_t}\frac{E^C+G^C(y_0)}{D+V(y_t)} &= \left[-\beta\frac{E^L+G^L(y_0)}{[D+\beta V(y_t)]^2} + \frac{E^C+G^C(y_0)}{[D+V(y_t)]^2}\right]\frac{dV(y_t)}{dy_t} \\ &= [f(1)-f(\beta)]\frac{\kappa^C(y_0)}{r-\mu},\end{aligned}$$

where the second equality follows Equation (A.7) and $f(\beta) = \beta\frac{D+\beta V(y_0)}{[D+\beta V(y_t)]^2}$. Following $r > \mu$, it is easy to see $\frac{df(\beta)}{d\beta} > 0$ when $y_t \in (y_w, y_0)$. Therefore, $f(1) - f(\beta) > 0$ so

$$\frac{d}{dy_t}\frac{E^L+G^L(y_0)}{D+\beta V(y_t)} - \frac{d}{dy_t}\frac{E^C+G^C(y_0)}{D+V(y_t)} > 0. \tag{A.8}$$

In addition, we have $\frac{d}{dy_t}\frac{\hat{G}^L(y_t)}{D+\beta V(y_t)} = \frac{1}{D+\beta V(y_t)}\frac{d\hat{G}^L(y_t)}{dy_t} - \frac{\beta\hat{G}^L(y_t)}{[D+\beta V(y_t)]^2}\frac{dV(y_t)}{dy_t}$ and $\frac{d}{dy_t}\frac{\hat{G}^C(y_t)}{V(y_t)} = \frac{1}{D+V(y_t)}\frac{d\hat{G}^C(y_t)}{dy_t} - \frac{\hat{G}^C(y_t)}{[D+V(y_t)]^2}\frac{dV(y_t)}{dy_t}$. Notice Proposition 3 suggests that $\lim_{m\to\infty} G^L(y_t) \to G^C(y_t)$ for all $y_t > y_w$. Hence, when the ABCP maturity $1/m$ is small enough, we have $\lim_{m\to\infty}\frac{d\hat{G}^L(y_t)}{dy_t} \to \frac{d\hat{G}^C(y_t)}{dy_t} > 0$. With a small enough β

$$\frac{1}{D+\beta V(y_t)}\frac{d\hat{G}^L(y_t)}{dy_t} > \frac{1}{D+V(y_t)}\frac{d\hat{G}^C(y_t)}{dy_t}. \tag{A.9}$$

Finally, $V(y_t) > V(y_w) > \sqrt{\beta}D$ gives $\frac{\beta}{[D+\beta V(y_t)]^2} > \frac{1}{[D+V(y_t)]^2}$. From Proposition 3, we have $\frac{\beta\hat{G}^L(y_t)}{[D+\beta V(y_t)]^2} < \frac{\hat{G}^C(y_t)}{[D+V(y_t)]^2}$ when $m \to \infty$. Combine this with Equation (A.8) and (A.9), we have $\frac{d\kappa^L(y_t)}{dy_t} > \frac{d\kappa^C(y_t)}{dy_t}$ and therefore $\frac{dK^L(y_t)}{dy_t} > \frac{dK^C(y_t)}{dy_t}$ for $y_t \in (y_w, y_0)$. $\square$

A.2 Bank balance sheet variable definitions

Table A.1: **Bank balance sheet variable definitions**
This table presents the data mnemonic, as well as the FR-Y9C data used, for the bank balance sheet variables used in the summary statistics and regressions.

Variable	Mnemonic	Expression
Total Assets (Bil.)	Book value of assets in Billion USD.	$\frac{BHCK2170}{1000000}$
Cash Ratio	Ratio of cash or cash equivalent to asset book value.	$\frac{BHCK0081+BHCK0395+BHCK0397}{BHCK2170}$
Loan to assets	Ratio of loan balance to asset book value.	$\frac{BHCK2122}{BHCK2170}$
RE loan to assets	Ratio of RE loan balance to asset book value.	$\frac{BHCK1410}{BHCK2170}$
Security to assets	Ratio of held-to-maturity and for-sale security balance to asset book value.	$\frac{BHCK1773+BHCK1754}{BHCK2170}$
FS security to assets	Ratio of for-sale security balance to asset book value.	$\frac{BHCK1754}{BHCK2170}$
Deposit to assets	Ratio of deposit balance to asset book value.	$\frac{BHDM6631+BHFN6631}{BHCK2170} + \frac{BHDM6636+BHFN6636}{BHCK2170}$
ROA (%)	Return on assets. The ratio (in percentage) of quarterly increase in net income divided by book value of assets.	$\frac{\Delta BHCK4340}{BHCK2170} \times 100\%$
EPS	Earnings per share. The ratio of quarterly increase in net income to total outstanding number of shares.	$\frac{\Delta BHCK4340}{BHCK3459}$
Tier-1 cap. ratio (%)	The ratio (in percentage) of Tier-1 risk capital to total risk-weighted assets.	$BHCK7206$
Liquid asset ratio (%)	The ratio (in percentage) of cash and liquid securities to total assets.	$(\frac{BHCK0081+BHCK0395+BHCK0397}{BHCK2170} + \frac{BHCK0211+BHCK1287+BHCK1289}{BHCK2170} + \frac{BHCK1293+BHCK1294+BHCK1298}{BHCK2170} + \frac{BHCK8496+BHCK8499}{BHCK2170}) \times 100\%$

A.3 More robustness checks and discussions

A.3.1 Capital requirements and growth in ABCP financing

In this section, we provide further evidence on banks using ABCP for regulatory arbitrage, by analyzing the quarterly growth of liquidity-guaranteed ABCP financing at the bank level. Specifically, we measure each loophole-exploiting BHC's usage of ABCP financing, or *ABCP financing ratio*, as the balance of liquidity-guaranteed paper normalized by the BHC's total assets. We then regress the quarterly increase in percentage points in the ABCP financing ratio using time dummies corresponding to the three stages of capital requirements, discussed in Section 2.2. The first stage corresponds to the introduction of FAS 140 that allows liquidity guarantors to avoid risk charge altogether (April 2001 - June 2002), the second stage corresponds to the Enron-induced FASB review (July 2002 - September 2004), and the third stage is the 2004 reassurance of ABCP exclusion till the ABCP market run in mid-2007 (October 2004 - June 2007).

We present the empirical estimates in Table A.2. When ABCP exclusion was first introduced and later reassured (until the ABCP shadow bank run), the adoption of liquidity-guaranteed ABCP financing increased significantly, but not as much when BHCs faced policy uncertainty due to the FASB review. The empirical findings, in addition to the nation-wide growth of ABCP outstanding presented in Figure 2, highlight BHCs' regulatory arbitrage incentives behind ABCP financing.

A.3.2 Correlation between ABCP maturity and guarantor exposure to conduit delinquency

Our theoretical model highlights the importance of ABCP maturity in the credit-loss transfer from conduit to investors. Nevertheless, as Covitz et al. (2013) depicts that the ABCP investors flocked to the ABCP with the shortest maturity when the conduit asset quality deteriorated during the ABCP market run in 2007, one might suspect that the change in conduit asset quality is the dominant driver of ABCP maturity. In other words, the reduced ABCP maturity is merely a symptom of credit-loss in ABCP conduit, rather than a factor influencing the credit-loss transfer.

To address such a concern, we present the correlation between the change in ABCP maturity,

Table A.2: **Capital requirements and growth in liquidity-guaranteed ABCP financing**
This table presents the quarterly percentage points increase in the ABCP financing ratio from April 2001 to September 2009, measured as each loophole-exploiting BHC's quarterly ABCP financing ratio in percentage as the balance of liquidity-guaranteed ABCP normalized by the BHC's total assets. The dependent variables are three dummies corresponding to the capital requirement stages discussed in Section 2.2. The first stage corresponds to the introduction of ABCP exclusion that allows liquidity guarantors to avoid risk charge altogether (April 2001 - June 2002), the second stage corresponds to the Enron-induced FASB review (July 2002 - September 2004), and the third stage is the 2004 reassurance of ABCP exclusion till the ABCP market run in mid-2007 (October 2004 - June 2007). BHC and quarter clustered standard errors are reported in parentheses. Significance: $^{*}\, p < 0.10$; $^{**}\, p < 0.05$; $^{***}\, p < 0.01$.

Variable:	Δ LG ABCP financing (1)
ABCP exclusion (0% risk capital)	0.40*
	(0.22)
FASB review (0% risk capital)	0.17
	(0.15)
ABCP exclusion reassured (10% risk capital)	0.44***
	(0.15)
Bank FE	Yes
Obs.	396
Adj. R^2	0.029
F-Statistics	3.98

mortgage delinquency, and guarantor's credit and liquidity guarantees exposure in Table A.3. The table shows that, during the sample period, the ABCP maturity is not significantly correlated with the mortgage delinquency or with the ABCP guarantors' exposures. In other words, while the ABCP conduit asset deterioration was the reason for the drop in ABCP maturity during the ABCP run in 2007, it was not the primary driver of the changes in ABCP maturity over the entire sample period. The lack of correlation alleviates the aforementioned concern in the interpretation of empirical results on market monitoring.

A.3.3 About the quality of Mahalanobis matching

This section discusses the quality of the Mahalanobis matching, which has been used in Section 5.1.2 to address the differences in size and capital structure between liquidity guarantors and the rest of the sample BHCs. Although the three largest guarantors BHCs (Bank of America, Citigroup, and

Table A.3: **Correlation among ABCP maturity and guarantors' exposures**
This table presents the correlation matrix among the change in ABCP maturity and BHCs' exposure to credit- and liquidity-guaranteed conduits. The sample period is from April 2001 to September 2009. Significance: $^{*}\,p < 0.10$; $^{**}\,p < 0.05$; $^{***}\,p < 0.01$.

	Δ OVN	Δ LG Delq. Exposure	Δ CG Delq. Exposure
Δ OVN	1.00		
Δ LG Delq. Exposure	-0.00	1.00	
Δ CG Delq. Exposure	-0.00	0.18***	1.00

JPMC) in Table 1 are among the largest BHCs in the United States, the rest are much smaller, with an average total asset of 159 billion USD.[56] Furthermore, not all major BHCs were involved in ABCP financing: among the largest U.S. BHCs actively engaged in securitizations, neither Wells Fargo nor Morgan Stanley sponsored a liquidity-guaranteed ABCP facility.

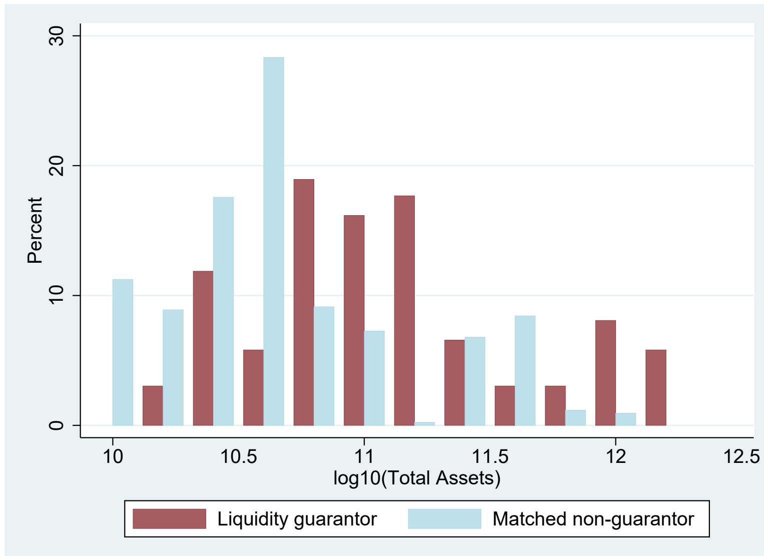
To provide more evidence on the quality of Mahalanobis matching, Figure A.1 shows the histograms in total quarterly assets between liquidity guarantors and Mahalanobis-matched non-liquidity-guarantors. The histogram illustrates the significant overlap between the distributions of liquidity guarantor sizes and matched non-liquidity guarantor sizes. To further mitigate the slight differences remaining in the size and capital ratio distributions between the liquidity guarantor and the matched non-guarantor sample, we also control for the bank characteristics in the matched sample regressions in Section 5.2.

A.3.4 Mortgage delinquency as a proxy of ABCP conduit losses

We provide further evidence to address the potential concern of using the U.S. mortgage delinquency as a proxy of credit losses among ABCP conduit assets. Unfortunately, the credit performance data of the ABCP conduit underlying assets are hard to obtain due to the opaqueness of shadow bank financing. Nonetheless, Covitz et al. (2013) show that when the assets underlying ABCP conduits suffer losses, the investors leave the ABCP market, which led to lower demand and higher spreads for the newly issued papers. Therefore, we could validate U.S. mortgage delinquency as a measure

[56]Calculated from Table 1.

Figure A.1: **Histograms of liquidity guarantor and matched non-guarantors**
This figure shows the distribution of $\log_{10}$(Total Assets) in USD for the quarterly observations of liquidity guarantor vs. the matched non-guarantor BHCs. Each bar represents the percentage of observations in a bucket of size 0.2: so the first bar represents the percentage of BHCs with $\log_{10}(\text{Total Assets}) \in [10, 10.2)$. More details on the matching are provided in Section 5.1.2 of the paper.



of ABCP conduit credit losses by examining the co-movement between mortgage delinquency rates and the spreads of newly issued ABCPs.

We obtained the daily interest rates of newly issued ABCPs and London Interbank Offer Rates (LIBOR), both with overnight, 7-day, 15-day, and 30-day maturities, during our sample period from April 2001 to September 2009 from the Federal Reserve Bank at St. Louis. We calculate the ABCP-LIBOR spreads for each maturity by subtracting the LIBOR from the interest rate of newly issued ABCP, which captures the credit risk premium of the newly issued ABCPs. Panel (a) of Table A.4 presents the descriptive statistics of the ABCP-LIBOR spreads.

As shown in Panel (b) of Table A.4, the mortgage delinquency highly correlates with the ABCP-LIBOR spreads for newly issued papers across maturities. The high correlation provides additional evidence on the close connection between the increase in the mortgage delinquency rate and the increase in overall losses of ABCP conduit assets, demonstrated by the rise in average spreads among the newly issued papers from ABCP conduits.

Table A.4: **Mortgage delinquency and ABCP-LIBOR spreads**
Panel (a) shows the descriptive statistics of daily overnight, 7-day, 15-day, and 30-day ABCP-LIBOR spreads in basis points. Panel (b) presents the correlation matrix among U.S. mortgage 60 day+ delinquency rate (in percentage), and overnight, 7-day, 15-day, and 30-day ABCP-LIBOR spreads. The sample period is from April 2001 to September 2009. Significance: $^{*}\,p < 0.10$; $^{**}\,p < 0.05$; $^{***}\,p < 0.01$.

(a) **Descriptive statistics of daily ABCP-LIBOR spreads**

	mean	sd	min	max	count
Overnight Spread	4.23	17.37	-112.38	173.38	2138
7-Day Spread	6.61	22.17	-84.88	216.50	2138
15-Day Spread	2.93	17.38	-79.50	196.63	2138
30-Day Spread	0.77	15.06	-37.13	212.38	2138

(b) **Correlation between mortgage delinquency and ABCP-LIBOR spreads**

	Overnight Spread	7-Day Spread	15-Day Spread	30-Day Spread	Mortgage Delq.
Overnight Spread	1.00				
7-Day Spread	0.71***	1.00			
15-Day Spread	0.63***	0.68***	1.00		
30-Day Spread	0.53***	0.52***	0.57***	1.00	
Mortgage Delq.	0.55***	0.73***	0.50***	0.38***	1.00

A.3.5 Market monitoring after the elimination of ABCP exclusion

In this section, we dive into market monitoring after January 2010, when U.S. regulators eliminated the ABCP exclusion. Although our theoretical model suggests that a shortened ABCP maturity should still cause the conduit credit loss to remain with the liquidity guarantor regardless of the regulatory capital requirement, the elimination of ABCP exclusion means that U.S. BHCs must prepare risk capital for the full outstanding of their liquidity guarantee obligation as they do for their credit guarantee obligation. Hence, we first test whether the U.S. market differentiates between a guarantor's liquidity guarantee exposure and its credit guarantee exposure in the post-ABCP-exclusion era.

Specifically, we re-estimate the model presented in Equation (5) using both the Mahalanobis-matched sample and the liquidity guarantor subsample from 2010 to 2011.[57] The estimates pre-

[57]Meanwhile, since the propensity score weighting is the estimated likelihood of committing regulatory arbitrage for each non-liquidity-guarantor in each quarter, we do not apply the propensity score weighting in the periods when the regulatory arbitrage opportunity has vanished. Moreover, Figure 2 shows the ABCP outstanding remained low but relatively stable in 2010 and 2011, and kept dropping in 2012. Hence, I choose to use a sample period of two years.

sented in Table A.5 reveal that, after the elimination of ABCP exclusion, the franchise value of BHCs no longer significantly associates with $\Delta\text{OVN}_t \times \Delta\text{LG Delq. Exposure}_{i,t}$ as in Tables 5 and 6. In other words, the franchise value no longer has significant responses to neither the liquidity-guarantee nor the credit-guarantee exposure. Hence, after the regulators eliminated the ABCP exclusion as a regulatory loophole, the U.S. stock market no longer differentiated between liquidity and credit guarantees as it did before.

However, besides the elimination of ABCP exclusion, the year 2010 also witnessed the passage of the Dodd-Frank Act, which profoundly changed the banking industry. Also, the Federal Reserve augmented the capital adequacy standards of banking institutions throughout 2010.[58] Hence, it is difficult to identify the elimination of ABCP exclusion as the exact cause of the change in market monitoring observed after January 2010. Nevertheless, we can still explore the sensitivity of market monitoring to guarantors' risk capital ratio and investigate whether the increased risk capital reserve caused the market to become less concerned about the losses in ABCP facilities, as these losses were less likely to cause risk capital shortfall.

We first present the summary statistics of Tier-1 capital ratios in Panel (a) of Table A.6. Driven by regulatory reforms enacted since the financial crisis (Schuermann, 2020), the average Tier-1 capital ratio among loophole-exploiting BHCs was 13.60% from 2010 through 2011, increasing from 9.47% during our sample period (April 2001 to September 2009). Subsequently, we re-estimate the model in Equation (6) with the dummy variable $\mathbf{1}_{i,t}^{\{\text{Lower Capital}\}}$ taking the value of 1 when guarantor i's Tier-1 risk capital ratio is lower than the average level of 13.60% at the closest quarter-end before the date t, and 0 otherwise. The results presented in Panel (b) of Table A.6 show that, under the much-increased risk capital among liquidity guarantors, the market's response to liquidity guarantee costs is no longer significantly sensitive to the guarantors' risk capital ratio.

Therefore, we believe the increased risk capital reserve might be a plausible cause for the market to become less concerned about the losses in ABCP facilities, as these losses were less likely to cause a risk capital shortfall. Still, market monitoring in the post-crisis era deserves further research.

[58]See the Federal Reserve's 2010 annual report on banking supervision and regulation at `https://www.federalreserve.gov/publications/annual-report/2010-banking-supervision-regulation.htm`.

Table A.5: **Market monitoring after the elimination of ABCP exclusion**
The table provides estimates for the model presented in Equation (5) after the federal agencies eliminate ABCP exclusion in January 2010. Column (1) presents the OLS estimates using the liqudity guarantors and the matched non-guarantors, whereas Column (2) presents the OLS estimates using the liquidity guarantors only. The dependent variable is the change in bank i's Tobin's q on date t. For the explanatory variables, ΔOVN_t measures the change in the ratio of ABCP outstanding matures overnight on date t. ΔLG Delq. $\text{Exposure}_{i,t}$ and ΔCG Delq. $\text{Exposure}_{i,t}$ are the products of the change in subprime mortgage delinquency rate on date t, multiplies the principal of liquidity guaranteed ABCP conduit and credit guaranteed ABCP conduit respectively, normalized by the bank's book value. Sample period is year 2010 and 2011. BHC and time-period clustered standard errors are reported in parentheses. Significance: $^{*}\, p < 0.10$; $^{**}\, p < 0.05$; $^{***}\, p < 0.01$.

Variable	Δ Tobin's q	
	Matched Sample (1)	Liquidity Guarantors Only (2)
Δ OVN $\times$ Δ LG Delq. Exposure	-42.54	-45.80
	(28.67)	(29.53)
Δ OVN $\times$ Δ CG Delq. Exposure	-8.15	-9.03
	(5.92)	(6.12)
Δ LG Delq. Exposure	-0.47	-0.39
	(0.45)	(0.50)
Δ CG Delq. Exposure	0.06	-0.01
	(0.09)	(0.10)
Δ OVN	-0.69***	-0.48
	(0.22)	(0.36)
Bank FE	Yes	Yes
Balance Sheet Controls	Yes	Yes
Macro Controls	Yes	Yes
Obs.	10999	4499
Adj. R^2	0.00799	0.00890
F-Statistics	4.294	2.448

Table A.6: **Market monitoring: Low-capitalized ABCP guarantors after the elimination of ABCP exclusion**

Panel (a) presents the summary statistics of the quarterly Tier-1 risk capital ratios among ABCP liquidity guarantors. Panel (b) shows the OLS estimates of Equation (6) using the sample data of ABCP liquidity guarantor BHCs only. Sample period is from 2010 to 2011. The dependent variable is the change in bank i's Tobin's q on date t. For the explanatory variables, ΔOVN_t measures the change in the ratio of ABCP outstanding matures overnight on date t. ΔLG Delq. $\text{Exposure}_{i,t}$ is the product of the change in subprime mortgage delinquency rate on date t, multiplies the bank's exposure to ABCP liquidity guarantee aforementioned, which is the principal of ABCP relative to the bank's book value. Lower Capital is an indicator equals 1 when the BHC's Tier-1 risk capital ratio at the closest quarter-end prior to date t is lower than 9.47%, the average quarterly Tier-1 risk capital ratio among all liquidity guarantors. BHC and time-period clustered standard errors are reported in parentheses. Significance: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

(a) **Summary statistics of Tier-1 risk capital ratio among liquidity guarantors**

	mean	sd	min	max	count
Tier-1 cap. ratio (%)	13.60	2.32	10.67	20.48	64

(b) **Liquidity guarantors with below-average Tier-1 capital ratios**

Variable	Δ Tobin's q		
	(1)	(2)	(3)
Δ OVN $\times$ Δ LG Delq. Exposure $\times$ Low Capital	23.28	23.48	23.43
	(70.63)	(70.31)	(69.44)
Δ OVN $\times$ Δ LG Delq. Exposure	-58.06	-58.20	-58.10
	(37.27)	(37.28)	(36.81)
Δ LG Delq. Exposure $\times$ Low Capital	-1.25	-0.71	-0.68
	(0.90)	(0.89)	(0.89)
Δ LG Delq. Exposure	-0.12	-0.16	-0.16
	(0.48)	(0.61)	(0.61)
Δ OVN $\times$ Low Capital	0.32	0.31	0.28
	(0.58)	(0.57)	(0.57)
LowCapital	0.01	0.01	0.01
	(0.01)	(0.01)	(0.01)
Δ OVN	-0.66	-0.66	-0.76
	(0.86)	(0.86)	(0.86)
Bank FE	Yes	Yes	Yes
Balance Sheet Controls	No	Yes	Yes
Macro Controls	No	No	Yes
Obs.	4499	4499	4499
Adj. R^2	0.00363	0.00554	0.00898
F-Statistics	1.100	0.992	1.057

B Liquidity risk management of ABCP guarantors

This section elaborates whether the market influences the liquidity risk management of ABCP guarantor during our sample period from April 2001 to September 2009. In the classical model of Diamond and Dybvig (1983), illiquid assets coupled with liquidity-promised liabilities leave banks vulnerable to runs. Hence, banks need to hold a reserve of high-quality liquid assets (Bourke, 1989; Cornett et al., 2011). Nevertheless, as Demirgüç-Kunt, Laeven, and Levine (2003) have demonstrated, banks with liquid assets have lower interest rate margins as they receive lower returns on holding cash or liquid securities but face a competitive market for deposits. Hence, banks have an incentive to reduce their holdings of liquid assets. Such an incentive causes banks to be less resilient to liquidity shocks necessitating regulatory intervention (Farhi, Golosov, and Tsyvinski, 2009).

It is worth noting that, during the sample period of our study, the Basel Accords had not included explicit regulatory requirements for the sufficiency of liquidity coverage ratio like it had for adequacy of risk capital yet.[59] Explicit regulatory liquidity requirements such as liquidity coverage ratio (LCR) and net stable funding ratio (NSFR) are post-crisis additions to the Basel Accords.[60] Nevertheless, the Basel Committee and regulators in the United States did promote principles for sound liquidity risk management and supervision among banks in the pre-crisis years. The Federal Reserve issued Supervision and Regulation Letter (SR letter) concerning BHC funding and liquidity management back in 1990 and updated it in 2008.[61] The Basel Committee also issued the "Principles for Sound Liquidity Risk Management and Supervision" in September 2008.[62] In summary, the U.S. BHCs faced supervisory *expectations* around internal liquidity risk management

[59]Meanwhile, U.S. deposit institutions do face reserve requirements on their deposits. Nonetheless, the deposit reserve management is very different from the liquidity risk management corresponding to banks' off-balance sheet positions. Hence, we differentiate our analysis of bank liquidity risk management from the deposit reserves since the latter is not the focus of our analysis.

[60]As part of the Basel III post-crisis reforms, the Basel Committee proposed the Liquidity Coverage Ratio (LCR), an explicit liquidity requirement, in December 2010. In 2013, U.S. regulators proposed a U.S. version of the LCR that was finalized in 2014. The Basel Committee also concluded the proposal of NSFR in November 2014.

[61]See SR letter 90-20, "Bank Holding Company Funding and Liquidity" and SR letter 08-9/CA letter 08-12, "Consolidated Supervision of Bank Holding Companies and the Combined U.S. Operations of Foreign Banking Organizations" by Federal Reserve.

[62]See "Principles for Sound Liquidity Risk Management and Supervision," by Basel Committee on Banking Supervision in September 2008 at `https://www.bis.org/publ/bcbs144.pdf`.

concerning their non-deposit assets and liabilities before the LCR and NSFR requirements were formulated.

Therefore, we follow Cornett et al. (2011) and use ABCP guarantor BHC's holdings of liquid assets to measure guarantor banks' liquidity, because the guarantor banks were not required to publish their LCRs or NSFRs and abide by regulatory minimum during our sample period. Specifically, we construct our measure of liquid assets ratio of bank i in quarter q as

$$\text{Liquid assets ratio}_{i,q} = \frac{\text{Cash}_{i,q} + \text{Liquid securities}_{i,q}}{\text{Assets}_{i,q}}. \tag{B.1}$$

Table B.1 presents the liquid assets ratio among our sample BHCs, as well as ABCP liquidity guarantors. Liquidity guarantors have a lower average liquid assets ratio, but the difference is insignificant compared to the rest of the sample or the matched non-guarantors. This finding is consistent with that of Kashyap, Rajan, and Stein (2002) who suggest that banks' liquidity risk management concerning their off-balance sheet assets are similar to their on-balance sheet assets, since off-balance-sheet commitment becomes an on-balance-sheet exposure when off-balance-sheet investors run. [63]

Next, we explore the effect of market discipline on guarantors' liquidity choices. Specifically, how would the guarantor adjust their liquid asset holdings if the market is responsive to the guarantor's liquidity guarantee cost? To investigate this, we examine the empirical relationship between a guarantor's β_{ABCP}, as the measure of the market's response to the BHC's liquidity guarantee exposure, and the guarantor's liquid assets ratio in the following quarter. In other words, we run the following regression:

$$\text{Liquid assets ratio}_{i,q+1} = \alpha_i + \alpha_q + \gamma_0 \times \beta_{i,q}^{ABCP} + \gamma_1 \times \mathbf{X}'_{i,q} + \varepsilon_{i,q+1}, \tag{B.2}$$

[63]Loutskina (2011) show that banks with loans easier to securitize (such as mortgage loans) are more likely to maintain a liquid balance sheet than banks with hard-to-securitize loans (such as C&I loans). Nonetheless, our analysis focuses on ABCP conduits rather than securitization in general as in Loutskina (2011). Besides, we are focusing on the effect of the existing ABCP conduit guarantee, whereas Loutskina (2011) discusses how the easiness of securitization affects the banks' balance sheet liquidity.

Table B.1: **Summary statistics of liquid assets ratio**
This table presents the cross-sectioanl summary statistics of the liquid assets ratio of all publicly-traded U.S. BHCs, including ABCP liquidity guarantors, with $10B+ total assets from April 2001 to September 2009. Column (1) shows the average liquid assets ratio and standard deviations. Column (2) shows the means and standard deviations of liquid assets ratios for BHCs that exploited the ABCP exclusion through liquidity-guaranteed ABCP conduits, whereas Column (3) shows the means and standard deviations for the remaining sample BHCs. Column (4) shows the means and standard deviations for the matched BHCs among the ramaining sample. Column (5) shows the differences in means between the liquidity guarantors and the remaining sample, and the corresponding standard errors. Column (6) shows the differences in means between the liquidity guarantors and the matched sample, and the corresponding standard errors. Standard deviations are in parentheses and standard errors are in brackets. Significance: $^{*}p < 0.10$; $^{**}p < 0.05$; $^{***}p < 0.01$.

	All	Liquidity Guarantor	Other	Matched other BHCs	Diff. (2)-(3)	Diff. (2)-(4)
	(1)	(2)	(3)	(4)	(5)	(6)
Liquid assets ratio (%)	10.39	10.24	10.42	11.87	-0.19	-1.64
	(8.40)	(9.53)	(8.21)	(10.06)	[2.18]	[3.27]
N. of Banks	100	18	90	18		
Obs.	2671	396	2275	427		

where $\mathbf{X}'_{i,q}$ is the guarantor's balance sheet controls, and α_q is the quarter fixed effect.[64] Similarly, we include the bank fixed effects α_i and run both an unweighted regression and a bank total asset weighted regression to ensure the results are not disproportionally driven by small or large BHCs.

The regression results presented in Table B.2 show that liquidity guarantors whose equity returns are more sensitive to the cost of ABCP liquidity guarantee obligation (more negative β^{ABCP}) tend to maintain a higher liquid assets ratio. This finding contributes to the existing empirical evidence on how BHCs choose their optimal capital structure (Berger et al., 2008; Gropp and Heider, 2010) by exemplifying how U.S. BHCs adjust their liquidity risk management following the stock market's response to their off-balance-sheet liability structures.

[64] We drop the cash ratio from the guarantor's balance sheet controls since it is highly co-linear with Liquid assets ratio$_{i,q+1}$.

Table B.2: **Market influence: bank liquidity assets and ABCP guarantee**
The table presents the OLS estimates of liquid assets ratio using the model in Equation (B.2), for liquidity guarantors from April 2001 to September 2009. Column (1) and (2) show estimates of liquid assets ratio using propensity score weighted regression and the matched sample regression respectively. Bank balance sheet control variables are described in Appendix. BHC and time-period clustered standard errors are reported in parentheses. Significance: $^{*}\, p < 0.10$; $^{**}\, p < 0.05$; $^{***}\, p < 0.01$.

Variable	Liquid asset ratio (%)	
	Unweighted (1)	Weighted (2)
β_{ABCP}	-0.62**	-0.62**
	(0.27)	(0.26)
Bank FE	Yes	Yes
Balance Sheet Controls	Yes	Yes
Quarter FE	Yes	Yes
Obs.	396	396
Adj. R^2	0.77	0.77
F-Statistics	61.1	61.9

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