Market Discipline and Regulatory Arbitrage: Evidence from Asset-backed Commercial Paper

Jiakai Chen*

November 2, 2018

Abstract

The "Asset-backed commercial paper (ABCP) exclusion" provides an opportunity to test whether the stock market disciplines loophole-exploiting banks. The exclusion ignores the effect of shortened ABCP maturity, under which more credit risk of conduit asset transfers to the liquidity guarantor bank. Nevertheless, the stock market prices the risk transfer and lowers the guarantor's franchise value. Besides, the risk-pricing causes the banks with franchise values more sensitive to the cost of the guarantee obligation to maintain a higher capital buffer. Hence, market discipline can alleviate the consequences of compromised capital regulations.

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

JEL classification: G01, G21, G28

*Shidler College of Business, University of Hawaii. Address: 2404 Maile Way, Honolulu, HI, 96822. E-mail: jiakai@hawaii.edu. I particularly wish to thank my advisor Christine Parlour and Nancy Wallace, as well as the late advisor Dwight Jaffee for their invaluable advice. Special thanks to Moody's Investor Service, who provided the proprietary asset-backed commercial paper data. This research has been supported by a research grant from the Fisher Center for Real Estate and Urban Economics, Haas School of Business, UC Berkeley.

1 Introduction

The Basel Committee on Banking Supervision (BCBS) designates minimum capital requirements and market discipline as two of the "Three Pillars" of bank compliance. In nations such as the United States where the bank funding structure is complex, loopholes in minimum capital requirements can be arcane enough to remain unnoticed by regulators for an extended period. Loophole-exploiting banks, which took excessive risks beyond regulatory presumption, played a critical role in the recent financial crisis. Many studies have focused on how to refine capital requirements in the pre-crisis Basel II framework by introducing countercyclical capital buffers (see, e.g., Hanson, Kashyap, and Stein 2011; Repullo and Suarez 2012), liquidity coverage requirements, and stable funding measures (see, e.g., Brunnermeier and Pedersen 2008), among others.[1] In contrast, post-crisis research on the effectiveness of market discipline under the presence of unnoticed capital requirement loophole is limited.

Market discipline is based on the semi-strong form of the efficient market hypothesis (Ashcraft and Bleakley 2006), which suggests that prices in an efficient market incorporate and reflect all relevant public information. When banks are circumventing the minimum capital requirements under the nose of regulatory watchdogs, is the US stock market efficient enough to spot them and lower their franchise value according to the excessive risk taken? Further, does the pressure from the market force the loophole-exploiting banks to increase their risk capital without regulatory intervention? Answering these questions will deepen our insights into the effectiveness of market discipline when capital requirements are compromised.

Using Moody's data on asset-backed commercial paper (ABCP) conduits, we investigate the stock market's response to bank regulatory arbitrage activities. Emerged in the mid-1980s, ABCP is an off-balance-sheet facility, also called "conduit", which allows banks to finance risky long-term assets using short-term senior commercial paper with a bank guarantee. The bank guarantee used to cover the credit loss of the ABCP investors—hence named *credit* guarantee—such that if the off-balance-sheet

[1]An extended but still incomplete list of related recent literature includes Horváth and Wagner (2017), and Jiménez, Ongena, Peydró, and Saurina (2017) for macroprudential regulation and countercyclical capital buffer, Berger and Bouwman (2009), Cornett, McNutt, Strahan, and Tehranian (2011), Loutskina (2011), and Acharya and Naqvi (2012) for the discussion on bank liquidity management and regulation. In the policy aspect, the members of the BCBS agreed upon the Basel III framework in 2010-2011 and introduced new capital and liquidity standards to strengthen the regulation of the banking and finance sector.

financing facility defaulted due to the losses in the long-term assets, the ABCP investor could still recover their principal. Since the early 2000s, banks started to offer *liquidity* guarantee, which offers to buy back the maturing commercial paper at par only if the conduit is not defaulted. When the off-balance-sheet facility defaults, liquidity guarantor banks do *not* cover the investor's credit loss.[2]

Regulators have required a credit guarantor bank to prepare risk capital for the ABCP facility as if the long-term assets are financed on-balance-sheet, since the bank bears the credit risk. On the other hand, regulators have been revising the risk capital requirement for a liquidity guarantor bank, since assessing the risk of liquidity guarantee is not as easy. Before 2010, regulators allow qualified liquidity guarantors to enjoy an "ABCP exclusion," such that the bank did not need to prepare risk capital at all, or only 10% of the risk capital required for comparable assets held on the balance sheet after a 2004 policy revision. Regulators finally eliminated the "ABCP exclusion" in 2010. The "ABCP exclusion" *would* be a regulatory loophole *if* it underestimated the risk carried by liquidity guarantor banks. In such case, the "ABCP exclusion" provides a test bed for investigating whether the stock market is aware of the risk associated with the loophole-exploiting banks.

We present a theoretical framework in which a bank guarantees an ABCP conduit and maintains a risk capital ratio above minimum regulatory requirements.[3] Specifically, the risk capital ratio is the bank equity value, which includes the cost of ABCP guarantee obligation, divided by the total risky assets, which includes the amount of ABCP-financed risky asset scaled by the "ABCP exclusion." We first show that the cost of *liquidity* guarantee obligation varies with the ABCP maturity. Therefore, a bank's risk capital ratio may change when the underlying assets remain the same. This finding calls for model-based regulation. Additionally, when the bank experiences an ABCP run, in which the maturity shortens towards overnight, the value of liquidity guarantees converges to that of credit guarantees.[4] Ignoring the effect of the maturity change leads to an insufficient risk capital requirement—a regulatory loophole—that allows liquidity guarantor banks to take excessive risk.[5] If the market is efficient enough

[2]Section 2 contains a more detailed discussion of ABCP guarantee.

[3]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.

[4]ABCP in the United States has maturity ranging from overnight to 270 days while, in Europe, the maturity typically ranges from overnight to 180 days.

[5]Pozsar, Adrian, Ashcraft, and Boesky (2010), Acharya, Schnabl, and Suarez (2012), Adrian and Ashcraft (2012), and Ordonez (2013) believe regulatory arbitrage is the primary driving force behind the growth of ABCP.

to discover the loophole-exploiting banks, the bank's equity returns would vary with the underlying asset credit quality and the commercial paper maturity.

The effective market monitoring causes the loophole-exploiting banks to lose franchise value when the cost of liquidity guarantee rise under shortened ABCP maturity. Subsequently, the regulator, unaware of the existence of loophole, would be alerted by the lowered capital ratio due to the loss of franchise value. Hence, in equilibrium, a liquidity guarantor bank should maintain a higher equilibrium capital ratio *ex ante*.

We test for the market response to bank regulatory arbitrage using a novel panel data set on the universe of ABCP conduits and their supporting banks from April 2001 to September 2009. We augment the panel data set using the delinquency rate of subprime mortgage loans, whose credit loss is the primary driver of the ABCP conduit asset value, as well as other macroeconomic variables over the same period. We construct each bank's liquidity and credit guarantee risk using the mortgage delinquency rate and the balance of ABCP conduit assets guaranteed by the bank. We then explore whether the risks from the ABCP guarantee, as well as the maturity of ABCP, escape the market's notice. We find that the franchise value of the liquidity guarantor banks vary with not only the conduit risk exposure but also the ABCP maturity, showing that the equity market is efficient enough to uncover the regulatory arbitraging banks.

Using the maturity of non-financial commercial papers as the instrumental variable that corrects for the simultaneity between the maturity of the ABCP and the sponsoring banks' stock returns, we confirm the model prediction that the ABCP maturity affects the risk transfer between the ABCP conduit and the liquidity guarantor bank: the interaction between the maturity and conduit risk significantly affects the sponsoring bank's return. For a liquidity guarantor bank under average guarantee exposure (approximately 3.86% of total assets) and under average subprime 2/28 adjustable-rate mortgage delinquency rate buildup (0.416% per month), a single standard deviation increase (approximately 1.14%) in the percentage share of ABCP with overnight maturity (such as increasing from the average of 7.4% to 8.54%) leads to a 7.5 basis points negative return.

Finally, we investigate whether the pressure emanating from the stock market can discipline the loophole-exploiting banks, using the subsample of ABCP guarantor banks and non-guarantor banks with similar size (more than $50 billion in assets).[6] The empirical finding confirms that the "ABCP exclusion" loophole-exploiting banks keep a higher capital ratio than both the credit guarantor banks and the non-guarantor banks with similar characteristics. Furthermore, the banks whose franchise value are more sensitive to the liquidity guarantee obligation maintain a higher Tier-1 and Total capital ratio, suggesting the linkage between the market pressure and the bank's risk capital choice.

Our paper belongs to the literature documenting market discipline, which includes both "market monitoring" and "market influence" according to the anatomy specified in Bliss and Flannery (2002). Market monitoring refers to the hypothesis that investors accurately evaluate firms and promptly incorporate the assessments into the security prices. Flannery and James (1984) show that the market notices the maturity mismatch between bank assets and liabilities; therefore, the bank stock returns vary with interest rates.[7] Market influence is the process by which security prices influence a firm's action. 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 (SND) 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 market discipline against obscure regulatory arbitrage.

Our paper also contributes to two additional strands of literature. First, the empirical findings on the high capital ratio of the loophole-exploiting banks extend the literature on optimal bank capital structure. The theoretical foundations of optimal bank capital structure are laid down by Flannery (1994), Myers and Rajan (1998), Diamond and Rajan (2000), Calomiris and Wilson (2004), and Allen, Carletti, and Marquez (2011) which find that capital requirements are not necessarily binding. Empirical studies (Berger, DeYoung, Flannery, Lee, and Öztekin 2008; Gropp and Heider 2010) suggest that capital requirements are not the only factor determining bank capital structure: banks hold optimal capital buffer above the regulatory minimum.[8] This article extends the literature

[6] According to Ashcraft (2008), the market may discipline banks directly by lowering their franchise value, or by imposing restrictive covenants through creditors. The market could also provide information about the default risk that helps regulators, such as offering aids to troubled banks or stop forbearing against problem banks.

[7] Other studies show the market prices bank stock using unexpected inflation shocks (Amihud 1996; Lajeri and Dermine 1999), exchange rate risks (Choi, Elyasiani, and Kopecky 1992), or changes in yield spreads and default spreads (Stiroh 2006).

[8] 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.

by showing that the loophole-exploiting banks do not take full advantage of the regulatory arbitrage opportunity, but keep additional risk capital likely due to the market pressure.

Second, the paper adds to the literature on ABCP market, rollover risk, and capital regulation (Brunnermeier 2008; Krishnamurthy 2009; Acharya, Gale, and Yorulmazer 2011; He and Xiong 2012b; Covitz, Liang, and Suarez 2013; Martin, Skeie, and von Thadden 2014; Kisin and Manela 2016), by focusing on the impact of rollover risk on the effectiveness of bank capital regulation. The seminal paper by Acharya et al. (2012) provides a thorough analysis on ABCP guarantees, and shows that banks with a more substantial ABCP guarantee obligation suffered a more extensive market value loss during the ABCP run in August 2007, but not in the months before the run. The theoretical part of this paper emphasizes the importance of ABCP maturity to the bank guarantee cost, whereas the empirical analysis attests that the market is aware of the relationship between the ABCP maturity and the risk transfer in the years before the ABCP crisis–a much longer time horizon.

In the remainder of the paper, Section 2 describes the institutional details of ABCP conduits. Section 3 lays out a theoretical framework to analyze the value of guarantee obligation. The theoretical results relate the cost of the guarantee to the bank stock return as well as the capital ratio and develop testable empirical hypothesizes. Section 4 summarizes the data used in Section 5, which carries out the empirical analysis. Section 6 concludes the paper, and all proofs are relegated to the Appendix.

2 The background of ABCPs

The ABCP market size reached 1.21 trillion USD in 2007, approximately 12.3% the size of commercial bank liability in the United States, as Figure 1 shows. The primary investors of ABCPs are money market funds who, under the SEC Rule 2a-7, may only invest in short-term debt with a Prime-1 rating.[9] To secure the Prime-1 rating for ABCP, the commercial bank that sets up the conduit needs to provide an explicit guarantee to the commercial paper because the assets in the conduits are usually

[9] According to Federal Reserve Financial Accounts of the United States, money market funds had an aggregate assets up to 2.69 trillion USD by the end of year 2008. The large size of money market funds leads to lower transaction costs of ABCP in the secondary market compared to equity or longer-term debt. Under SEC Rule 2a-7, a money market fund may only hold the highest rated debt (a Prime-1 rating), which matures in under 13 months and must maintain an overall portfolio weighted average maturity of 60 days or less. The short maturity of ABCP allows the ABCP investors to liquidate their investment by not rolling over a maturing paper if they believe the underlying assets are deteriorating but yet have reached the default threshold.

illiquid, long-term securities.[10]

There are two types of guarantees that banks can offer: credit guarantees (also called full guarantees) vs. liquidity guarantees (also called partial guarantees).[11] An investor in ABCP with a credit guarantee can receive support under two scenarios. First, when the investors with maturing ABCP no longer want to reinvest or "rollover" the commercial paper, the sponsoring bank pays the commercial paper's principal amount back to the ABCP investors. Therefore, the ABCP investor can always recover their principal when the conduit has not reached the default threshold. The bank usually reissues ABCP, typically at a discounted price. Second, when the underlying conduit is deemed default, that is, under the wind-down trigger, the sponsoring bank also guarantees the principal of commercial paper.

On the other hand, an investor of ABCP with a liquidity guarantee only recovers the remaining collateral value of the conduit's underlying assets when the conduit defaults.[12] Before the conduit hits the wind-down trigger, the ABCP investors receive the similar rollover support as in credit guarantee.

In September 2000, the Financial Accounting Standards Board (FASB) introduced Financial Accounting Standards (FAS) 140, which allowed a bank to transfer its assets to a "qualified SPE" and book the transaction as a "true sale."[13] This means that an ABCP liquidity guarantor bank can enjoy the "ABCP exclusion" and avoid the costly risk capital requirement completely.[14] In 2004, regulators

[10]In many cases, the guarantor bank is the same bank that creates, and is funded by, the ABCP conduit. In other words, the bank transfers assets, such as mortgage-backed securities (MBS), from its balance sheet to the conduit. When the long-term underlying assets of the conduit are paid off, the bank replaces them by moving new assets to the conduit.

[11]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 structure and support in ABCP conduit, include but not limit to Collateralized Debt Obligations, repurchase agreeements, and total return swaps. We do not include these alternative structures in our sample and analysis.

[12]Although the conduits typically have some credit enhancement measures, such as a subordinate or over-collateralization tranche as the first group to absorb the loss of the defaulted assets, 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 10% of the conduit assets.

[13]Both the Financial Accounting Standards Board (FASB) and financial regulators such as the Federal Reserve, FDIC, and Department of the Treasury shape regulatory guidelines as to how much risk capital banks need to hold against the risky assets moved to the conduit.

[14]An ABCP conduit achieves a "qualifying SPE" status if the bank moves its assets to the conduit and satisfies the following four conditions. 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, sale or disposal of the conduit assets must be specified in the legal documents and exercised by a party that puts the holders' beneficial interest back to the SPE.

increased the capital standard and required the banks to hold risk capital against 10% of the size of ABCP liquidity facilities.[15] Unlike the liquidity guarantee, the credit guarantee consistently has capital requirements similar to on-balance sheet loans because it violates the "true sales" condition.

In mid-2007, the deterioration of the underlying risky assets, such as mortgage-backed securities (MBS), caused the ABCP market to freeze abruptly. The collapse of the ABCP market as a major funding source limited the capability of the U.S. banking sector to raise capital and became an important reason for the subsequent crisis. Finally, on January 28, 2010, the financial regulators collectively decided to eliminate the ABCP exclusion on March 29, 2010.

3 Theoretical framework

We start with a parsimonious model of an ABCP guarantor bank that is 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 balance sheet asset $B = D + E$. 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, which issues and then rolls bank-guaranteed ABCP. To focus on the analysis of the off-balance-sheet financing, we let the value of balance sheet asset B and of deposit D to remain constant over t.

Following Leland (1994a) and He and Xiong (2012a), we assume the ABCP maturity τ_m follows an exponential distribution with parameter $m > 0$, or $\tau_m \sim Exp(m)$, so the expected remaining time-

[15] In December 2003, the Office of the Comptroller of the Currency (OCC), Board of Governors of the Federal Reserve System, Federal Deposit Insurance Corporation (FDIC), and Office of Thrift Supervision (OTS) collectively permitted the 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). Effective since September 30, 2004. These guidelines are responses to FASB Interpretation 46(R), which required banks to consolidate SPE assets to its balance sheet.

to-maturity of ABCP is $1/m$.[16] For each dollar of its face value, the ABCP pays a fixed coupon k such that the paper is originated at par.

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 $G^L(y_t, m)$. The guarantor bank pays the ABCP investor the face value of the paper if the investor chooses not to rollover his maturing ABCP. The bank then reissues the commercial paper at the market price $A(y_t, m)$. Such guarantee lasts until the ABCP conduit winds down, which happens when the conduit assets' cash flow y_t drops below the threshold y_w. Since guarantees are options offered to investors, it is costly to the sponsoring banks: so $G^C(y_t, m) \leq 0$ and $G^L(y_t, m) \leq 0$. Panel (a) of Figure 2 demonstrates the timing of the events for a credit guarantor bank and how it pays investors holding maturing ABCP respectively, whereas the panel (b) of Figure 2 covers a liquidity guarantor bank.

We assume that the initial bank capital E, being E^C for a credit guarantor or E^L for a liquidity guarantor, is large enough to cover the guarantee such that $E^C + G^C(y_t, m) \geq 0$ or $E^L + G^L(y_t, m) \geq 0$ 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 reputation damage.

Following the BCBS definition, a bank's capital ratio is the value of equity capital, including the credit guarantee obligation, over bank assets. As the credit guarantor bank has to prepare risk capital as if they finance the ABCP conduit assets on-balance-sheet, its capital ratio $K^C(y_t)$ at $t \geq 0$ is

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

The risk capital reduction from "ABCP exclusion" allows a liquidity guarantor bank enjoys only books $\beta V(y_t)$ in the calculation of the capital ratio $K^L(y_t)$.[17] We have $\beta = 0$ before December 2003 and $\beta = 0.1$ until "ABCP exclusion" was eliminated. In other words,

$$K^L(y_t) \equiv \frac{E^L + G^L(y_t, m)}{D + E^L + G^L(y_t, m) + \beta V(y_t)}. \tag{2}$$

[16]Specifically, the probability density function of $\tau_m \in (0, +\infty)$ is $f(x) = me^{-mx}$.

[17]For simplicity, we assume all the assets, both on and off balance-sheet, have a risk weight of 100%.

We assume the liquidity guarantor has a significant involvement in off-balance-sheet financing such that $V(y_w) \geq \sqrt{\beta}D$. Finally, we let the bank to maintain its capital ratio above a minimum requirement $\underline{K}$, or face a regulatory penalty.[18] Apparently, a credit guarantor would set $K^C(y_0) \geq \underline{K}$, and a liquidity guarantor would set $K^L(y_0) \geq \underline{K}$.

3.1 Pricing of ABCP

To evaluate teh guarantee obligations, we first need to derive the value function of credit and liquidity guaranteed ABCPs and study how the values of credit and liquidity guarantees vary with ABCP maturities. The non-arbitrage condition suggests that the ABCP value function $A(y_t, m)$ satisfies the differential equation

$$rA(y_t, m) = kV(y_0) + m(V(y_0) - A(y_t, m))\mathbf{1}_{\{A(y_t,m)<V(y_0)\}} + \mu y_t \frac{\partial A(y_t, m)}{\partial y_t} + \frac{1}{2}\sigma^2 y_t^2 \frac{\partial^2 A(y_t, m)}{\partial y_t^2}, \quad (3)$$

in which $A(y_t, m)$ may refer to both ABCP with a credit guarantee $A^C(y_t, m)$ and a liquidity guarantee $A^L(y_t, m)$.[19] 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 $A^L(y_w, m) = V(y_w)$.[20] The value functions are solved in Proposition 1 and 2 below.

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 function of ABCP with a liquidity guarantee* $A^L(y_t, m) = \mathbf{1}_{\{y_t \geq y_0\}} A_h^L(y_t, m) +$

[18] 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.

[19] 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 $A(y_t, m) < V(y_0)$.

[20] 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.

$\mathbf{1}_{\{y_t<y_0\}} A_l^L(y_t,m)$, *where*

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

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 ABCP with liquidity guarantee, Proposition 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 3 shows that when the ABCP maturity gets shorter, i.e., from 6 month to 1 month, the value of a discounted ABCP (whose underlying asset value $y_t < y_0$) goes up.

Before the ABCP conduit default, the liquidity guarantor's cost from buying back a discounted one-month paper at par is lower than the loss from buying back a six-month paper, as the one month ABCP values higher than a six-month paper conditional on the same $y_t < y_0$. However, a shorter ABCP maturity also means the bank has to buy back the discount papers more frequently. Does the high rollover frequency dominate the low cost of rollever—a lower ABCP maturity leads to a higher cost of liquidity guarantee—or the other way around? We address the question by looking at the cost of guarantee next.

3.2 Guarantee cost and market monitoring

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

$$rG(y_t,m) = m\left(A(y_t,m) - V(y_0)\right)\mathbf{1}_{\{A(y_t,m)<V(y_0)\}} + \mu y_t \frac{\partial G(y_t,m)}{\partial y_t} + \frac{1}{2}\sigma^2 y_t^2 \frac{\partial^2 G(y_t,m)}{\partial y_t^2}, \quad (4)$$

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.[21] Only under credit guarantee G^C does the guarantor bank 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 $G^L(y_w, m) = 0$.[22] Proposition 3 describes how the ABCP maturity sways the costs of the credit and liquidity guarantees.

Proposition 3. *When the ABCP maturity decreases, the liquidity support value function converges to the credit support value function. When the maturity $1/m$ approaches 0, $\lim_{m\to\infty} G^L(y_t, m) = G^C(y_t, m)$ for $\forall y_t > y_w$.*

Proposition 3 indicates that a drop in ABCP maturity leads to a larger cost of liquidity guarantee. Proposition 3 also shows that the "ABCP exclusion", which reduces the risk capital requirement for a liquidity guarantor bank to 10% of the ABCP principal amount regardless of the ABCP maturity, is a regulatory loophole when the ABCP maturity is short. Ignoring the effect of ABCP maturity gives the regulator a false sense that the liquidity guarantee is safer than the credit guarantee. Subsequently, the liquidity guarantor obtains an opportunity for regulatory arbitrage to take excessive risks by moving risky assets to a liquidity-guaranteed ABCP conduit.

The intuition of Proposition 1, 2, and 3 is further illustrated in Figure 3, which presents the value functions of credit and liquidity guaranteed ABCPs and the value of those guarantees under different maturities. Panel (b) of Figure 3 shows when the ABCP maturity drops the value function of the liquidity guarantee converges to the value function of credit guarantee. Proposition 3 also provides theoretical support to the empirical finding in Acharya et al. (2012), which states that the ABCP sponsor bank kept the risk to themselves.

More importantly, Proposition 1, 2, and 3 suggest that the franchise value of a liquidity guarantor should vary with the ABCP maturity as well as the underlying asset value if the market is aware of the loophole, whereas the franchise value of a credit guarantor bank would not demonstrate such property. We can then test whether the stock market is aware of the regulatory loophole in the "ABCP exclusion," which has remained unnoticed by regulators for years.

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

[22] 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.

H1: The change in the maturity of the ABCP with a credit guarantee does not affect the risk transfer between the ABCP conduit and the guarantor bank. In other words, the interaction term between the maturity and underlying asset value should not significantly affect a credit guarantor bank's abnormal return.

H2: The drop in the maturity of the ABCP with a liquidity guarantee allows more risk transfer from the ABCP conduit to the guarantor bank. In other words, the interaction term between a shortened ABCP maturity and deteriorating underlying asset value lowers the liquidity guarantor bank's abnormal return.

3.3 Capital ratios and market influence

If we can empirically prove that the stock market is efficient enough to lower the franchise value of loophole-exploiting banks according to the excessive risk they have taken, we can then ask a more interesting question: whether this risk-pricing would actually cause banks to maintain a higher risk capital? In other words, under an effective market discipline, would the bank concern about whether the $K^C(y_t)$ or $K^L(y_t)$, which is driven by the market value of the equity capital and bank assets, can stay above the minimum requirement $\underline{K}$? How would such concern affect the bank's choice of initial capital ratio $K^C(y_0)$ and $K^L(y_0)$?

To address these questions, we first compare how $K^L(y_t)$ and $K^C(y_t)$, the capital ratios of liquidity and credit guarantors when the stock market has efficient risk-pricing, vary under the adverse realization of y_t.

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

Proposition 4 suggests that a liquidity guarantor with $K^L(y_0)$, *ceteris paribus*, finds itself violates the minimum requirement $\underline{\kappa}$ earlier than a credit guarantor with $K^C(y_t) = K^L(y_t)$. In other words, the liquidity guarantor faces a higher expected cost of breaching minimum capital requirement.

Both theoretical studies in dynamic capital structure (Leland 1994a; He and Xiong 2012b) and in optimal bank capital structure (Flannery 1994; Myers and Rajan 1998; Diamond and Rajan 2000; Allen et al. 2011) suggest that banks actively 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. Hence, Proposition 4 establishes a connection between market discipline and bank capital ratio: Under effective market discipline, the liquidity guarantor banks should maintain a higher level of equilibrium *initial* capital ratio $K^L(y_0)$, or the book-value based capital ratio, than their otherwise equivalent credit guarantor counter-parties.[23] This motivates the following hypothesis for testing the effectiveness of market influence.

H3: Under an effective market influence, the ABCP liquidity guarantor banks keep a higher capital ratio than the credit guarantor banks do.

We test the empirical hypotheses in the following sections.

4 Data

We obtain the quarterly information on the outstanding amount of ABCP conduits, conduit guarantee types, and the guarantor institution from Moody's Investors Service, which publishes quarterly spreadsheets summarizing the basic information on most of the ABCP conduits. Our sample starts from April 2001, when FAS 140 became effective, to September 2009 when the "ABCP exclusion" ended.[24] We drop the data points of alternative conduits, including Collateralized Debt Obligations (CDO), Asset Backed Securities (ABS), repurchase agreements, total return swaps, and mortgage warehouses, from Moody's data.[25] We also remove the conduits with non-bank guarantors, such as asset manage-

[23]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)

[24]The "ABCP exclusion" was officially dropped in January 2010. However, the banks were aware of the coming policy change months before the final announcement. Therefore, we do not include the fourth quarter 2009 data point.

[25]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 with a counterparty other than the sponsoring bank. We drop these records because the repo and total return swap protection sellers, instead of banks, carry the credit risk. Some mortgage lenders use ABCP conduits as mortgage 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,

ment firms and automotive manufacturers. This leaves 18 publicly traded US bank holding companies (BHCs) as ABCP guarantors in our sample. We then collapse the observations by aggregating the principal amount of outstanding ABCP across all the conduits supported by each bank in each quarter. The resulting dataset contains quarterly updates on each bank's liquidity guarantees and credit guarantees exposure.

We then merge the bank conduit exposure information with bank financial statement information from the Federal Reserve Board's FR Y-9C forms for BHCs, by matching bank and quarter.[26] We normalize the credit and liquidity guarantee exposure for each bank i at period t by the book value of the bank's balance sheet assets:

$$\text{LG Conduit Exposure}_{i,t} = \left[\frac{\text{Outstanding of ABCP with bank } i\text{'s liquidity guarantee}}{\text{Book value}}\right]_{i,t},$$
$$\text{CG Conduit Exposure}_{i,t} = \left[\frac{\text{Outstanding of ABCP with bank } i\text{'s credit guarantee}}{\text{Book value}}\right]_{i,t}.$$

The nature of off-balance sheet financing makes obtaining complete information on the underlying assets in ABCP conduits difficult. However, Moody's Investors Service does release, on an irregular basis, the mix of underlying assets for a few large ABCP conduits and show that a significant fraction of the underlying assets is residential MBS. Therefore, we use the monthly subprime mortgage delinquency information from ABSNet, our third data source, as a proxy for the expected future credit loss in ABCP conduit assets.

Specifically, we focus on the delinquency status of subprime 2/28 adjustable-rate mortgage (ARM), a subprime mortgage product that first proliferated during the housing boom and later suffered massive credit loss.[27] Since the borrowers with low credit quality typically do not recover once they are over

are in many ways different from regular bank holding companies.

[26]The FR Y-9C, also named call reports, gives quarterly updates on the balance sheet and income statement information for the guarantor and non-guarantor banks as well as important capital ratios such as the Tier 1 risk capital ratio, Tier 1 leverage ratio, and total risk capital ratio.

[27]The term 2/28 means the borrower will enjoy a low fixed teaser mortgage rate for the first two years followed by a floating rate thereafter. The total term of the mortgage is 30 years. Adjustable-rate subprime mortgages allowed the borrowers with low income to enjoy a low initial teaser rate, which made the mortgage loan more affordable than fixed-rate subprime mortgages in the first few years. During the housing boom, it was widely believed that the borrowers could accumulate housing equity from the rising house prices while enjoying the first two years of teaser rate. The borrowers could then either sell the house for a profit or refinance into a mortgage with a lower rate. When the growth in home prices began to soften in 2007, the subprime ARM borrowers show an increasing level of delinquency.

60 days delinquent, the 60-day delinquency rate was a closely watched indicator of the healthiness of ABCP collateral quality.[28] We aggregate the monthly balance of over 60-day delinquent subprime ARM 2/28 loans and normalize it with the monthly total current balance of subprime ARM 2/28 loans:

$$\text{Mortgage Delinquency}_t = \left[\frac{\text{Balance of over 60-day delinquent subprime ARM 2/28 loans}}{\text{Balance of subprime ARM 2/28 loans}}\right]_t .$$

Figure 4 shows the change in the subprime ARM 2/28 delinquency ratio during the study period.

Finally, we measure the risk exposure of the sponsoring bank to ABCP conduits as the product of relative conduit exposure and the percentage of over 60-day subprime ARM 2/28 delinquent ratios:

$$\text{LG Conduit Risk}_{i,t} = \text{LG Conduit Exposure}_{i,t} \times \text{Mortgage Delinquency}_t,$$

$$\text{CG Conduit Risk}_{i,t} = \text{CG Conduit Exposure}_{i,t} \times \text{Mortgage Delinquency}_t.$$

To compare the risk capital ratios between the guarantor and non-guarantor BHCs, we also obtain the balance sheet and income statement information of non-guarantor BHCs from April 2001 to September 2009. Following the common practices in Erel, Nadauld, and Stulz (2013), we drop all BHCs with missing data on total assets or with maximum total assets less than 1 billion USD during this period. This gives me 362 BHCs that are not ABCP guarantors.

We obtain the daily maturity distribution for all newly issued U.S. ABCP and non-financial commercial paper from Federal Reserve.[29] The non-financial commercial paper maturity is an instrumental variable that solves the endogeneity between ABCP maturity and bank return, which we discuss shortly after. We calculate the daily distribution of maturity for the *outstanding* commercial papers by summing the issuance balance of the commercial paper with different maturities. We then use the ratio of the outstanding amount of ABCP maturing overnight to the total outstanding of ABCP with

[28] There are two standard approaches to calculate days in delinquency: the Office of Thrift Supervision (OTS) standard, and the Mortgage Banker's Association (MBA) standard. A mortgage loan that is 30 days delinquent in OTS standards is usually 60 days delinquent in MBA standards. Similarly, a 60 days delinquent loan in OTS standard is 90 days delinquent in MBA standards. The OTS standard has wider acceptance for subprime mortgage products. We follow the OTS standard in this paper.

[29] It would be great to have the daily maturity distribution of newly issued commercial paper by sponsor banks or issuers. Unfortunately the bank-level ABCP maturity information is not available (either as public information or as commercial dataset) in our best knowledge.

all maturities in the same period as a measurement of ABCP maturity:

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

The $\%\mathrm{OVN}_t$ corresponds to the parameter m in Section 3. A higher overnight share at day t implies that the bank must deliver more liquidity guarantee on that day. We calculate the maturity of non-financial commercial paper, $\%\mathrm{OVN}$ Non-financial$_t$, in a similar manner. Panel (a) and (b) of Figure 5 show the daily fraction of ABCP and non-financial commercial paper maturing overnight. The maturity of ABCP shortened during the 2007 ABCP market freeze while the maturity of non-financial commercial paper shortened during the 2006 downgrade of General Motors. Panel (c) shows the correlation between the maturities in two markets.

We obtain the daily returns of the BHCs and the common market factors including daily riskless rate, Fama-French factors, Carhart momentum factor, by merging CRSP and Fama-French data. This gives me $26,015$ observations of bank returns for 18 panel banks over the study period. We merge the daily returns of banks with the daily commercial paper maturity and the level of mortgage delinquency. We then merge the resulting dataset with the quarterly ABCP conduit outstanding information and banks' call reports before the return date. Finally, we augment the dataset with macroeconomic data. The macroeconomic datasets include the monthly US GDP and the magnitude of quantitative easing (QE); both can change the banks' returns as well as investor appetite to for ABCP. The GDP data are from Macroeconomic Advisers LLC, and the QE data are from the weekly MBS purchase amount published by the Federal Reserve.

Table 1 summarizes the sample used in the empirical analysis. The sample consists of 18 US bank equity returns starting from 2001Q2 to 2009Q3. The ABCP maturity measure %OVN shows that on average, 7.4% of the outstanding ABCP matures overnight, whereas the ratio becomes 21.68% during the ABCP run. The average and maximum share of non-financial CP with overnight maturity are 10.26% and 41.60% respectively. Liquidity and credit guarantee conduit exposure show the outstanding ABCP that the bank guarantees relative to its book value. The size of liquidity guarantee facility is about 3.87% as large as the bank balance sheet on average, whereas the size of credit guarantee facility is about 0.87%.[30]

[30]The sum of the average liquidity and credit exposure is about 4.7%, less than implied by Figure 1, since we

Table 2 summarizes the balance sheet information of 380 US bank holding companies, both ABCP guarantor and non-guarantors, from 2001Q2 to 2009Q3. There are $7,963$ bank-quarter observations in total. Among them, 18 bank holding companies are ABCP guarantors in 417 bank-quarters. The remaining $7,546$ bank-quarter observations from 367 bank holding companies are non-guarantors with maximum book assets larger than 1 billion.[31] The number of bank-quarter observations drops to $1,428$ and 345 when we keep only non-guarantors with more than 10 billion and 50 billion USD book assets, respectively, whereas the number of banks becomes 74 and 23. The average total assets of ABCP guarantors are higher by orders of magnitude than the average of non-guarantor BHCs, which suggests that the ABCP guarantors tend to be larger than average BHCs. Guarantor and non-guarantor banks also differ in other aspects such as higher ROA and less amount of loans on the balance sheet.

5 Empirical analysis

5.1 Model specification and the likelihood ratio (LR) test

We first test whether a shortened ABCP maturity together with a drop in conduit value leads to a negative return for the credit or liquidity guarantor (Hypothesis 1 and 2), using the unrestricted model

$$\begin{aligned} r_{i,t}^{FF4} &= \alpha_i + \beta_0 \times \Delta\%\mathrm{OVN}_t \\ &+\beta_1 \times \Delta\mathrm{LG\ Conduit\ Risk}_{i,t} + \beta_2 \times \Delta\%\mathrm{OVN}_t \times \Delta\mathrm{LG\ Conduit\ Risk}_{i,t} \\ &+\beta_3 \times \Delta\mathrm{CG\ Conduit\ Risk}_{i,t} + \beta_4 \times \Delta\%\mathrm{OVN}_t \times \Delta\mathrm{CG\ Conduit\ Risk}_{i,t} \\ &+\beta_5 \times \mathbf{X}_{i,t} + \beta_6 \times \Delta\%\mathrm{OVN}_t \times \mathbf{X}_{i,t} + \beta_7 \times \mathbf{Y}_t + \varepsilon_{i,t}, \end{aligned} \tag{5}$$

and a group of restricted models in which regressors with insignificant regression coefficients are dropped. The dependent variable in equation (5), $r_{i,t}^{FF4}$ is the Fama-French-Carhart abnormal return of bank i at the holding period t. We drop the observations with excess return outside the $[-20\%, 20\%]$

drop the alternative conduits and non-bank guaranteed conduits.

[31]Five banks started to sponsor ABCP conduits later than 2001Q2. They appear as non-guarantors in the earlier periods and as guarantors later. Hence, the total number of guarantor and non-guarantor banks is greater than 380.

range, and end up with $25,918$ observations. Among the explanatory variables, $\Delta\%\text{OVN}_t$ measures the change in the ratio of ABCP outstanding maturing overnight from period $t-1$ to t. Bank balance sheet variables $\mathbf{X}_{i,t}$ contain the book value per share, the earnings per share, and the deposit ratio. We also interact $\mathbf{X}_{i,t}$ with the ABCP maturity $\Delta\%\text{OVN}_t$ to ensure we are controlling at the same level of variation used for coefficients of interest. The time-series control variables $\mathbf{Y}_t$ include controls for the macroeconomic and general market conditions that can also influence banks' returns and investor appetite for ABCP. This includes the magnitude of the Federal Reserve's quantitative easing during the financial crisis by using the weekly mortgage-backed security purchase amount, and the GDP growth as an indicator of the general economy. Finally, $\varepsilon_{i,t}$ is a bank-specific error term. Standard errors are clustered at the bank level and the year level to account for heteroscedasticity and serial correlation of errors as in Petersen (2009). We then identify the most appropriate regression specification using likelihood ratio tests.[32]

Table 3 shows the OLS regression and LR test results. The OLS regression results for the unrestricted model (1), and the results of the restricted models (2) to (5) are shown in panel (a). The result presented in the model (1) shows that consistent with the model prediction and the hypothesis H1, neither $\Delta\text{CG Conduit Risk}_{i,t}$ nor $\Delta\%\text{OVN}_t \times \Delta\text{CG Conduit Risk}_{i,t}$ have a significant effect on bank returns. More importantly, consistent with the hypothesis H2, the interaction between maturity and the riskiness of the conduit significantly affects the liquidity guarantor banks' abnormal returns. In other words, the stock market discovers the banks that practice regulatory arbitrage and varies their stock prices according to the risk exposure.

The LR test results in the panel (b) of Table 3 suggest the best empirical specification for further empirical tests. The test results reject the hypothesis that the model (4) is not nested in the model (3). Thus, the interaction term between the ABCP maturity and liquidity guarantee exposure, $\Delta\%\text{OVN}_t \times \Delta\text{LG Conduit Risk}_{i,t}$, has to be included in the model. The LR test also rejects the hypothesis that the model (5) is nested in the unrestricted model (1). The factors $\Delta\%\text{OVN}_t \times \Delta\text{CG Conduit Risk}_{i,t}$ and

[32] Acharya et al. (2012) study the risk transfer in ABCP securitization using the baseline specification$r_i = \alpha + \beta \times \text{Conduit Exposure}_i + \gamma \times \mathbf{X}_i + \varepsilon_i$, where r_i is the cumulative equity return of bank i computed over the three-day period from August 8 to 10, 2007, and $ConduitExposure_{i,t}$ is bank i's conduit exposure relative to total assets at time t. They find that for those banks that provide liquidity guarantees to ABCP conduits, a larger ABCP conduit exposure was associated with more negative stock returns during the short period of the ABCP market freeze. Acharya et al. (2012) challenge the belief that by transferring assets to an ABCP conduit and providing liquidity guarantees, a bank unloads the credit risk of those assets from its balance sheet.

ΔCG Conduit Risk$_{i,t}$ do not have significant regression coefficients. We also observe that dropping these two terms leads to higher overall F-statistics in the regressions, as in the panel (b) of Table 3, which suggests a better model fit. This confirms that the change in ABCP maturity is more relevant to the risk of a liquidity guarantee than to that of a credit guarantee. Hence, we focus on the liquidity guarantee exposure and its interaction term with ABCP maturity in the following analysis.

5.2 Market monitoring: ABCP maturity and bank equity return

Investors demand short maturity ABCP not only due to their idiosyncratic maturity preferences but also because of a deteriorated creditworthiness of the sponsor bank which might be signaled by a low stock price. Hence, it is difficult to establish a causal link from an elevated cost of ABCP guarantee obligation to a lower stock return. Although using the average maturity of ABCP partly resolves this problem since the idiosyncratic risks among the banks can cancel out each other, additional identification will bring in more reliable empirical results.[33]

We use the maturity of non-financial commercial paper as a plausible identification of the investors' idiosyncratic maturity preference, which is hard to measure directly. Many large non-financial firms issue commercial papers with similar credit and liquidity profiles as that of ABCP, and typically sold to the same group of investors such as money market mutual funds. The maturity of non-financial commercial paper correlates with the maturity of ABCP since both are driven by the idiosyncratic maturity preferences of investors. Similar to the ABCP, the non-financial commercial paper may also experience runs when the abnormal returns of the issuing firms are low. In other words,

$$\begin{aligned}
\Delta\%\text{OVN}_t &= \rho_0 + \rho_1 \times \Delta\text{maturity preference}_t + \rho_2 \times \mathbf{r}_t^a + u_t, \\
\Delta\%\text{OVN Non-financial}_t &= \theta_0 + \theta_1 \times \Delta\text{maturity preference}_t + \theta_2 \times \bar{\mathbf{r}}_t^a + \bar{u}_t,
\end{aligned}$$

in which %OVN Non-financial$_t$ is the maturity of non-financial commercial paper at period t. The $\mathbf{r}_t^a$ and $\bar{\mathbf{r}}_t^a$ refer to the vectors of abnormal returns of the financial and non-financial sector respectively.

[33]There is also a simultaneity concern when analyzing how the mortgage delinquency affects bank returns. A poorly performed bank, usually associated with negative equity returns, may also adversely affect the credit access of households, therefore leads to higher mortgage deliquency rate. However, this usually happens in a longer time horizon such as a few months. On the other hand, the release of high mortgage deliquency rate information may affect the bank returns within a day if not quicker.

Given the financial sector and non-financial sector together represents the equity market, the market factors (Fama-french and Carhart factors) should absorb the correlated components of the non-financial and financial sector returns, leave the abnormal return of banks and non-financial firms orthogonal to each other. As a result, a change in $\Delta\%\text{OVN Non-financial}_t$ does not subject to the simultaneity—the effect of the change in $\mathbf{r}_t^a$—and can be used as an instrumental variable for the ABCP maturity $\Delta\%\text{OVN}_t$.

We implement the identification strategy by using a two-stage least squares estimation (2SLS). In the *first stage*, we estimate $\Delta\%\text{OVN}_t$, $\Delta\%\text{OVN}_t \times \Delta\text{LG Conduit Risk}_{i,t}$, and $\Delta\%\text{OVN}_t \times \mathbf{X}_{i,t}$ using regression:

$$\begin{aligned}
& \{\Delta\%\text{OVN}_t, \Delta\%\text{OVN}_t \times \Delta\text{LG Conduit Risk}_{i,t}, \Delta\%\text{OVN}_t \times \mathbf{X}_{i,t}\} \\
= \;& \alpha_i + \gamma_0 \times \Delta\%\text{OVN Non-financial}_t + \gamma_1 \times \Delta\text{LG Conduit Risk}_{i,t} \\
& +\gamma_2 \times \Delta\%\text{OVN Non-financial}_t \times \Delta\text{LG Conduit Risk}_{i,t} \\
& +\gamma_3 \times \mathbf{X}_{i,t} + \gamma_4 \times \Delta\%\text{OVN Non-financial}_t \times \mathbf{X}_{i,t} + \gamma_5 \times \mathbf{Y}_t + v_t.
\end{aligned} \tag{6}$$

In the *second stage*, we estimate:

$$\begin{aligned}
r_{i,t}^{FF4} \;=\;& \alpha_i + \beta_0 \times \widehat{\Delta\%\text{OVN}_t} + \beta_1 \times \Delta\text{LG Conduit Risk}_{i,t} \\
& +\beta_2 \times \widehat{\Delta\%\text{OVN}_t \times \Delta\text{LG Conduit Risk}_{i,t}} \\
& +\beta_3 \times \mathbf{X}_{i,t} + \beta_4 \times \widehat{\Delta\%\text{OVN}_t \times \mathbf{X}_{i,t}} + \beta_5 \times \mathbf{Y}_t + \varepsilon_{i,t},
\end{aligned} \tag{7}$$

where $\widehat{\Delta\%\text{OVN}_t}$, $\widehat{\Delta\%\text{OVN}_t \times \Delta\text{LG Conduit Risk}_{i,t}}$, and $\widehat{\Delta\%\text{OVN}_t \times \mathbf{X}_{i,t}}$ are estimated from first-stage regressions. We include similar controls, as in section 5.1, in both the first and second-stage regressions.

Table 4 reports the IV regression results: panel (a) shows the result of the second stage as in Equation (7), and panel (b) shows the first stage regressions of $\Delta\%\text{OVN}_t$ and $\Delta\%\text{OVN}_t \times \Delta\text{LG Conduit Risk}_{i,t}$ as in Equation (6). Specifically, given the average exposure of liquidity guarantees (approximately 3.86% of total assets) for a sponsor bank under average speed of mortgage delinquency buildup (0.416% per month), a 1.14% absolute increase in the percentage share of ABCP with overnight maturity (such as an increase from the average 7.40% to 8.54%) leads to a 7.5 bps negative abnormal return for the sponsoring bank.[34] The result is robust with respect to the inclusion of bank fixed effect, bank balance sheet variables, and macroeconomic variables as discussed in Section 5.1.

5.2.1 Robustness

In addition to the alternative regression specification, which has been addressed in the LR test, we note the following reservations concerning our empirical results in Table 4. The first concern is that the regression results are driven solely by the financial crisis period, we run the regression in two separate periods. To mitigate the concern, we first try to separate the regression in the periods before and after the beginning of 2007 when the ABCP market experienced an abrupt change. The first period observed a steady growth in the ABCP market while the second period witnessed the market's topping and decline. Panel (a) of Table 5 shows the results are significant both before and after the ABCP market froze. Therefore, the empirical result presented using the whole sample data is not driven solely by the post-ABCP crisis period.

A similar concern is that the low-interest environment during the 2002 and 2004 made the ABCP attractive to yield-seeking investors who are bound to hold only high-quality assets. The low-interest environment was also one of the primary reasons behind the housing boom. Hence, we run separate regressions for the periods before and after the beginning of 2005 to capture the regression under different mortgage rate environments. Panel (b) of Table 5 shows the results are robust in the periods of both low and high mortgage rates.

The third potential concern is that the empirical result is driven by a small amount of extreme bank daily returns. Table 6 shows the robustness of the baseline results by using the observations in which bank returns within the $[-30\%, 30\%]$ range, as well as the returns that are winsorized at the $(1\%, 99\%)$ and the $(0.5\%, 99.5\%)$ level. The results remain under alternative winsorizations and trimming.

[34] Although the magnitude of the effect of the key explanatory variable in the IV regression result (e.g., -0.0410 in the model (3) of Table 4) is larger than that of the OLS regression (e.g., -0.00855 in the model (3) of panel (a) in Table 3), the F-statistics of the key first stage regressions are much higher than 10, alleviating the concern of weak instruments. Figure 5 also shows the moment condition of the instrumental variable, the change in non-financial commercial paper maturity %OVN Non-financial$_t$, is very informative about the variable of interest, the change in ABCP maturity %OVN$_t$.

The fourth concern is that the empirical results are driven by the particular choice of bank return. To check the robustness of our regression result, we use the Fama-French abnormal return as the alternative measures of the sponsoring bank's value. Table 7 confirms that the empirical findings remain under alternative return measure.

5.2.2 Interpretation and discussion

We interpret the empirical estimates as the evidence that the financial market was aware of the excessive risk taken by the liquidity guarantor banks through "ABCP exclusion," since the market prices in the risk transfer between the ABCP conduit and the bank modulated by the ABCP maturity. Hence, the market discipline not only observes the on-balance-sheet activities such as maturity mismatch (Flannery and James 1984) or deposit credits (Demirgüç-Kunt and Huizinga 2004), but also the off-balance-sheet activities.

Our finding relates to Acharya et al. (2012) which also look at the stock return of publicly traded ABCP sponsor banks, among many other aspects of the ABCP market. Specifically, they focus on the relationship between the equity return and conduit exposure using the regression specification $R_i = \alpha + \beta \text{ConduitExposure}_i + \gamma X + \varepsilon_i$. They found that banks have higher conduit exposure only experienced a more negative cumulative return in August 2007, or more specifically over the 3-day period from August 8 to 10 in 2007, when the ABCP market experienced a run. The stock return in other months from January to July 2007 do not show a statistically significant relation with conduit exposure. Acharya et al. (2012)'s finding is consistent with our result in Table 4 that the coefficient of $\Delta LGConduitRisk$ is insignificant. Our finding suggests that when the ABCP maturity is extended, the loss in conduit asset does not transfer to the liquidity guarantor bank much. Therefore, the bank return does not drop significantly even though the market monitoring is effective.

5.3 Market influence: bank risk capital buffer

We then examine the market influence by investigating whether loophole-exploiting banks, particularly liquidity guarantors, maintain a higher risk capital buffer (the Hypothesis H3). First, we set the liquidity guarantors' capital ratio against that of the credit guarantors using the specification

$$\kappa_{i,q+1} = \alpha_i + \gamma_0 \times 1_{i,q}^{\{\text{Liquidity guarantor}\}} + \gamma_1 \times \mathbf{X}_{i,q} + \gamma_2 \times \mathbf{Y}_q + \varepsilon_{i,q}, \tag{8}$$

in which $\kappa_{i,q+1}$ is the bank i's *book-value based* capital ratio at quarter $q+1$, $1_{i,q}^{\{\text{Liquidity guarantor}\}}$ is the indicator variable for the bank i is a liquidity guarantor at quarter q. Besides, $\mathbf{Y}_q$ is the time fixed effect, and $\mathbf{X}_{i,q}$ is the vector of control variables for bank i, at quarter q. Following Gropp and Heider (2010), the control variables include each bank's market beta, market-to-book ratio, collateral-to-assets ratio, dividend payout ratio, EPS, ROA, and the logarithm of book assets (the square of logarithm book assets is also included to capture the nonlinear effect). We also run partial specifications without bank balance sheet controls.

Second, we compare the risk capital ratios of ABCP guarantor banks with those of non-guarantors, including both credit guarantors and non-guarantor BHCs. However, as Table 2 has shown, the ABCP guarantor banks are quite different from their non-guarantor counterparts. Table 8 further compares the risk capital ratios, total assets, net income, and other bank characteristics among the ABCP guarantor banks and non-guarantor banks with asset book values above the 1 billion, 10 billion, and 50 billion USD threshold. The difference between ABCP guarantor banks and non-guarantor banks consistently reduces when we eliminate the small BHCs from the comparison, since the guarantors tend to have more massive balance sheets. Hence, we analyze guarantor banks and non-guarantor BHCs with book assets above 50 billion USD (TBTF banks) by the regression

$$\kappa_{i,q+1} = \alpha_i + \gamma_0 \times 1_{i,q}^{\{\text{Liquidity guarantor}\}} + \gamma_1 \times 1_{i,q}^{\{\text{Credit guarantor}\}} + \gamma_2 \times \mathbf{X}_{i,q} + \gamma_3 \times \mathbf{Y}_q + \varepsilon_{i,q}, \tag{9}$$

with similar covariates $\mathbf{X}_{i,q}$ and $\mathbf{Y}_q$.[35]

The results are presented in Table 9. Panel (a) demonstrates that a liquidity guarantor bank tends to have a higher Tier-1 capital ratio and Total (Tier-1 and Tier-2) capital ratio than its credit guarantor counterpart. Both results are statistically significant. When compared only with credit guarantor

[35] Additionally, banks with book assets above 50 billion USD are deemed to be "too-big-to-fail" (TBTF) banks because they are so large and interconnected that their failure would be disastrous to the economic system. They are subject to more restrictive regulations, but they are also more likely to be bailed out when distressed. All of these differences affect banks' capital structure decisions.

banks, a liquidity guarantor bank on average has a 0.93% higher Tier-1 risk-capital ratio and 0.88% total risk-capital ratio, both in absolute difference, after controlling for the balance sheet and bank riskiness covariates. Since the average Tier-1 and total risk capital ratios are 9.438% and 12.929% respectively, a 0.93% Tier-1 risk-capital ratio and a 0.88% total risk-capital ratio are economically significant differences.

Panel (b) of Table 9 provides additional evidence to support that a liquidity guarantor bank has higher capital ratios than a non-guarantor large BHC. After controlling for the balance sheet and bank riskiness covariates, a bank that provides ABCP liquidity guarantee has a 0.74% higher Tier-1 risk-capital ratio and a 0.73% total risk-capital ratio than non-guarantor TBTF BHCs. Again, both results are statistically and economically significant.

To provide further evidence showing it is the pressure from the negative stock return that causes the liquidity guarantors to maintain a high regulatory capital, we investigate how the stock prices sensitivity to ABCP conduit risk affects the risk capital buffer of the guarantors. Specifically, we first estimate the connection between an ABCP guarantor bank's stock return with its ABCP obligation exposure. We run separate regressions, within each quarter q for each bank i, the bank's daily Fama-French-Carhart abnormal return at date t with the interaction of bank's guarantee exposure and ABCP maturity change:

$$\begin{aligned} r_{i,q,t}^{FF4} &= \alpha_{i,q} + \beta_0 \times \Delta\%\text{OVN}_{q,t} + \beta_1 \times \Delta\text{LG Conduit Risk}_{i,q,t} \\ &\quad + \beta_{i,q}^{ABCP} \times \Delta\%\text{OVN}_{q,t} \times \Delta\text{LG Conduit Risk}_{i,q,t} + \varepsilon_{i,q,t}. \end{aligned} \tag{10}$$

We focus on the coefficient $\beta_{i,q}^{ABCP}$, which represents each ABCP guarantor bank i's average stock price sensitivity to the risk from the ABCP guarantee obligation in quarter q. We then run a panel regression

$$\kappa_{i,q+1} = \alpha_i + \gamma_0 \times \beta_{i,q}^{ABCP} + \gamma_1 \times \mathbf{X}_{i,q} + \gamma_2 \times \mathbf{Y}_q + \varepsilon_{i,q}, \tag{11}$$

to evaluate the relationship between a guarantor's choice of capital ratio and the sensitivity of stock price to ABCP guarantee risk.[36]

[36] 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

Table 10 presents the regression result of Equation (11) where the $\beta_{i,q}^{ABCP}$ are estimated from Equation (10). A guarantor bank more sensitive to the ABCP risk—a bank suffers more negative stock return under an increased share of ABCP with overnight maturity and an increased conduit asset delinquency—has a more negative β^{ABCP}.

5.4 Interpretation and discussion

We interpret these results as evidence that effective market monitoring does lead to effective market influence for loophole-exploiting banks. The empirical results in Table 9 and 10 demonstrate the association that a liquidity guarantor bank, whose stock value suffers from the elevated risk of ABCP guarantee obligation, does keep a higher risk capital. Further, a more negative β^{ABCP} leads to a higher risk capital ratio in the next quarter. In other words, the guarantor banks increase their risk capital as a response to the pressure of franchise value emanated from the ABCP guarantee obligation. The finding extends the existing study on optimal bank capital structure (Berger et al. 2008; Gropp and Heider 2010) in the sense that despite the regulator is not aware of the regulatory arbitrage, loophole-exploiting banks still increase their risk capital buffer due to market discipline. Therefore, an efficient capital market can mitigate the consequence of regulatory loophole.

6 Conclusion

Does the stock market recognize loophole-exploiting banks? We first show that the "ABCP exclusion" is a regulatory loophole which allows me to investigate whether the stock market is aware of the regulatory arbitrage opportunity. The empirical test confirms our assertion by showing that the interaction between the change in ABCP maturity and conduit assets credit loss affects the abnormal returns of the ABCP liquidity guarantor banks, but not the returns of the credit guarantors.

Subsequently, does the pressure emanated from the stock market influence the capital structure of the banks? Our model shows that, compared to the credit guarantors or non-guarantors, liquidity guarantor banks are more likely to violate the minimum risk capital requirement, *ceteris paribus.*

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.

Hence, under the market influence, a liquidity guarantor bank shall hold higher risk capital *ex ante*. Empirical evidence shows that the liquidity guarantor banks have a Tier-1 risk capital ratio that is 93 basis points higher than that of credit guarantors and 74 basis points higher than that of non-guarantor banks. Further, guarantors whose franchise value are more sensitive to the risk from ABCP guarantee obligation maintains a higher risk capital buffer.

In summary, the loophole-exploiting banks taking on ABCP guarantee risk face the pressure in their franchise value and increase their capital buffer accordingly. This paper presents both active market monitor and influence on the ABCP guarantor banks and points to the effectiveness of market discipline when the minimum capital requirements are compromised.

A Appendix

A.1 Proof of Propositions

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 (3) becomes

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

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 function 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*

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

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 (see Karatzas 1991) 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. $\square$

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 $\frac{\partial}{\partial y}A_h^L(y_t,m)=\frac{\partial}{\partial y}A_l^L(y_t,m)$ at $y_t=y_0$, suggest that

$$\frac{k}{r}V(y_0)+\lim_{m\to\infty} C_h(m)\phi(y_t;y_w) = V(y_0)+\lim_{m\to\infty} C_l(m)\bar{\psi}(y_t;y_w)=V(y_0), \tag{A.1}$$

$$\lim_{m\to\infty} C_h(m)\frac{\partial}{\partial y}\phi(y_t;y_w) = \lim_{m\to\infty} C_l(m)\frac{\partial}{\partial y}\bar{\psi}(y_t;y_w). \tag{A.2}$$

It is then easy to see Equation (A.1) suggests that $\lim_{m\to\infty} C_l(m)\bar{\psi}(y_t;y_w)=0$. Hence, $\lim_{m\to\infty} C_l(m)=0$. With $\frac{\partial}{\partial y_t}\phi(y_t;y_w)=\frac{\partial}{\partial y_t}\left(\frac{y_t}{y_w}\right)^G=G\left(\frac{y_t}{y_w}\right)^{G-1}<0$, Equation (A.2) suggests $\lim_{m\to\infty} C_h(m)=0$ as well. Use Equation (A.1) again, with $\frac{k}{r}V(y_0)+\lim_{m\to\infty} C_h(m)\phi(y_t;y_w)=V(y_0)$ together with $\lim_{m\to\infty} C_h(m)=0$ and $\lim_{m\to\infty}\phi(y_t;y_w)=0$, we have $k=r$. Summarize the value of C_l, C_h, G and $\bar{G}$ under $m\to\infty$, we get $\lim_{m\to\infty} A^L(y_t,m)=V(y_0)$ for $\forall y_t\in(y_w,\infty)$. □

Proposition 3. *When the ABCP maturity decreases, the liquidity support value function converges to the credit support value function. When the maturity $1/m$ approaches 0, $\lim_{m\to\infty} G^L(y_t,m)=G^C(y_t,m)$ for $\forall y_t>y_w$.*

Proof. By Equation (4), 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

$$rG^C(y_t)=\mu y_t\frac{\partial G^C(y_t)}{\partial y_t}+\frac{1}{2}\sigma^2y_t^2\frac{\partial^2G^C(y_t)}{\partial y_t^2}, \tag{A.3}$$

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

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

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

and using Lemma A.1, we have $\lim_{m\to\infty} A^L(y_t, m) = V(y_0)$ for $\forall y_t \in (y_w, \infty)$, and $A^L(y_w, m) = V(y_w)$. Therefore, with $G^C(y_w) = -V(y_0) + V(y_w)$

$$r\bar{G}^L(y_t) = mG^C(y_w)\mathbf{1}_{\{y_t=y_w\}} + \mu y_t \frac{\partial \bar{G}^L(y_t)}{\partial y_t} + \frac{1}{2}\sigma^2 y_t^2 \frac{\partial^2 \bar{G}^L(y_t)}{\partial y_t^2}, \tag{A.4}$$

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.3) and (A.4) share the same general solution, and the inhomogeneous term $mG^C(y_w)\mathbf{1}_{\{y_t=y_w\}}$ in differential equation (A.4) is a delta function on $y_t = y_w$. Following the standard Green function method, we have $G^C(y_t) = \bar{G}^L(y_t)$ for $\forall y_t \in (y_w, \infty)$. $\square$

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

Proof. First, 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

$$\frac{E^L + G^L(y_0)}{D + \beta V(y_0)} = \frac{E^C + G^C(y_0)}{D + V(y_0)}. \tag{A.5}$$

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.5) 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

$$\frac{d}{dy_t}\frac{E^L + G^L(y_0)}{D + \beta V(y_t)} - \frac{d}{dy_t}\frac{E^C + G^C(y_0)}{D + V(y_t)} > 0. \tag{A.6}$$

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

$$\frac{1}{D + \beta V(y_t)}\frac{d\hat{G}^L(y_t)}{dy_t} > \frac{1}{D + V(y_t)}\frac{d\hat{G}^C(y_t)}{dy_t}. \tag{A.7}$$

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.6) and (A.7), 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 $y_t \in (y_w, y_0)$. $\square$

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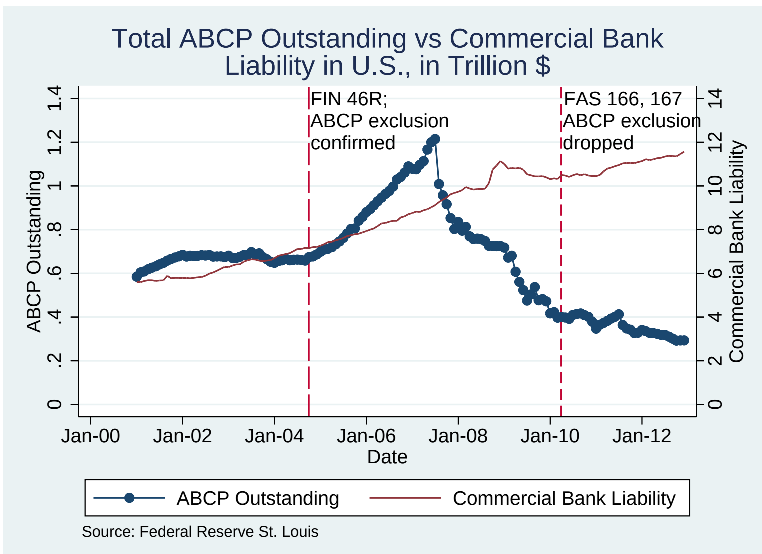
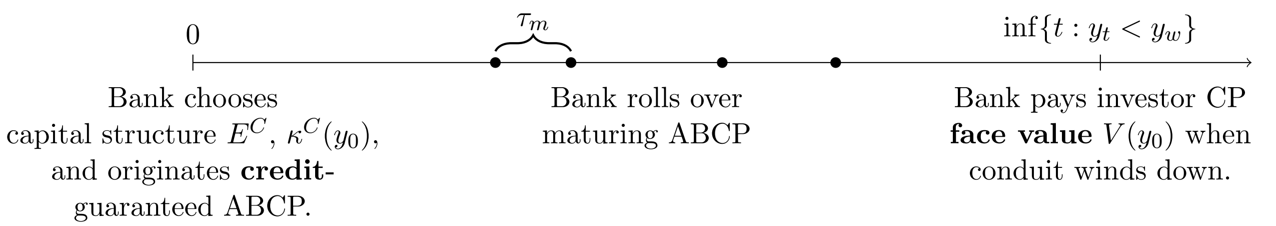
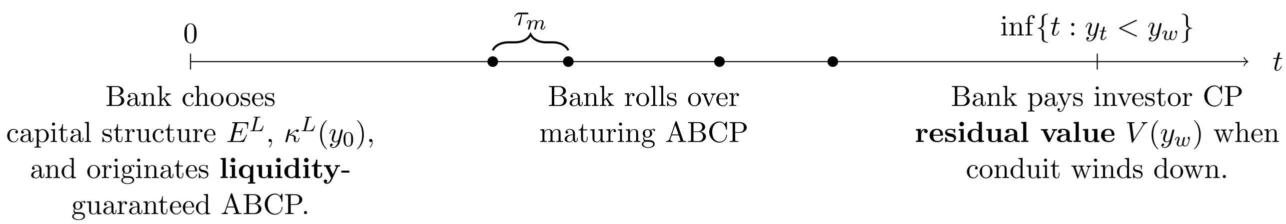


Figure 1: **Total ABCP outstanding vs commercial bank liability**
The left y-axis is for total ABCP outstanding, and the right y-axis (scaled ten times) is for commercial bank liabilities. In the early 2000s, the total ABCP outstanding is about 10% the size of total commercial bank liability in the United States. The left dashed line marks the confirmation of ABCP exclusion in risk capital calculation. The ABCP market size picked up rapidly then, reaching 1.21 Trillion USD in July 2007. The ABCP market experienced a rapid drop in size in the summer of 2007, and never recovered since. The ABCP exclusion was dropped in March 2010, as the second dashed line marks. Source: FRED Economic Data from the Federal Reserve Bank of St. Louis.

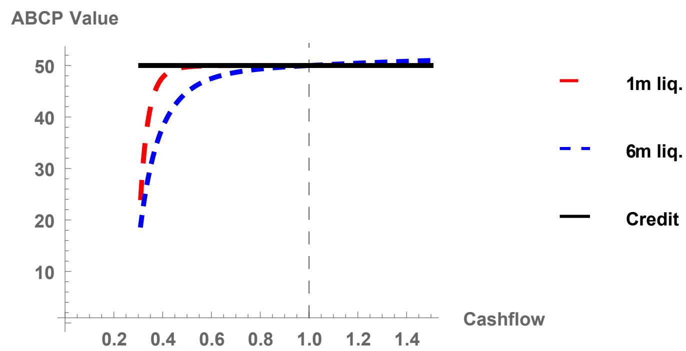


(a) **Credit guaranteed ABCP**

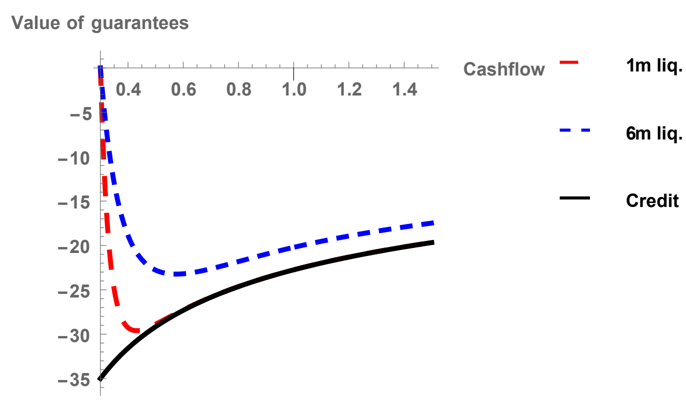


(b) **Liquidity guaranteed ABCP**

Figure 2: **Model timeline.**
Panel (a) and (b) presents the timelines for credit and liquidity guarantor banks in the model respectively. There are multiple events of rolling over maturing ABCP, marked by the 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, the credit guarantor bank needs to pay the face value of the commercial paper to the investors, whereas the liquidity guarantor bank pays the residual value of underlying assets to the investors.



(a) **Value functions of ABCP**



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

Figure 3: **Value functions by ABCP maturity and guarantee type**
Panel (a) shows the value functions of credit guaranteed ABCP (solid line), liquidity guaranteed ABCP with one month maturity (long dashed line), and liquidity guaranteed ABCP with six months maturity (short dashed line). Panel (b) shows the value functions of credit guarantee (solid line), liquidity guarantee for one month ABCP (long dashed line), and liquidity guarantee for three month ABCP (short dashed line). Parameters are $r = 0.05$, $\mu = 0.03$, $\sigma = 0.5$, $y_w = 0.3$, and $y_0 = 1$.

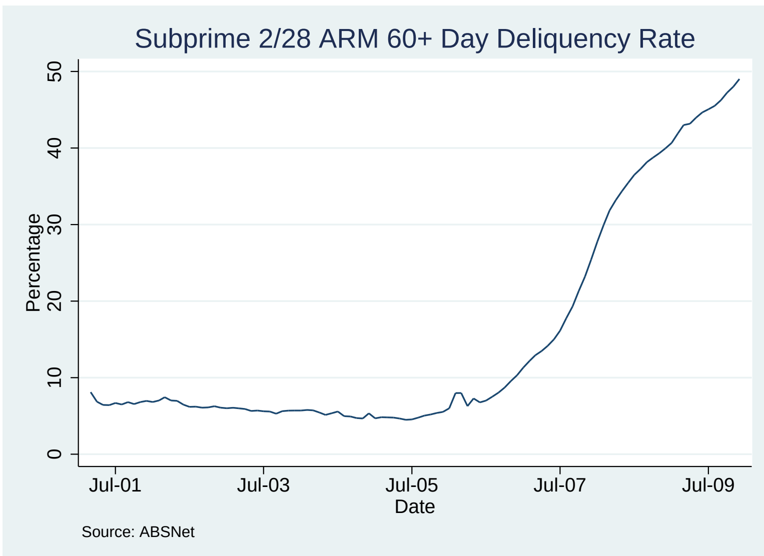
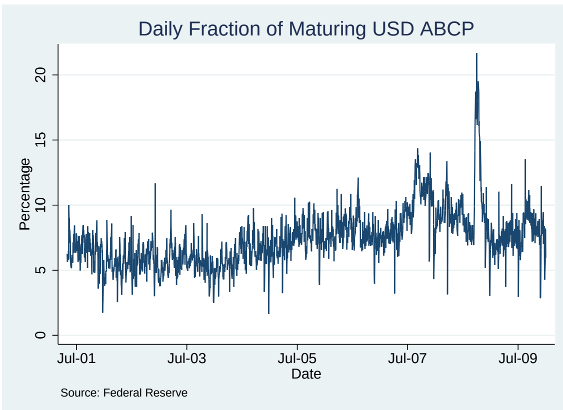
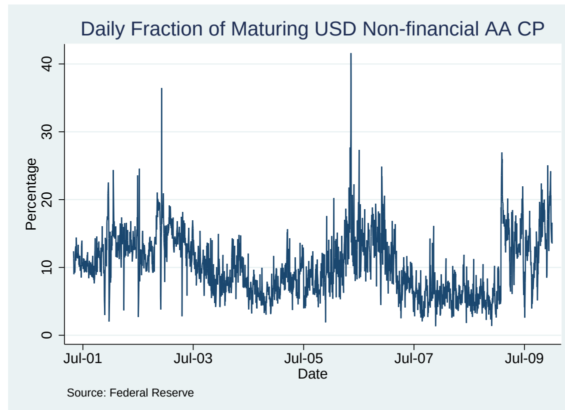


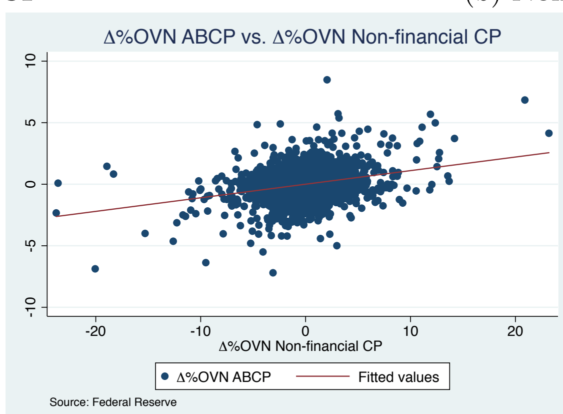
Figure 4: **Subprime ARM 2/28 60+ day delinquency ratio**
The delinquency status of 30-year adjustable-rate subprime mortgages with a fixed rate for the first two years. We aggregate the monthly balance of over 60-day delinquent subprime ARM 2/28 loans and normalize it with the monthly total current balance of subprime ARM 2/28 loans. The delinquency rate was stable before mid-2006, then started to pick up as the U.S. housing market softened. By the end of 2009, about 50% of the subprime ARM 2/28 borrowers are over 60 days delinquent.



(a) **ABCP**



(b) **Non-financial CP**



(c) **CP maturity**

Figure 5: **USD CP maturing overnight**
Panel (a) presents the share of outstanding ABCP with overnight maturity. Panel (b) presents the share of non-financial commercial paper with overnight maturity. Both time series are on a daily basis. The maturity of ABCP shortened during the 2007 ABCP market freeze, while the maturity of non-financial commercial paper shortened during the 2006 downgrade of General Motors. Panel (c) shows the clear correlation between the change in ABCP maturity (y-axis) versus the change in non-financial CP maturity (x-axis) on the same day.

Table 1: **Summary statistics: ABCP guarantor bank return and ABCP market**
This table summarizes the ABCP guarantor bank return, the ABCP market condition, as well as related macroeconomic conditions used in the empirical analysis. The sample consists of 18 U.S. bank equity returns starting from 2001Q2 to 2009Q3, as well as the market return in the same period. Both returns are holding period returns from CRSP: the market return is the value-weighted return including the dividend. Maturities of both ABCP and non-financial commercial paper are from the Federal Reserve – %OVN and %OVN Non-financial measure the percentages of the outstanding ABCP and non-financial commercial paper with overnight maturity on a daily basis. Liquidity (credit) guarantee exposure shows the outstanding ABCP that the bank guarantees relative to its book value. ΔMortgage Delq. shows the change in the fraction of Subprime 2/28 loans that are 60+ day delinquent. Bank balance sheet data are from call reports. Monthly GDP growth is from Macroeconomic Advisers LLC. Fed QE is the weekly mortgage-backed security purchase amount published by the Federal Reserve.

	mean	sd	min	max	count
Daily returns					
Bank returns (%)	0.039	3.255	-81.600	90.217	26015
Market return (%)	0.030	1.285	-8.977	9.528	26015
Maturity of ABCP					
%OVN	7.405	2.162	1.632	21.681	2133
Δ%OVN	-0.001	1.140	-7.200	8.484	2133
Maturity of non-financial CP					
%OVN NFCP	10.259	4.464	1.330	41.604	2131
Δ%OVN NFCP	0.003	2.837	-23.594	20.901	2131
Exposure to ABCP conduit					
Exposure (%)	3.866	3.845	0.000	20.100	417
Credit Guarantee Exposure (%)	0.867	1.958	0.000	11.804	417
Mortgage delinquency					
Δ Mortgage Delq. (%)	0.416	0.686	-1.709	2.376	2138
Macro					
Monthly GDP Growth%	0.131	0.597	-1.688	1.580	105
Fed QE (USD Bil.)	2.044	12.901	-4.782	167.531	2138

Table 2: **Summary statistics: ABCP guarantors vs. other bank holding companies**
This table summarizes the balance sheet information about the U.S. bank holding companies from 2001Q2 to 2009Q3. Column "All BHCs" shows the means and standard deviations of variables for all bank holding companies (BHC). Column "Guarantors" shows the means and deviations for all banks that provided a guarantee to ABCP conduits. Column "Non-guarantors 1B+ assets," "Non-guarantors 10B+ assets," and "Non-guarantors 50B+ assets" show the statistics for all the non-guarantor banks with maximum book assets larger than 1 billion, 10 billion, and 50 billion USD respectively. The total assets of ABCP guarantors are around ten times higher than the population average of BHCs, suggesting the ABCP guarantors are large banks. Guarantor and non-guarantor banks also differ in many other aspects including Tier 1 risk capital ratio, Tier 1 leverage ratio, and Total risk capital ratio. Nevertheless, the difference gets smaller when we compare ABCP guarantor banks with larger non-guarantor BHCs. In particular, the Total risk capital ratio of ABCP guarantors are lower than the average of non-guarantors with more than 1 billion USD assets but higher than that of large non-guarantor BHCs with 50 billion or more assets.

	(1) All BHCs 1B+ assets	(2) Guarantors	(3) Non-guarantors 1B+ assets	(4) Non-guarantors 10B+ assets	(5) Non-guarantors 50B+ assets
Total Assets (Bil.)	30.554	351.216	12.834	55.300	167.629
	(150.830)	(521.229)	(55.054)	(117.390)	(200.296)
Market-to-book	1.818	2.104	1.803	1.905	1.735
	(0.837)	(0.889)	(0.831)	(0.900)	(0.781)
Collateral to assets (%)	26.725	28.568	26.624	27.616	22.831
	(12.502)	(16.007)	(12.273)	(13.254)	(14.113)
Beta	0.956	1.109	0.947	1.060	1.160
	(0.555)	(0.391)	(0.562)	(0.415)	(0.437)
Asset risk	0.049	0.048	0.049	0.046	0.046
	(0.035)	(0.027)	(0.035)	(0.028)	(0.035)
EPS	0.343	0.668	0.325	0.523	0.718
	(0.844)	(0.911)	(0.837)	(0.991)	(1.262)
Payout ratio (%)	37.406	43.991	37.042	41.504	40.101
	(53.236)	(62.037)	(52.688)	(56.630)	(55.449)
ROA (%)	0.199	0.289	0.194	0.234	0.239
	(0.555)	(0.315)	(0.565)	(0.414)	(0.517)
T1 lev. ratio (%)	8.689	7.517	8.754	8.186	8.099
	(1.862)	(1.762)	(1.846)	(1.687)	(2.341)
T1 cap. ratio (%)	11.513	9.438	11.627	10.755	9.580
	(3.431)	(2.312)	(3.446)	(2.627)	(2.461)
Total cap. ratio (%)	13.247	12.929	13.265	13.162	12.712
	(3.194)	(2.001)	(3.246)	(2.375)	(2.595)
Observations	7963	417	7546	1428	345
N. of banks	380	18	367	74	23

Table 3: **Model selection**
Panel (a) reports the OLS regressions as in section 5.1 with combinations of regressors. The model (1) is the unrestricted model as the equation (5), whereas the model (2), (3), (4) and (5) are the restricted models. As shown in the coefficient table, the model (2) drops the Δ%OVN $\times$ ΔCG Conduit Risk, the model (3) further drops ΔCG Conduit Risk, and the model (4) further drops Δ%OVN$\times\Delta$LG Conduit Risk. The model (5) drops Δ%OVN$\times\Delta$LG Conduit Risk from the unrestricted model. The dependent variable, $r_{i,t}^{FF4}$, is the holding period equity abnormal return of bank i at period t, after controlling for the Fama-French and Carhart factors. For the explanatory variables, $\Delta\%\text{OVN}_t$ measures the change in the ratio of ABCP outstanding matures overnight from period $t-1$ to t. $\Delta\text{Conduit Risk}_{i,t}$ is the product of subprime mortgage delinquency rate change between period $t-1$ and t, multiplies the bank's exposure to ABCP liquidity guarantee aforementioned, which is the principal of ABCP relative to the bank's book value. The regression controls for bank fixed effect, bank balance sheet variables, and macroeconomic variables. Model (3), which the interaction term Δ%OVN $\times$ ΔLG Conduit Risk drives down the bank returns, shows the highest overall F-statistics. Panel (b) reports the Likelihood ratio (LR) test to test the hypothesis of nested models. The LR χ^2 show that removing Δ%OVN $\times$ ΔLG Conduit Risk rejects the nested model hypothesis, whereas removing Δ%OVN $\times$ ΔLG Conduit Risk and ΔLG Conduit Risk, which does not reject the nested model hypothesis, leads to higher F-statistics.

(a) **OLS regressions**

	(1) $r_{i,t}^{FF4}$ (%)	(2) $r_{i,t}^{FF4}$ (%)	(3) $r_{i,t}^{FF4}$ (%)	(4) $r_{i,t}^{FF4}$ (%)	(5) $r_{i,t}^{FF4}$ (%)
Δ%OVN	-0.0362	-0.0413	-0.0413	-0.0340	-0.0269
	(0.0362)	(0.0358)	(0.0358)	(0.0357)	(0.0358)
Δ LG Conduit Risk	0.00248	0.00245	0.00391	0.00398	0.00256
	(0.00454)	(0.00454)	(0.00375)	(0.00375)	(0.00454)
Δ%OVN $\times$ Δ LG Conduit Risk	-0.00644*	-0.00856***	-0.00855***		
	(0.00372)	(0.00292)	(0.00292)		
Δ CG Conduit Risk	0.00467	0.00471			0.00456
	(0.00821)	(0.00821)			(0.00821)
Δ%OVN $\times$ Δ CG Conduit Risk	-0.00579				-0.0126**
	(0.00631)				(0.00495)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes
Balance Sheet Controls	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes
Observations	25918	25918	25918	25918	25918
Overall F-Statistics	2.359	2.739	3.542	1.018	2.199

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

(b) **LR test results**

Likelihood-ratio test assumption	LR χ^2
Model (2) nested in model (1)	0.84
Model (3) nested in model (2)	0.33
Model (4) nested in model (3)	8.60***
Model (5) nested in model (1)	3.00*

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: **Effect of ABCP maturity on bank abnormal returns (IV)**
Panel (a) reports the IV betas of the model presented in equation (7) in section 5.2. The dependent variable, $r_{i,t}^{FF4}$, is the holding period equity abnormal return of bank i at period t, after controlling for the Fama-French and Carhart factors. For the explanatory variables, $\Delta\%\text{OVN}_t$ measures the change in the ratio of ABCP outstanding matures overnight from period $t-1$ to t. $\Delta\text{Conduit Risk}_{i,t}$ is the product of subprime mortgage delinquency rate change between period $t-1$ and t, multiplies the bank's exposure to ABCP liquidity guarantee aforementioned, which is the principal of ABCP relative to the bank's book value. Standard errors are clustered at the bank and year level. Panel (b) presents the corresponding first-stage regressions for the regressors of the model (3) presented in panel (a) as in Equation (6).

(a) **IV Regression: Second stage**

	(1) $r_{i,t}^{FF4}$ (%)	(2) $r_{i,t}^{FF4}$ (%)	(3) $r_{i,t}^{FF4}$ (%)
Δ%OVN $\times$ Δ LG Conduit Risk	-0.0409***	-0.0409***	-0.0410***
	(0.0155)	(0.0154)	(0.0155)
Δ%OVN	-0.122	-0.118	-0.120
	(0.126)	(0.126)	(0.124)
Δ LG Conduit Risk	0.00437	0.00395	0.00355
	(0.00506)	(0.00399)	(0.00382)
Bank Fixed Effects	Yes	Yes	Yes
Balance Sheet Controls	No	Yes	Yes
Macro Controls	No	No	Yes
Observations	25918	25918	25918
N. of Bank Clusters	18	18	18
N. of Time Clusters	9	9	9
Overall F-Statistics	3.267	7.541	5.518

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

(b) **IV Regression: First stage**

	(1) Δ%OVN	(2) Δ%OVN $\times$ Δ LG Conduit Risk
Δ%OVN NFCP	0.119***	-0.0977***
	(0.00228)	(0.00830)
Δ%OVN NFCP $\times$ Δ LG Conduit Risk	-0.00705***	0.0714***
	(0.000614)	(0.00224)
Δ LG Conduit Risk	0.00275	-0.0110
	(0.00221)	(0.00805)
Bank Fixed Effects	Yes	Yes
Balance Sheet Controls	Yes	Yes
Macro Controls	Yes	Yes
Observations	25918	25918
Overall F-Statistics	360.5	145.1

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: **Robustness: IV regression by periods**

This table presents two sets of robustness checks of the IV betas, as in section 5.2.1, for the model presented in equation (7). The model (1) in panel (a) presents the regression results using data before the end of 2006 when the US ABCP market enjoyed rapid growth, whereas the model (2) uses data afterward. The model (1) in panel (b) presents the result using data before the end of 2004, when mortgage borrower enjoyed low mortgage rates, whereas the model (2) presents the result using rest of the data. The dependent variable, $r_{i,t}^{FF4}$, is the holding period equity abnormal return of bank i at period t, after controlling for the Fama-French and Carhart factors. For the explanatory variables, $\Delta\%\mathrm{OVN}_t$ measures the change in the ratio of ABCP outstanding matures overnight from period $t-1$ to t. ΔConduit $\mathrm{Risk}_{i,t}$ is the product of subprime mortgage delinquency rate change between period $t-1$ and t, multiplies the bank's exposure to ABCP liquidity guarantee aforementioned, which is the principal of ABCP relative to the bank's book value. Standard errors are clustered at the bank and year level.

(a) **IV regression by periods: 2001-2006 vs. 2007 - 2009**

	(1) $r_{i,t}^{FF4}$ (%)	(2) $r_{i,t}^{FF4}$ (%)
Δ%OVN $\times$ Δ LG Conduit Risk	-0.0341***	-0.0337**
	(0.0101)	(0.0156)
Δ%OVN	-0.0272	-0.474
	(0.0463)	(0.537)
Δ LG Conduit Risk	-0.00398	0.00892*
	(0.0115)	(0.00491)
Bank Fixed Effects	Yes	Yes
Balance Sheet Controls	Yes	Yes
Macro Controls	Yes	Yes
Observations	16139	9779
N. of Bank Clusters	17	15
N. of Time Clusters	5	4
Overall F-Statistics	16.09	0.711

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

(b) **IV regression by periods: 2001-2004 vs. 2005 - 2009**

	(1) $r_{i,t}^{FF4}$ (%)	(2) $r_{i,t}^{FF4}$ (%)
Δ%OVN $\times$ Δ LG Conduit Risk	-0.0273**	-0.0355**
	(0.0138)	(0.0169)
Δ%OVN	-0.0186	-0.300
	(0.0540)	(0.354)
Δ LG Conduit Risk	-0.0265*	0.00686**
	(0.0153)	(0.00343)
Bank Fixed Effects	Yes	Yes
Balance Sheet Controls	Yes	Yes
Macro Controls	Yes	Yes
Observations	9700	16218
N. of Bank Clusters	16	15
N. of Time Clusters	3	6
Overall F-Statistics	4.473	1.230

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: **Robustness: IV regression using alternative winsorizing and trimming schemes**
This table presents the robustness of the IV betas, as in section 5.2.1, for the model presented in equation (7). The model (1) shows the regression results when we trim the observations with daily excess return beyond $\pm 30\%$ range. The model (2) and (3) shows the regression results under $(1\%, 99\%)$ level and $(0.5\%, 99.5\%)$ level respectively. The dependent variable, $r_{i,t}^{FF4}$, is the holding period equity abnormal return of bank i at period t, after controlling for the Fama-French and Carhart factors. For the explanatory variables, $\Delta\%\text{OVN}_t$ measures the change in the ratio of ABCP outstanding matures overnight from period $t-1$ to t. $\Delta\text{Conduit Risk}_{i,t}$ is the product of subprime mortgage delinquency rate change between period $t-1$ and t, multiplies the bank's exposure to ABCP liquidity guarantee aforementioned, which is the principal of ABCP relative to the bank's book value. Standard errors are clustered at the bank and year level.

	(1) $r_{i,t}^{FF4}$ (%)	(2) $r_{i,t}^{FF4}$ (%)	(3) $r_{i,t}^{FF4}$ (%)
$\Delta\%\text{OVN} \times \Delta$ LG Conduit Risk	-0.0409***	-0.0457**	-0.0454**
	(0.0153)	(0.0189)	(0.0189)
$\Delta\%\text{OVN}$	-0.134	-0.224	-0.174
	(0.193)	(0.265)	(0.222)
Δ LG Conduit Risk	0.00283	0.00408	0.00404
	(0.00420)	(0.00383)	(0.00385)
Bank Fixed Effects	Yes	Yes	Yes
Balance Sheet Controls	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes
Observations	25993	26015	26015
N. of Bank Clusters	18	18	18
N. of Time Clusters	9	9	9
Overall F-Statistics	4.194	2.280	9.707

Standard errors in parentheses. $^{*}\, p < 0.10$, $^{**}\, p < 0.05$, $^{***}\, p < 0.01$.

Table 7: **Robustness: IV regression using Fama French 3-factor residual return**
This table presents the robustness of the IV betas, as in section 5.2.1. The dependent variable, $r_{i,t}^{FF}$, is the holding period equity residual return of the Fama-French 3-factor model for bank i at period t. For the explanatory variables, $\%\text{OVN}_t$ measures outstanding ABCP during period t, so $\Delta\%\text{OVN}_t$ measures the change in the ratio of ABCP outstanding matures overnight from period $t-1$ to t. $\Delta\text{Conduit Risk}_{i,t}$ is the product of subprime mortgage delinquency rate change between period $t-1$ and t, multiplies the bank's exposure to ABCP liquidity guarantee aforementioned, which is the principal of ABCP relative to the bank's book value. Standard errors are clustered at the bank and year level.

	(1) $r_{i,t}^{FF}$ (%)	(2) $r_{i,t}^{FF}$ (%)	(3) $r_{i,t}^{FF}$ (%)
Δ%OVN × Δ LG Conduit Risk	-0.0408***	-0.0407***	-0.0409***
	(0.0150)	(0.0149)	(0.0148)
Δ%OVN	-0.119	-0.116	-0.117
	(0.114)	(0.113)	(0.111)
Δ LG Conduit Risk	0.00381	0.00225	0.00207
	(0.00307)	(0.00216)	(0.00249)
Bank Fixed Effects	Yes	Yes	Yes
Balance Sheet Controls	No	Yes	Yes
Macro Controls	No	No	Yes
Observations	25918	25918	25918
N. of Bank Clusters	18	18	18
N. of Time Clusters	9	9	9
Overall F-Statistics	0.828	1.347	1.022

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 8: **Descriptive statistics and Student t-test: ABCP guarantors vs. non-guarantors**
This table lists the t-test result to compare ABCP guarantor banks and non-guarantor banks in the sample period 2001Q2 - 2009Q3. Column "Guarantors vs. 1B+ Non-guarantors," "Guarantors vs. 10B+ Non-guarantors," and "Guarantors vs. 50B+ Non-guarantors" show the difference in means as well as the corresponding standard errors between the ABCP guarantor banks and non-guarantor BHCs with maximum assets larger than 1 billion, 10 billion, and 50 billion USD respectively during the sample period. Guarantor and non-guarantor banks also differ in many aspects from total assets to risk capital ratios. Nevertheless, the difference gets smaller or insignificant when we compare ABCP guarantor banks with larger non-guarantor BHCs. Indeed, the Tier-1 risk capital ratio and Total risk capital ratio of ABCP guarantors are significantly lower than the average of non-guarantors with more than 1 billion USD assets, but not so when compared with that of large non-guarantor BHCs with 50 billion or more assets.

	(1) Guarantors vs. 1B+ Non-guarantors	(2) Guarantors vs. 10B+ Non-guarantors	(3) Guarantors vs. 50B+ Non-guarantors
Total Assets (Bil.)	338.382***	295.916***	183.587***
	(25.533)	(25.713)	(27.709)
Market-to-book	0.301***	0.199***	0.369***
	(0.045)	(0.050)	(0.061)
Collateral to assets (%)	1.944**	0.951	5.737***
	(0.796)	(0.859)	(1.092)
Beta	0.161***	0.048**	-0.051*
	(0.020)	(0.022)	(0.030)
Asset risk	-0.002	0.002	0.002
	(0.001)	(0.002)	(0.002)
EPS	0.343***	0.144***	-0.050
	(0.046)	(0.052)	(0.081)
Payout ratio (%)	6.949**	2.487	3.890
	(3.098)	(3.387)	(4.259)
ROA (%)	0.095***	0.055***	0.050
	(0.017)	(0.019)	(0.032)
T1 lev. ratio (%)	-1.237***	-0.669***	-0.582***
	(0.089)	(0.097)	(0.153)
T1 cap. ratio (%)	-2.189***	-1.317***	-0.141
	(0.120)	(0.133)	(0.174)
Total cap. ratio (%)	-0.335***	-0.232**	0.217
	(0.105)	(0.116)	(0.171)
Observations	7963	1845	762
N of banks	380	92	41

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: **Capital ratios of ABCP guarantors**
Panel (a) presents the higher risk capital buffer of liquidity guarantor BHCs compared to all ABCP guarantor banks. Panel (b) presents the higher risk capital buffer of liquidity guarantor BHCs compared to TBTF banks. The dependent variables are the Tier 1 capital ratio, presented in columns (1) and (2), and Total capital ratio, presented in columns (3) and (4). Estimation results with or without bank balance sheet control variables are presented. Reported in the parenthesis, Newey-west standard errors are used to adjust for the autocorrelation in the bank risk capital ratios.

(a) **ABCP Liquidity guarantors vs. all ABCP guarantors**

	(1) T1 cap. ratio (%)	(2) T1 cap. ratio (%)	(3) Total cap. ratio (%)	(4) Total cap. ratio (%)
Liquidity guarantor	1.103***	0.932***	0.880**	0.677*
	(0.385)	(0.355)	(0.408)	(0.386)
Balance Sheet Controls	No	Yes	No	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	417	417	417	417
Adj. R^2	0.399	0.537	0.354	0.482
Overall F-Statistics	5.994	8.219	5.190	6.816

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

(b) **ABCP Liquidity guarantors vs. all TBTF BHCs**

	(1) T1 cap. ratio (%)	(2) T1 cap. ratio (%)	(3) Total cap. ratio (%)	(4) Total cap. ratio (%)
Liquidity guarantor	0.823***	0.739***	0.788***	0.727***
	(0.258)	(0.241)	(0.270)	(0.252)
Credit guarantor	-1.009***	-1.074***	-0.875**	-0.886***
	(0.332)	(0.306)	(0.346)	(0.320)
Balance Sheet Controls	No	Yes	No	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	762	762	762	762
Adj. R^2	0.371	0.450	0.358	0.444
Overall F-Statistics	9.382	10.35	8.770	9.935

Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 10: **Capital ratios and β^{ABCP}**
This table presents the ABCP beta and capital ratio. Banks with higher price sensitivities maintain higher capital ratios, suggests that the ABCP channel leads to higher buffer: so market discipline keeps loophole-exploiting banks in check. Estimation results with or without bank balance sheet control variables are presented. The dependent variables are the Tier 1 capital ratio, presented in columns (1) and (2), and Total capital ratio, presented in columns (3) and (4). Reported in the parenthesis, Newey-west standard errors are used to adjust for the autocorrelation in the bank risk capital ratios.

	(1) T1 cap. ratio (%)	(2) T1 cap. ratio (%)	(3) Total cap. ratio (%)	(4) Total cap. ratio (%)
β^{ABCP}	-0.153***	-0.120***	-0.120***	-0.0871***
	(0.0346)	(0.0315)	(0.0358)	(0.0331)
Balance Sheet Controls	No	Yes	No	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	417	417	417	417
Adj. R^2	0.00699	0.160	0.0157	0.115
Overall F-Statistics	19.58	8.993	11.21	6.647

Standard errors in parentheses. $^{*}\ p < 0.10$, $^{**}\ p < 0.05$, $^{***}\ p < 0.01$.