The Evolution of a Financial Crisis:
Panic in the Asset-Backed Commercial Paper Market*

by

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Abstract

The $350 billion contraction in the asset-backed commercial paper (ABCP) market in the last five months of 2007 played a central role in transforming concerns about the credit quality of mortgage-related assets into a global financial crisis. This paper attempts to better understand why the substantial contraction in ABCP occurred by measuring and analyzing runs on ABCP programs over the period from August 2007 through December 2007. While it has been suggested that commercial paper programs, like commercial banks, may be prone to runs, we are the first to conduct a comprehensive empirical analysis of runs in the ABCP market using a rich and novel issue-level data set for all ABCP programs in the U.S. market. A program is defined as being run when it does not issue new paper during a week despite having a substantial share of its outstandings scheduled to mature, and then continuing in a run until it issues. We find evidence of extensive runs: more than 100 programs (one-third of all ABCP programs) were in a run within weeks of the onset of the turmoil and the odds of subsequently leaving the run state were very low. We interpret this finding as an indication that the ABCP market was subject to a bank-like "panic." We also find that while runs were linked to credit and liquidity exposures of individual programs, runs were also related importantly to non-program specific variables in the first several weeks of the turmoil, indicating that runs were relatively indiscriminate during the early part of the panic. Thus the ABCP market may be inherently unstable and a source of systemic risk.

Keywords: Commercial paper, asset-backed commercial paper, bank runs, financial crisis, panics

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1. Introduction

The U.S. asset-backed commercial paper (ABCP) market erupted in late summer of 2007 and played a pivotal role in the global financial crisis that would become increasingly severe. In the ABCP market, where investors expect to be able to access their funds on demand at par value, even limited concerns about risk can instigate flight from the market. A narrative of the turmoil begins with mounting delinquencies of subprime mortgages triggering a decline in investor confidence in mortgage financial intermediaries and ratings downgrades of structured mortgage securities. Reflecting these concerns, investors became reluctant to roll over ABCP, yields on new issues of ABCP soared, and outstanding ABCP plummeted $190 billion, almost 20 percent, in August, and fell by an additional $160 billion by the end of the year (see Figure 1). The steep contraction in ABCP, in turn, sparked concerns about whether banking institutions that explicitly provided program back-up liquidity support or implicitly provided liquidity as sponsors would be able to meet their obligations. As a result, banking institutions began to hoard their cash and became extremely hesitant to lend in inter-bank funding markets, and risk spreads for interbank funds even at overnight terms widened sharply. In addition, demand from ABCP programs for AAA-rated tranches of mortgage backed securities (MBS) declined, which made it difficult to structure new securitizations of mortgages. Thus the events in the ABCP market had far-reaching and long-lasting consequences for the broader financial markets and the economy.

An open question with implications for the stability of the U.S. and other financial systems with sizable ABCP markets is whether a large number of ABCP programs were subject to investor runs and so entirely shut out of the market, consistent with a bank-like "panic."[1] Another important question is whether this "panic" can be entirely explained as runs on ABCP

[1] The term "panic" is used in different ways in the academic literature. We follow Gorton (1988), where banking panics refer to periods with many bank runs. Runs can either be linked to deteriorating fundamental factors, or are not explainable by fundamental factors, in which case they are indiscriminate runs. Alternatively, Calomiris and Mason (2003) discuss periods of bank failures which could reflect "fundamental" deterioration in bank health, or alternatively "panics," sudden crises of illiquidity that may force viable banks to fail. Thus, Calomiris and Mason use the word panic to describe unpredictable behavior, while Gorton uses the word panic to describe periods of multiple runs, which would include runs that are based on fundamental factors and those that are not.

programs with liquidity or credit impairment; the alternative is that runs were not explained by program risks and were, to some extent, indiscriminate. Indiscriminate runs can be thought of as equilibria in which investors refuse to rollover paper because they believe that other investors will do the same, perhaps forcing the programs to sell assets at fire sale prices. Knowing whether a market is prone to such behavior is important because it would suggest that shocks to asset prices are magnified in the ABCP market, and thus the ABCP market may pose significant risks for financial stability.

The possibility that the ABCP market is prone to indiscriminate runs is suggested by the similarities between ABCP programs and banks. Like banks, ABCP programs issue liquid short-term debt to finance illiquid and long-term assets. Moreover, if we define banks as entities that create informationally-insensitive debt, as argued in Gorton and Pennacchi (1990), then ABCP conduits are similar to banks because they issue debt that is highly-rated, collateralized, and short-term. As a consequence, the well-accepted theoretical notion formalized most classically in Diamond and Dybvig (1983) that banks may be vulnerable to runs not based in fundamentals suggests that ABCP programs may be vulnerable as well. In addition, the fact that ABCP conduits and banks appear to require some form of liquidity support to issue short-term debt suggests that they are both prone to such runs.[2] Of course, ABCP programs, like banks, may also be subject to fundamentals-driven runs, whereby investors quickly flee from potentially insolvent and poorly supported programs.[3]

In this paper, we measure runs in the ABCP market during the financial turmoil and evaluate whether the runs are linked to fundamental risks of the programs, such as credit and liquidity exposures, and also whether runs are linked to non-program specific variables, such as weekly time dummies, measures of broader financial market strains, concerns about subprime mortgage defaults, and market-wide proxies for credit and liquidity risks in the overall ABCP market. A finding that non-program specific variables are related to runs, after controlling for program fundamentals, would suggest that investors in this market ran from all types of programs, even ones with apparently solid fundamentals. We focus on the period from August

[2] To be more precise, the need for liquidity support is suggestive of runs, while the existence of liquidity support should help to mitigate runs.
[3] Diamond and Dybvig (1983) are the first to make the distinction between fundamentals-driven and indiscriminate runs.

through December 2007 to better understand the origins of the financial crisis. It is during this period that concerns first surfaced about commercial bank liquidity positions, and the demand by ABCP conduits and investors in the repurchase market for highly-rated MBS disappeared, which set the stage for the shutdown of new MBS without explicit backing by the government.[4, 5]

While we are the first to conduct a comprehensive empirical analysis of runs in the ABCP market, others have suggested that runs of one kind or another have taken place in the unsecured segment of the commercial paper market.[6] For example, Calomiris (1995) uses the term "run" to describe the events in the unsecured commercial paper market surrounding the failure of Penn Central in 1970, during which it defaulted on about $80 million of unsecured commercial paper. Apparently alarmed by the default, investors refused to roll over large quantities of maturing paper at other unrelated programs, and issuers were forced to turn to commercial banks for emergency financing. Another run on unsecured commercial paper programs reportedly occurred following Enron's failure in 2001. As Gatav and Strahan (2006) describe, many firms faced difficulty borrowing in the commercial paper market during that time as the accuracy of financial statements came into question. They cite (p. 870) a Wall Street Journal article describing the commercial paper market as the corporate world's automated teller machine, which began sputtering after Enron's collapse and sent firms scrambling for funds "after getting a cold shoulder from commercial-paper investors." More recently, Acharya, Gale, and Yorulmazer (2009) provide a theoretical model that explains sudden freezes in secured debt markets when assets are financed with short-term debt subject to rollover risk, even when the assets are subject to very limited credit risk. Similarly, He and Xiong (2009) model rollover risk as an equilibrium bank run when short-term debt contracts are staggered and investors use fundamental impairment as a coordination device for their decision to run or stop rolling short-term debt contracts.

[4] See Gorton (2009) for a discussion of the link between the sharp increase in haircuts and other difficulties in the repurchase market and the collapse of securitization activity in the summer of 2007.

[5] We plan to investigate runs and panic in the commercial paper market in the fall of 2008 in a separate paper. Events in the fall of 2008 are distinct from those in August to December of 2007, the period of study in this paper. In particular, runs occurred on ABCP programs but not unsecured programs in 2007, whereas there was a steep rise in runs on unsecured CP programs in the fall of 2008. Moreover, the runs on CP programs in 2008 appear to have been accompanied by large withdrawals from money market mutual funds, which are major investors in CP, whereas flows to money market mutual funds were relatively stable during August to December 2007.

[6] Gorton and Metrick (2009) and Han and Li (2009) study runs in other short-term funding markets, namely the repo market and municipal ARS markets, respectively.

In addition, a number of studies have analyzed the nature of bank runs. Calomiris and Mason (2003) find that runs not driven by fundamentals played only a small role in the bank failures of the 1930s. In addition, Gorton (1988) finds that banking panics, periods with many runs, in the National Banking Era (1863-1914) could be predicted by deteriorations in economic conditions, though he does not rule out that the deteriorations in fundamentals could lead to indiscriminate runs. Similarly, Demirguc-Kunt and Detragiache (1998) find that systemic banking crises in a variety of countries from 1980-1994 tended to occur when growth in a country was low and inflation high. While runs in the ABCP market could be explained by deterioration in program risks, the broad scale contraction in the ABCP market in late 2007 raises the possibility that runs also were indiscriminate, and viable programs became insolvent because of illiquidity.

In our empirical analysis, we contribute to the understanding of runs using a rich new data set based on all transactions and amounts of paper outstanding by ABCP programs in the United States in 2007. We define a program as entering a run during a week in which it does not issue paper despite having 10 percent or more of its outstandings scheduled to mature, and then continuing in a run until it issues again. Our data set contains proprietary information from the Depository Trust and Clearing Corporation (DTCC) on the prices and quantities of almost 700,000 transactions by about 350 ABCP programs in the U.S. commercial paper market, as well as weekly information on outstandings at these commercial paper programs. These data were supplemented by detailed information that was hand-collected from reports by major rating agencies on the type of program, credit rating, the type of liquidity support, and the identity of the sponsor, to create a dataset that is unparalleled in detail about the risks of different types of ABCP programs. In addition, the high frequency of our data allows us to study the weekly evolution of runs and their determinants at the onset and through the crisis, which could not be addressed in prior studies of runs. We also use daily information on yield spreads of new ABCP issues to buttress our interpretation of runs as constraints on the ability of conduits to borrow rather than a reduction in the demand for short-term financing.[7]

[7] The notion that the risk of a run can be priced is shown in Goldstein and Pauzner's (2005) theoretical model of bank runs, and more recently in Morris and Shin (2009).

Our analysis provides substantial evidence of panic in the ABCP market. Indeed, we find that about 30 percent of programs were in a run within weeks of the onset of the turmoil and nearly 40 percent of programs, more than 120 programs, were in a run at the end of 2007. During the five-month period, a program's apparent exposure to subprime mortgages and weak liquidity support helped to explain runs. But the rapid proliferation of runs in August and September also was related importantly to non-program specific variables. Moreover, nearly all the runs that began in the early weeks of the crisis persisted in subsequent months. Thus, while the relatively indiscriminate nature of runs may have been brief, its impact was prolonged as programs that were run rarely issued again. In addition, yield spreads for programs able to issue shot up in the first several weeks of the crisis for all types of programs, but rose especially for the types of programs identified as being subject to runs. The variation in spreads bolsters our evidence that runs represent an inability to issue or to issue only at high spreads, rather than a choice by high-quality programs to exit the market.

The remainder of this paper proceeds as follows. In Section II we discuss why one might expect ABCP programs to be subject to runs, types of ABCP programs, data, and summary statistics on outstandings and spreads that are suggestive of runs. Section III describes our methodology for estimating and analyzing runs, and our empirical results follow in Section IV. We conclude in Section V with a discussion of implications.

2. Background on the ABCP Market and Data

2.1. ABCP programs are like banks, but without explicit deposit insurance

There are different types of ABCP programs, but they share important common features that make them like banks. In general, ABCP conduits issue liquid short-term debt to finance assets, such as receivables, loans, or securities, which generally are longer term and more illiquid than its debt (Figure 2). Sponsors of the ABCP programs make all the economic decisions, such as which assets to purchase and how to finance in the ABCP market. Often the sponsor provides various forms of liquidity and credit support. Traditionally, liquidity of ABCP was achieved by limiting portfolios to assets with high credit quality and short maturity, and by explicit support provided by a line or letter of credit from the sponsoring commercial bank. Thus, like banks, ABCP programs provide liquidity and maturity transformation services. In addition, a prominent

feature of many ABCP programs is that they were created by banks to fund bank assets in an off-balance sheet conduit, possibly as a way to avoid regulatory capital requirements.[8]

More than half of ABCP daily issuance has maturities of 1 to 4 days (referred to as "overnight"), and the average maturity of outstanding paper is about 30 days. ABCP is thought to be liquid because investors can liquidate their positions, as often as every day, with no price impact. ABCP is held largely by money market mutual funds, investors who are ultra-sensitive to any delay in payment, and do not want to risk a less than full payment. Pennacchi (2006) describes money funds as a safe haven asset, and thus want to hold only high quality assets to avoid "breaking the buck" (when the net asset value falls below $1).[9] The evident strains that typically occur in the CP market near every year-end and around the century turn Y2-K also strongly indicate that investors are anxious about timely payments (Downing and Oliner, 2007).

As in banks, the maturity of assets in ABCP conduits generally is longer than the maturity of the liabilities. Loan and lease receivables, which are commonly purchased by ABCP conduits, likely have terms of 30 days or more, and while relatively short, are still longer than most ABCP. Most loans and debt securities, which are also funded with ABCP, have even longer terms and may be even less liquid. In addition, asset holdings of ABCP conduits, like at banks, are not transparent. While the vast majority of ABCP programs have credit ratings from the major rating agencies, credit support mechanisms vary and the specific assets held in the programs are not widely known. For example, some ABCP programs viewed their holdings to be 'proprietary' investment strategies and deliberately did not disclose. Thus, random events or concerns about an economic downturn can create uncertainty about asset values. This uncertainty is greater when less information is available about the assets.

[8] See Acharya and Schnabl (2009). For alternative interpretations, see Arteta et al. (2009).

[9] There are only two cases of money funds breaking the buck. The first case happened in 1994 when the net asset value of a fund that held structured notes fell to .96 as interest rates rose, and this fund was consequently liquidated. The SEC later disallowed money funds from holding this type of structured notes that led to the loss. The second case occurred in September 2008, when a money fund with relatively large exposures to defaulted short-term debt issued by Lehman Brothers broke the buck. To prevent more money funds from breaking the buck or facing even more massive redemptions, the Treasury established a temporary guarantee program on existing 2a-7 money fund accounts, and the Federal Reserve implemented a liquidity facility to allow money funds to orderly liquidate their ABCP holdings.

While ABCP programs are like banks, a key distinction, with important implications for financial stability, is that ABCP programs do not have explicit deposit insurance provided by the government. Most traditional ABCP programs are sponsored by commercial banks that also provide explicit liquidity support. As the ABCP market grew dramatically in recent years, nearly doubling in size between 2004 and 2007, some programs, as described below, began to employ other techniques for liquidity support or offered less than full support.

2.2. Types of ABCP programs

ABCP programs differ importantly by type of assets held, sponsors, and services provided by the sponsor (see Table 1). The most traditional ABCP program is a *multi-seller* program, in which a bankruptcy-remote conduit purchases receivables and loans from multiple firms. The sponsor is typically a financial institution that provides the conduit with a committed liquidity line, administers its daily operations, and sometimes also provides the conduit with credit enhancement through a letter of credit that absorbs credit losses. At the end of July 2007, just before the widespread turmoil, there were 98 multi-seller programs in the U.S. ABCP market with outstandings of $525 billion, about 45 percent of total ABCP outstanding.

Single-seller programs involve a conduit that issues paper backed by assets from only one originator, which frequently also sponsors the conduit. The majority of single-seller conduits mainly fund credit-card receivables, mortgages, mortgage-backed securities, or auto loans. Such programs tended not to have explicit liquidity support, but were thought to be implicitly supported by originators. In addition, many of these programs issued extendible paper, which allows the issuer the option to extend the maturity of its paper and pay a pre-specified penalty rate to the investor. This feature presumably is an alternative for explicit liquidity support to mitigate roll-over risk. In July 2007, there were 40 *non-mortgage single-seller* programs, about 11 percent of the U.S. ABCP market. There also were 11 *mortgage single-seller* programs that primarily warehoused mortgages prior to their securitization.

Even more similar to a bank structure are the *securities arbitrage* programs. These programs involve banks sponsoring conduits to finance long-term assets through a special purpose entity that has a lower regulatory capital charge than if the assets were held on balance sheet. The sponsor banks typically provide full liquidity support. By using off-balance-sheet

funding, commercial banks exploit regulatory capital arbitrage opportunities. In July 2007, there were 35 programs that accounted for about 13 percent of the U.S. ABCP market.

Similarly, *structured investment vehicles* (or SIVs) fund highly-rated securities. But unlike the securities arbitrage programs, SIVs do not have explicit agreements with their sponsoring banks for committed back-stop liquidity lines covering all their short-term liabilities. Instead SIVs relied on dynamic liquidity management strategies, which involved liquidating assets to pay investors if needed. Specifically, mark-to-market accounting for SIVs was implemented with liquidation clauses that transferred the control of the program to a trustee that could liquidate the SIV's assets if its junior liabilities eroded or asset prices declined rapidly. Before the financial turmoil caused SIVs to change their practices (and ultimately disappear), most SIVs issued medium-term notes (senior liabilities with longer maturity than commercial paper), in addition to ABCP, to attenuate liquidity risks. In addition, SIVs also issued junior liabilities to absorb the first credit losses to attenuate credit risks to ABCP investors. At their peak in July 2007, there were 35 SIVs that accounted for $84 billion of U.S. ABCP.[10]

Some ABCP is issued by *collateralized debt obligations* (CDOs), sometimes called SIV-lites. CDOs are similar to SIVs in structure, but are not actively managed and tend to rely on explicit but only partial liquidity support. There were 36 ABCP CDO programs in July 2007, with ABCP outstanding of $47 billion.

Finally, *hybrid* programs combine features of securities arbitrage and multi-seller programs, pooling securities and receivables in their portfolios. In January 2007, hybrid programs accounted for about 8 percent of the U.S. market, respectively, and other programs not classified elsewhere accounted for another 10 percent.

2.3. Mortgage Exposures

An important trigger in this financial crisis was expected losses on subprime mortgages and highly-rated structured products that contained these mortgages. Runs in ABCP could arise because asset returns are expected to fall or become more uncertain, or because investors need

[10] Moody's (2008) reports that assets under management in SIVs totaled almost $400 billion in July 2007. Medium term notes financed about 65 percent of the assets, U.S. ABCP financed 21 percent, Euro CP and repos financed 5 percent, and junior debt financed about 9 percent.

more liquidity or become more risk-averse. Thus, when asset holdings are better understood and liquidity is more fully supported, investors can be more confident and runs would be less likely. However, while investors could easily categorize ABCP programs by the types of assets held, there is little information about the specific underlying assets and thus considerable uncertainty about expected loss exposures of individual programs.

Investors likely had the clearest insight into single-seller mortgage conduits, because their assets were mortgages originated by the lender, and liquidity was often also supported by that lender. Securities arbitrage, SIVs, and CDOs were also known or suspected to hold subprime MBS, but specific securities holdings often were not disclosed and, indeed, viewed as representing proprietary investment strategies. A Moody's report (2007a) documents that for SIVs that they rated, about one-quarter of the combined assets were in highly-rated private label mortgage-backed securities. In a separate report, Moody's (2007b) documents that securities arbitrage programs, like SIVs, also had about 27 percent of its assets in highly-rated private label mortgage-backed securities. While both SIVs and securities arbitrage programs had substantial subprime mortgage exposures, specific asset holdings were opaque. An important distinction between securities arbitrage and SIVs, however, is that the latter lacked explicit full liquidity support, which may help to explain a result below that investors ran on SIVs but not securities arbitrage programs.

2.4. Contractual features of ABCP programs

Most ABCP programs are rated by the major nationally recognized statistical rating organizations. Money market mutual fund investors rely on ratings to determine eligibility for their purchase. Because many are secured by receivables, or underlying assets are AAA-rated, or because of its structure, the vast majority of ABCP programs carry the highest rating, designated as P1 by Moody's Investors Service. This rating is determined by the ability of the program to pay in full.

Some programs carried an extendibility provision that allowed them to extend the maturity of paper past its due date for some period of time at a pre-set rate. Most single-seller programs and about 20 percent of multi-seller programs contained an extendible feature. Notably, American Home Mortgage, a non-bank mortgage lender, declared bankruptcy on

August 6, 2007 and extended its ABCP program, named Broadhollow, at a rate that turned out to be well below market rates. For money market mutual funds, the extendibility feature can be costly because of the low rates earned during the extension period, and because the feature is mostly likely to be exercised by programs only when they are downgraded or they fail.[11]

Programs also vary by type of sponsor. Large U.S. banks (those with more than $500 billion in assets in mid-2007) have long sponsored ABCP programs, mostly multi-seller and single-seller programs. Some smaller U.S. banks also sponsor some conduits, but represent a very modest share of the market. Foreign banks sponsor a substantial share of ABCP, about 40 percent in 2007, and relative to domestic banks were more likely to sponsor securities arbitrage programs.

Non-bank institutions, such as mortgage lenders, finance companies, or asset managers, also sponsor a considerable share of the market. Programs sponsored by non-bank institutions grew more dramatically than other programs from 2004 to 2007, more than doubling in assets to $400 billion. Non-bank institutions that sponsor ABCP can pay commercial banks to provide full liquidity support to their programs; otherwise they utilize extendibility features, dynamic liquidity management techniques, such as for SIVs, or simply offer less than full liquidity support, such as for SIV-lites. With the salient exception of Citigroup, no other U.S. institutions were substantially involved in the SIV segment of the market. Sponsor-type may provide to investors signals of program quality or the strength of its liquidity support.

2.5. Data

Our raw data include all transactions in the asset-backed commercial paper (ABCP) market issued in the United States market in 2007: 693,762 primary market transactions (new issues) by 349 programs over 251 trading days. These data are from the Depository Trust and Clearing Corporation (DTCC), the agent that electronically clears and settles directly- and dealer-placed commercial paper. The issues in the sample are discount instruments paying face value at maturity. For each transaction, DTCC provides the identity and industry of the issuer, the face and settlement values of the transaction, and the maturity of the security. Using these

[11] In addition, rule 2a-7 imposes an upper limit on the average maturity of the portfolio of registered money market mutual funds.

data, we calculate implicit yields on new overnight paper (maturity of 1-4 days) paid by issuers using standard money market conventions.[12] We also calculate overnight risk spreads as the ABCP rate less the target federal funds rate, an overnight lending rate for banks set by the Federal Open Market Committee. Notably, our spread measures do not incorporate any fees charged by dealers. We also obtain from DTCC a separate weekly file that contains program-level information on the maturity distribution of outstandings. Further, we supplement the DTCC data with hand-collected information on program type, credit ratings, liquidity features, and sponsor identity from various reports from Moody's Investors Service. We are able to find this information for 303 of the 349 programs in the raw data.

Data in Table 2 shows that total outstanding ABCP grew slightly over the first half of 2007 to almost $1.2 trillion, but plunged by roughly $190 billion in August, and then fell another $160 billion over the remaining months of the year. As a result, the market at year-end was nearly 30 percent less than at mid-year. Program types were not hit equally hard. Outstandings at multi-seller programs fell about $56 billion, about 10 percent, from July to December. But outstandings in some other program categories plummeted. Notably, SIVs fell about $70 billion, about 80 percent, and mortgage single-seller programs virtually disappeared as outstandings fell from $23 billion to $2 billion.

Summary statistics on overnight ABCP yield spreads over the target federal funds rate are shown in Table 3 and Figure 3. Overnight spreads for the overall market were relatively narrow in the first seven months of 2007, ranging between monthly averages of 2 and 6 basis points. Spreads across all program types soared to an average 47 basis points in August, and remained high and volatile through the end of the year. While the jump in spreads was evident across all program types in August, spreads for single-seller and SIVs continued to escalate in subsequent months, while spreads on multi-seller programs narrowed relatively slightly until year-end pressures intensified.[13]

[12] Money market yields are annualized yields calculated under the assumption of a 360-day year.

[13] Average spreads bumped up to an average of 53 basis points in December as strains in the market were likely compounded by typical year-end pressures, while spreads for multi-seller programs rose to 41 basis points. See Downing and Oliner (2007), Musto (1997), and Covitz and Downing (2007) for discussions of year-end effects in the commercial paper market.

Another feature of the period is that the maturity of new issues shortened considerably. For example, the share of gross issuance with maturities of less than 10 days rose to 82 percent in August and September, from an average of 66 percent from January to July 2007. For programs not able to issue, the maturity of remaining outstanding paper shortens automatically as time progresses. For programs not in a run and thus able to issue, the maturity of new issues may also shorten if investors are less willing to extend longer-term paper at long maturities, preferring to issue at much shorter terms when financial market conditions are uncertain. As the share of paper due in less than 10 days rises, pressures in this market intensify as more programs have to issue more frequently. Investors would constantly be assessing the likelihood that maturing paper would be unable to roll, which could become self-fulfilling if they chose not to roll because they fear other investors would not.

These patterns in our data are suggestive of runs in 2007 as outstandings dropped, maturities shortened, and programs came under substantial pricing pressure. Moreover, the distinctions that eventually emerged between spreads and the contraction in outstandings for single-seller and SIVs relative to multi-seller programs suggests that some tiering in the market along fundamentals took place after an initial period of less discrimination among programs. Of course, programs could contract while continuing to issue, and program types could be correlated with other factors, such as sponsor type, contract features, and ratings. To study runs more directly, we develop a measure of runs and a methodology for studying the potentially changing determinants of runs over time.

3. Methodology

In traditional bank runs, depositors withdraw demand deposits from commercial banks. We define a run on a commercial paper program analogously as occurring when a program is unable to issue new paper to fund maturing obligations.

In our analysis, we define program *i* as being run in any period *t* in which it has more than 10 percent of its outstanding paper scheduled to mature but does not issue.[14] The program is also considered to be in a run if it was defined as being run in the prior period and does not

[14] The 10 percent cutoff is arbitrary and intended to capture the program's need to issue. About 10 percent of all ABCP outstanding in the U.S. market is typically scheduled to mature the next business day. Our main results do not depend on small variations in this percentage.

issue in the current period. That is, programs remain in a run state until they issue. More formally:

$$\text{Run}_{it} = \begin{cases} 1 \text{ if } \dfrac{\text{Maturing}_{it}}{\text{Outstanding}_{it}} > 0.1 \text{ and Issuance}_{it} = 0 \\ 1 \text{ if Run}_{i(t-1)} = 1 \text{ and Issuance}_{it} = 0 \\ 0 \text{ Otherwise} \end{cases} \quad (1)$$

In our analysis, *t* is a particular week because our data on program outstandings, used to measure the need to issue, are available only weekly. While daily frequency might yield some additional information, measuring runs on a weekly basis seems to be of sufficiently high frequency to help uncover changing run dynamics through the period of financial turmoil. The condition that maturing paper is more than 10 percent of outstandings is intended to capture the need to issue. The condition that issuance is zero is intended to capture the inability to issue. The zero-issuance condition makes our definition of runs conservative in the sense that programs that issue even a small amount relative to the amount of maturing paper, perhaps at very high cost, will not be classified as being in a run.

One potentially problematic implication of this definition of runs is that programs with less than 10 percent outstandings scheduled to mature and that do not issue will be treated as not being in a run, provided they were not in a run in the prior period, even though such programs might be unable to issue. To avoid the possibility of mischaracterizing programs that are unable to issue but have no need to fund maturing paper as not being in a run, we drop such observations from the sample. Importantly, all our results are both qualitatively and quantitatively similar if we include these observations.

When market conditions are stable, a program that is viable but unable to roll its paper will likely be able to place it with its ABCP dealer, who will accept it in the normal course of business and then subsequently re-sell the paper to investors. However, in August of 2007, when dealers were facing increasing pressures in interbank and repo markets and did not want to commit capital, and some programs had subprime assets that were falling in value, this option of

selling to dealers was not available to all programs. Instead, many programs facing runs were forced to sell assets, draw on available capital of the conduit, or draw on liquidity lines from providers. If the programs could not successfully raise funds, the paper would be in default. If the program had an extendible feature, the issuer could extend at a pre-paid rate for a pre-specified period of time, during which time sponsors could try to sell sufficient assets to pay off the maturing paper.

Our run measure cannot distinguish between issuers being shut out or just viewing it as too costly to issue ABCP. However, in either case, the program identified as experiencing a run by our measure will be contracting and perhaps forced to sell assets or draw on support from liquidity providers or sponsors. Whether shut out or higher cost, these developments would put pressure on the balance sheets of liquidity providers or sponsors, a key policy concern that motivates our analysis.

Our primary hypothesis relating to runs is that runs are related to fundamentals, with the alternative being that runs are indiscriminate.

H1: Runs are related to program fundamentals.
H2: Runs are indiscriminate, and are related to broader market risks.

These hypotheses are not mutually exclusive and thus both can be true. To test our first hypothesis H1, we measure program fundamentals with program type, sponsor type, program rating, and extendibility feature in our baseline specification. The presumption is that concerns about the exposure of some program types to losses on mortgage-related assets or to weakness in liquidity support were the fundamental factors that triggered and maintained runs.

To test our second hypothesis H2, we also include weekly time dummies in the baseline specification. A finding that the time dummies are significant would indicate that runs are not explained entirely by program risk characteristics, and thus are, to some extent, non-discriminating. Additional specifications include measures of broad financial market strains (discussed in more detail later) in place of the time dummies to better understand the nature of any apparent indiscriminate concerns.

Why would runs be indiscriminate? First, the triggering events – extension of ABCP by the Broadhollow program and the bankruptcy of its parent American Home Mortgage, suspension by BNP Paribas of redemptions from money market mutual funds because of inability to value subprime credit securities – followed by extensions and defaults of some programs in subsequent weeks, may have created uncertainty among investors and led to a fear-based pullback. After no program defaults for many years (from at least 2001 to July 2007), two programs defaulted in August, accounting for 2 percent of outstandings, and an additional three programs defaulted by December, with paper in default cumulating to 4 percent of outstandings by year-end. Similarly, although two programs extended before August, extensions did not escalate sharply until August, and an additional 19 programs were extended by year-end.

Second, investors might not fully understand the ABCP programs in which they had invested. There are many reasons to believe that some investors relied only on the high ratings of the programs, and did not understand the assets and liquidity support of the conduit. Rating agency and analysts' reports that were issued around this time strongly support this presumption. In particular, Moody's issued a report titled "SIVs: An Oasis of Calm in the Subprime Maelstrom" in July 2007, just weeks before the panic erupted, and J.P. Morgan issued "ABCP: A Cheat Sheet" in August 2007, in response to "numerous questions […] from investors both inside and outside of the short-term credit markets," noting in the first paragraph of the report that "ABCP is a complex investment that would take volumes to explain completely."[15]

Another possibility is that even fully-informed investors fled fundamentally sound programs because they became concerned about the ability of sponsors to be able to meet their commitments if all programs needed to be supported at the same time. This explanation would strongly suggest that the ABCP market is susceptible to instability, because concerns about some programs could cause investors to flee others that, in more normal market conditions, are fundamentally sound.

More specifically, to empirically test for the drivers of runs, we estimate a probit model for the latent probability of a run on program *i* in week *t* as a function of program-level variables

[15] See Moody's (2007a) and J.P. Morgan Securities Inc. (2007).

and aggregate weekly time indicator variables.[16] The model of runs is estimated as a panel regression in which coefficients on program variables are allowed to vary each month, which we index by *m*. Letting the coefficients vary each month allows the relationship between fundamentals and runs to evolve through the crisis, a possibility suggested by Martinez-Peria and Schmukler (2001). More formally, our primary specification is as follows:

$$\Pr(\text{Run}_{it}=1) = F\left(\alpha + \sum_j \sum_m \beta_{j,m}\text{Program Type}_{ji} + \sum_k \sum_m \gamma_{k,m}\text{Sponsor Type}_{ki} + \sum_m \delta_m \text{Extendibility}_i + \sum_m \theta_m \text{Rating}_{it} + \sum_t \tau_t D_t\right) \quad (2)$$

where *F* denotes the cumulative distribution function of a standard normal variable. The first fundamental variable is *Program Type*$_{ji}$, which equals 1 if program *i* is type *j* and is 0 otherwise. The set of *j* program types includes multi-sellers, non-mortgage single-seller conduits, mortgage single-seller conduits, securities arbitrage programs, SIVs, CDOs, and other programs (includes hybrids and unclassified programs), the omitted category. The second fundamental variable is *Sponsor Type*$_{ki}$, which equals 1 if program *i* is sponsored by an institution of type *k* and is 0 otherwise. The set of *k* sponsors includes large U.S. banks (the omitted category), small U.S. banks, non-U.S. banks, and nonbanking institutions. Additional fundamental variables are *Extendibility*$_i$, which equals 1 for programs that issue paper with the option of extending maturity at the issuer's request (often at a penalty rate that we do not observe), and *Rating*$_{it}$, which is an indicator variable that equals 1 for programs rated P2 or P3 (i.e., the two lowest short-term prime ratings given to the programs in our data) by Moody's Investors Service. The final explanatory variables are weekly time dummies, denoted with D_t. To account for the likely correlation in errors within a particular program across time, we cluster standard errors at the program level.

Under the first hypothesis that runs are related to fundamentals, coefficients on single-seller mortgages, securities arbitrage, SIV, and CDO programs should be positive, while coefficients on the other types of programs that do not hold subprime mortgages would not be. In addition, coefficients on extendibility, non-bank sponsors, and on SIVs and CDOs, because

[16] We obtain very similar results when using a logit model.

these programs do not have full liquidity support, should be positive in the estimations. The second hypothesis that runs are indiscriminate would be supported if the coefficients on the weekly time dummies are positive and significant.

To supplement our analysis of runs, we study daily new-issue yield spreads of those ABCP programs that were able to issue. Specifically, we estimate:

$$\text{Spread}_{it} = \alpha + \sum_j \beta_j \text{Program Type}_{ji} + \sum_k \gamma_k \text{Sponsor Type}_{ki} + \delta \text{Extendibility}_i + \theta \text{Rating}_{it} + \sum_t \tau_t D_t + \varepsilon_{it}, \quad \text{for } i = 1, \ldots, N, \tag{3}$$

where $Spread_{it}$ is the spread over the target federal funds rate paid by program i on day t to issue overnight paper. All program-specific variables are defined as in equation (2), but time-dependent variables are now measured at a daily frequency. We estimate equation (3) as monthly panels with daily data.

The results from our analysis of new-issue spreads will help us interpret the findings from our analysis of runs. In particular, if fundamentals predict runs, they should also predict higher spreads. If this was not the case, then one might question whether our run variable is capturing runs or instead the ability of some programs to locate alternative funding sources.

4. Empirical Analysis of Runs

4.1. Runs during financial turmoil were pervasive and fully absorbing

The percent of ABCP programs in a run, as defined in equation (1), was quite low in each week from January to July of 2007, but then shot up in August as the financial market turmoil erupted (see Figure 4). Before August, the share of programs experiencing a 'run' hovered at less than 5 percent each week. Starting in August, the percent of ABCP programs experiencing a run each week climbed sharply through September to above 30 percent of all ABCP programs. The share rose again, though less sharply, in November. By the end of 2007, more than 40 percent of programs were in a run. Our run variable is consistent with the plunge in outstanding ABCP that occurred from August to December 2007. While the fraction of programs that experienced a run was very large, and explaining which ones ran is the subject of this study, it is

worth noting that many ABCP programs were able to continue issuing in the first few months even as outstandings were plummeting.

To further assess our identification of runs, we evaluate the likelihood that a program that enters a run subsequently exits a run. Such a pattern of cycling in and out of runs would seem inconsistent with the intuitive notion that a run is an absorbing state in which a program is essentially shut out of the market. The estimated unconditional hazard rate over time of the probability that a program in a run would leave the run state is shown by the dotted line in Figure 4. As shown in the first seven months of the year, the estimated hazard rate is high on average, and generally ranges from around 20 to 50 percent, suggesting that the few programs identified as having been in a run during this period may indeed not be "true" runs in the sense of being unable to subsequently issue new paper. In contrast, the estimated hazard rate fell notably to less than 10 percent on average in early August, and then declined to near zero by the end of the year, providing strong evidence that the mounting number of programs identified as having been in runs during this period were indeed subject to runs. In other words, the runs we identify during the financial crisis appear to be absorbing states.

4.2. Runs are related to program fundamentals, but runs in the initial weeks of the financial turmoil also were indiscriminate

We begin our analysis of runs by estimating equation (2), the probability of a run based on program characteristics and aggregate weekly time dummies. The model is estimated based on weekly data from August 2007 to December 2007, the period for which we are confident that our measure accurately characterizes runs.[17] Coefficients on the program characteristics are interacted with a monthly indicator variable to allow coefficients to vary as the crisis progresses. The results from this baseline regression are shown in Table 4.

Overall, our results indicate that runs are related importantly to program fundamentals, but there is strong evidence that programs that would be sound in more stable market conditions

[17] We excluded the last two weeks of December from our estimations because there are sizable year-end effects that are typical in this market. Spreads tend to rise in the days ahead of the year-end then fall once into the new year (see Downing and Oliner, 2007, and Musto, 1997). Similarly, gross issuance falls in the days before the year-end as issuers issue longer paper earlier in December to get past the year-end or turn to other sources for funds. Because our measure of runs could pick up typical year-end behavior, rather than unusual stresses in this market, we excluded the last two weeks of December.

were also subject to runs in the early weeks of the financial crisis. To characterize the broad findings, the p-values for the entire set of program variables representing fundamentals (i.e., all variables but the time dummies) are significant, and the coefficients on the program variables when significant have the expected signs. At the same time, the coefficients on the weekly time dummies are significant and sizable during August and September, but are less consistently so during October through December. The significant time dummies indicate that runs in August and September were, at least to some extent, indiscriminate in these two months.

Turning to the results in detail, among program-type variables, we find evidence that investors were more likely to run from programs with substantial exposure to mortgage-related assets. The coefficients on *mortgage single-seller* were consistently positive, and mostly significant, suggesting greater concerns about the credit risk related to mortgage warehouse lending activities. In contrast, coefficients on multi-seller programs, which do not have exposure to subprime mortgages, were consistently negative and often significant. Coefficients on *structured investment vehicles* were generally positive, significant, and large, consistent with investors concerns about credit losses on conduits that held highly-rated subprime MBS.

The higher propensity for runs on SIVs likely also reflects that SIVs lack full liquidity support. This possibility is further supported by the result that the coefficients on *securities arbitrage* were often negative despite the similarity of such programs to SIVs in their exposures to subprime mortgages. Recall that securities arbitrage programs have full liquidity support from their sponsor banks, unlike SIVs that use dynamic liquidity management strategies and rely on asset sales to protect investors. More direct evidence that liquidity is an important determinant is provided by the consistently significant and large coefficients on *extendibility*.[18] If programs have the option to extend, then ABCP investors, such as money funds, may not receive a market rate or funds on demand, a feature that is especially costly if money funds are facing

[18] When we exclude the 60 programs with the extendibility feature from our sample, about one-third of which actually extended at some time during the five months and therefore were unlikely to issue even as paper came due, the estimates are roughly unchanged. In particular, coefficients on SIVs and lower rating remain positive and significant, and coefficients on multi-seller remain negative and significant. While the coefficients on mortgage single seller remain positive, they are not significant as often as shown in Table 4, in part because the exclusion of extendibility leads to the exclusion of almost all of these programs. Importantly, the coefficients on the time dummies are highly significant in August, mostly significant in September, and mostly insignificant in October to December. The most notable difference is that the coefficients on nonbank sponsor, which still positive, are not significant, likely because extendibility was a way that nonbank sponsors could provide liquidity support without the additional cost of paying a bank for a line or letter of credit.

redemptions. In addition, the significant and large coefficients on *lower rating* indicates that programs with greater credit and liquidity risk were more subject to runs than fundamentally stronger programs, although only about 5 percent of programs are lower-rated by the end of 2007.

In addition to results suggesting runs are linked to program fundamentals, we find compelling evidence that runs in August and September had an important indiscriminate element. In particular, the coefficients on the weekly time dummies were positive and significant starting in the third week of August (the week starting August 9), and remained significant through September.[19] In contrast, while runs remained very elevated in October through December, the coefficients on the weekly time dummies in that period are largely insignificant, indicating that runs not explained by program fundamentals were not greater relative to the first week of August, when there were very few runs.

The onset of the proliferation of runs in August is linked directly to the numerous dramatic liquidity and credit events in money markets that took place during that period. The key events (and their correspondence to our weekly time dummies in equation (2)) are tabulated for each week from July to December 2007 in Table 5. Of special note, BNP Paribas halted redemptions from three affiliated money market mutual funds after it announced on Thursday August 9 (Week 3 of August) that it could no longer value the holdings of U.S. subprime MBS. The European Central Bank (ECB) immediately announced they would supply reserves as needed to promote stability, which totaled $130 billion on Aug. 9 and an additional $84 billion on August 10. On Aug. 10, the Federal Reserve announced they would also supply reserves, but still overnight ABCP rates in the U.S. market jumped to over 6 percent. The following Tuesday, the ABCP market in Canada was severely disrupted and some banks reportedly refused to provide emergency funding (under agreements that apparently provide liquidity support in more limited circumstances than is typical in the U.S. ABCP market).

These events could have caused investors to increase their views about the insolvency risk of ABCP programs with subprime mortgage exposures and weak liquidity support and to run

[19] Because our data on CP outstandings are available for weeks ending Wednesday, week 3 of August starts on August 9.

these programs. Given the rapid and dramatic events, it also is plausible that investors changed their behavior, leading to runs because they believed others would run, or because available information was reviewed to be inadequate. To the extent these concerns triggered a broader liquidity crisis for the ABCP market, the illiquidity itself may have led to greater solvency risk of stronger programs.

4.3. Interpreting the coefficients on weekly time indicator variables

To interpret the coefficients on the weekly time indicator variables, we run the baseline specification of equation (2), but replace the weekly indicator variables with alternative measures that reflect financial market stresses that are broader than the risks for a specific program type. The weekly variables could reflect general market liquidity or credit risks that might affect all programs, not just those with weaker fundamentals. In particular, we estimate the regression model (2) using the following measures in sequence: (a) the Libor-OIS spread, an indicator of banks' willingness to lend to one another and thus their access to funds; (b) the return on the ABX, an index of the value of subprime MBS that is widely followed; (c) the share of aggregate ABCP issuance that is less than 10 days of maturity, an indicator of rollover risk in the ABCP market; and (d) the lagged share of aggregate ABCP outstanding that is in default or has been extended.

The first two variables, the Libor-OIS spread and ABX return are highlighted and discussed in detail in Gorton and Metrick (2009) as measures of market stresses in broad financial markets in the fall of 2007. The Libor-OIS spread shot up notably in August and though it eased in late September, it remained elevated relative to pre-crisis levels through the remainder of the year (Figure 5, Panel A). The higher spread is consistent with greater doubts by investors about the ability of banks, individually or as a whole, to meet their previously-made commitments and support liquidity in the ABCP market. These doubts could become self-fulfilling because runs will pressure sponsors and liquidity providers to support the programs, which leaves them less capacity to support others, and induces more runs, including on solvent programs. Declines in the ABX index could reflect investors' views about the deterioration in the asset quality of ABCP programs since some were exposed to subprime mortgage assets (see Figure 5, Panel B). If these programs were forced to sell assets to meet redemptions, the resulting lower asset prices could increase the risk of insolvency of other programs. While

returns on the ABX were negative in August, they reversed course for a time before turning sharply negative again in November.

The two other variables reflect market-wide liquidity and credit risks of the ABCP market (see Figure 5, Panels C and D). As the maturity of aggregate ABCP issues shortens, the share of ABCP that has to roll over frequently increases, which could increase roll-over risk for all programs for a given level of investor demand. Similarly, the share of aggregate ABCP in default or that has extended could reflect general anxiety in the market about losses or payment delays for all programs, not just those with deteriorating fundamentals.

Results from the four regressions with the alternative market-wide financial variables are summarized in Table 6. In general, the replacement of the weekly indicator variables with any of the financial market variables did not importantly affect the coefficients on the program-type variables. Thus, for ease of exposition, we show only the coefficients on the financial market variables, and do not repeat the coefficients on the program variables in each regression. In addition, because the weekly indicator variables are significant in August and September but not in October to December, we split the sample period into these two periods. If the coefficients on the market-wide variables follow a similar time pattern to those on the weekly indicator variables, it provides an economic interpretation of the weekly indicator variables.

As shown in the first row of Table 6, the coefficient on the Libor-OIS spread is positive and significant for the entire period. When the sample period is split, the coefficient is positive and significant in the first subperiod of August to September, but is not significant in the later subperiod, following the pattern of the weekly time indicator variables. These results indicate that runs on ABCP programs increased initially with the Libor-OIS spread, after controlling for program fundamentals, but were unrelated to this spread after it began to narrow in late September. Thus, one interpretation of the significant coefficients on the weekly indicator variables is that they reflect investor anxiety about banks' access to funding, and risks that programs with sound credit and liquidity fundamentals might also hit troubles if banks had to support all the programs at once.

Similarly, the measure of aggregate ABCP issuance with maturity of less than 10 days (Equation 3) may reflect intensifying pressures to rollover more paper more frequently, increasing the odds that programs would need to draw on their sponsors. The coefficient on this variable is positive over the entire period. When the period is split, the coefficient is positive and significant in the first period but not in the second, following the pattern for the coefficients on the weekly indicator variables.

In the regression with the ABX index (Equation 2), the coefficient on the ABX for the first subperiod is positive, not the expected sign, but it turns negative in the second subperiod. We also tried other specifications, but coefficients were not consistent. These results suggest that the significant coefficients on the time dummies do not reflect broad concerns about the value of subprime mortgages not directly related to specific program types.

The fourth alternative regression includes the lagged share of aggregate ABCP that has defaulted or extended. We combine defaults with maturity extensions, because investors in the ABCP market are very sensitive to any payment delays. Greater delays and losses could trigger concerns about losses at other programs, perhaps through downward pressures on prices as assets are liquidated, and thus lead to runs on viable programs.[20] Because defaults and extensions would likely result in a run, creating an almost mechanical relationship between our run measure and the lagged share of programs in default or extension, we exclude observations after the week in which they default or extend. As a result, the coefficient on the lagged default and extension variable measures the impact of defaults and extensions on the likelihood that other programs were run. The coefficient is positive and significant in August and September, but not in October to December, suggesting that the weekly indicator variables could reflect greater risks to strong programs because of problems at weaker programs.

Overall, the evaluation of market-wide financial stress indicators suggest that these pressures could lead to runs on programs in August and September that would have been

[20] For example, money market mutual funds, which held about 40 percent of commercial paper outstanding in the U.S. market in 2007, promise their own investors the ability to access their funds on demand at par. Furthermore, money market mutual funds registered under rule 2a-7 of the Investment Company Act of 1940 are subject to restrictions on the average maturity of their portfolio, and program extensions may push money market funds closer to the boundary of the restriction.

considered solvent in more stable financial conditions. In this way, general risks of illiquidity may have led to insolvency.

As runs remained elevated and panic continued, why did the indiscriminate nature of runs diminish or end? It may be that investors became better informed about the credit and liquidity risks of individual programs, which allowed them to re-enter and selectively purchase new issues. Indeed, various authorities took actions in the weeks after the onset of the panic to increase available information to investors and to provide funds to ease liquidity pressures. For example, in September, trade organizations representing securities dealers and investors, including the Securities Industry and Financial Markets Association (SIFMA), the American Securitization Forum (ASF), and the European Securitization Forum (ESF), recommended improvements in disclosures of assets held in ABCP programs. Actions by central banks also may have reduced liquidity risks. In particular, after announcing on Aug. 10 that reserves would be made available, the Federal Reserve announced that it would accept high-quality ABCP as collateral at the discount window, and it cut the target federal funds rate in mid-September, which apparently led to some easing of the Libor-OIS spread. However, even though we find that non-discriminating runs eased relatively quickly, our finding that runs were absorbing states suggest that the consequences were longer-lasting.

4.4. Robustness of result that initial runs were indiscriminate

We bolster our argument that runs in the initial weeks of the crisis were non-discriminating by evaluating the effects of additional program level variables that vary over time. These variables are not included in the baseline specifications for a number of different reasons. First, investors may not have had program-type-level information, at least not on a timely basis, on which to make purchase decisions. One such variable is the share of new issuance that matures in less than 10 days for each program category. This variable is similar to that for the aggregate market, which we believe is observable and could be gleaned from information reported on the Federal Reserve Board's website during this period.[21] However, we do not believe that investors have such granular information on maturity of new issues by program category (and certainly not by program). Nonetheless, it is possible that they have a general sense that maturity varies across program categories in stable times and might try to infer

[21] http://www.federalreserve.gov/releases/cp/

changes from that benchmark. For example, during the first half of 2007 (i.e., prior to the turmoil), single-seller mortgage programs tended to place a fairly high fraction of new issues with maturities of less than 10 days relative to other program types, such as securities arbitrage, and investors might have inferred from that roll-over risk for mortgage single-seller would escalate more quickly than for securities arbitrage programs.

As shown by Equation 1 in Table 7, when maturity by program type is included in addition to maturity for the overall ABCP market, the market-wide-level variable remains significant, suggesting market-wide liquidity stresses increase the likelihood of runs. However, the program-type-level variable is not significant in the full period, or in either subperiod.

We similarly evaluate the lagged share of ABCP outstanding by *program type* that is in default or was extended. As we did for the regression with the lagged share of *overall* ABCP outstanding that is in default or extension (in Table 6), we exclude observations after the week in which they default or extend to avoid the almost mechanical relationship between our run measure and the lagged share of programs in default or extension. Thus, the coefficient on the program-type-level lagged default and extension variable measures the impact of defaults and extensions in the program category on the likelihood that other programs in the program category would be run. We did not include this variable in the baseline specification because of the sample restrictions necessary to eliminate the mechanical link between this variable and the run variable. As shown by Equation 2 in Table 7, the coefficient on the market-wide default/extension variable is positive and significant in August and September, but not in the second period, consistent with results in Table 6. For the program-type-level variable, the coefficients have the reverse pattern: that is, the coefficient is not significant in August and September, but is significant in the later subperiod. These results bolster our interpretation that runs in October to December were more centered on program-level fundamentals, while runs in August and September has a more indiscriminate element to them.

Another robustness check is to include the failure risk of the sponsor of the ABCP program, in addition to the funding risk of the aggregate banking sector, as represented by the Libor-OIS spread. In the baseline results (reported above in table 4), we believe that the indicator variables for sponsor type capture the significant cross-sectional variation in ratings

between, for example, large domestic banks and nonbank sponsors, and that the ABCP program rating variable should capture time-series variation in risk. Here we include the CDS of the program sponsor as an explanatory variable, but many sponsors, especially nonbank sponsors such as asset managers, do not issue public debt and thus do not have bond prices or CDS premiums. Thus regressions that include the CDS of the sponsor include only about half of the sample. The results show that the coefficient on the change in the sponsor's CDS premium was not significant. Moreover, the coefficients on program ratings lose their significance when the sponsor CDS is included.

Overall, the addition of these program-level variables (with their limitations) do not change our basic results that while runs appear to be linked to greater program-level risks, they also appeared to have a non-discriminating element in August and September.

4.5. Risk spreads for ABCP indicate runs reflect difficulties in issuing, not less willingness to issue

We next examine daily risk spreads on overnight ABCP to more fully characterize conditions in the market. If the types of programs subject to runs are also the types that are able to issue at relatively low spreads, one might argue that the runs indicate that such programs have access to low-cost alternatives to ABCP, and that such runs do not indicate expulsion from the market. But if similar programs are issuing, and the required spreads are high, that evidence would suggest stresses for that type of program and less ability to issue.

Prior to the eruption of turmoil in August 2007, yield spreads were extremely narrow, but did show significant differences across programs types and features. As seen in Figure 3 and in Table 3 (referenced earlier), daily spreads on overnight paper for ABCP programs averaged about 3 to 6 basis points above the target federal funds rate in the first seven months of the year. The results from estimating equation (3) are shown in Table 8. The results show that prior to the turmoil in August, coefficients on program type were generally insignificant, although mortgage single-seller and CDOs paid a slight premium of about 2-1/2 basis points relative to the omitted group. Lower-rated programs paid about 9 to 10 basis points more, extendible programs paid about 4 to 5 basis points more, and programs with sponsors that were not large US banks generally paid about 1 to 5 basis points more to issue.

As the crisis erupted, average spreads rose from about 15 basis points to about 90 basis points in the early days of the turmoil. Spreads rose for all types of programs, including multi-seller, SIVs, and securities arbitrage. The regression results in Table 8 tell a similar story. The constant in the regressions increases from less than 1 basis point in June and July to 54 basis points in August, consistent with a sharp rise in spreads across all types of programs.

The regression results also show that during the crisis, yield spreads were substantially higher for the programs identified earlier as being subject to runs, buttressing our interpretation of our run measure as an indication of a withdrawal of investor demand rather than a pull-back in supply. The coefficient on extendibility increased almost five times to 25 basis points in August and rose again to 36 basis points in September, after which very few programs with extendibility issued any paper. The coefficient on rating rose similarly, as did the coefficient mortgage single sellers. Further, spreads on all types of sponsors that were not *large US banks* were also significantly larger in the last five months of the year. More generally, the finding that distinctions among key features were amplified after the crisis began is consistent with Martinez-Peria and Schmuckler (2001), who find that higher premiums were required for risk characteristics of financial institutions after the onset of troubles.

4.6. Summary of results

Overall, we find strong evidence of runs on ABCP programs in the last five months of 2007. And, throughout the period under study, programs that were run had a very low probability of accessing the market again. We also find that deteriorating fundamentals were an important determinant of runs. Indeed, by the end of the year, nearly all ABCP programs with exposures to possible mortgage credit losses and less-than-full liquidity support were shut out of the market. We also find evidence that the proliferation of runs in the early weeks of the crisis was not well-explained by deteriorating program fundamentals, but appeared, to some extent, indiscriminate reflecting increasing strains in the aggregate ABCP market and broader financial markets. In addition, programs with weaker fundamentals that were able to issue paper during this entire panic period had to pay significantly higher spreads.

One question that we cannot address directly in our empirical analysis is why the indiscriminate component of the runs subsided in a matter of weeks. One possibility is that more information became available about the various programs which permitted investors to make distinctions in risk. Another possibility is that investors came to the realization that not all programs would be run as many had no exposure to subprime mortgages or had full liquidity protection. A third and related possibility is that the Federal Reserve, in its role of lender of last resort, may have calmed investors by its actions, including providing reserves, accepting ABCP as collateral at the discount window, and cutting the target federal funds rate in mid-September.

5. Implications

Our results highlight how the ABCP market is central to understanding the current financial crisis. First, concerns about credit losses on subprime mortgages affected this market, through runs on programs with exposure to these assets. However, the effects through subprime mortgage losses are only part of the story, and it is likely that had only those programs been run, the effects on broader markets would have been more limited. Another channel is that concerns about these losses led investors in ABCP to question the strength of the liquidity support on other programs, and programs with extendibility features or less-than-full liquidity support were run. As investors lost confidence and ABCP could not roll over, explicit and implicit supports provided by banks were called on, pressuring bank balance sheets. Banks became uncertain about further draws on their commitments and, in turn, reduced lending to others, thereby magnifying the effects of the initial ABCP runs.

A third significant effect is that as investors ran, ABCP programs as a buyer of the AAA-rated tranches of new securitizations disappeared. Combined with the pull-back in the repo market, another market that funded AAA-rated tranches with short-term debt, securitizations became increasingly difficult, forcing banks to look for other ways to fund their origination of mortgages and other loans. As a consequence, at a time when banks were concerned about further calls on their explicit and implicit commitments to support ABCP, they also lost access to securitization as a source of funding, further magnifying the effects of ABCP runs.

Our finding of indiscriminate runs suggests that the ABCP markets may be inherently unstable: Investors appeared to run in some cases only because they feared that others would run

as well. Even investors in programs with solid fundamentals may pull back on concerns that the bank as liquidity provider might not be able to support multiple programs at the same time. Indeed, it seems implausible that the entire ABCP market of $1.2 trillion could be fully supported by the private bank sector if supports were called upon all at once. Thus, investors may run from the entire market. Thus an important implication is that financial institutions, even in developed countries with credible deposit insurance systems, may be exposed to runs through off-balance-sheet exposures to ABCP programs.[22] A corollary to this is that the federal government can be exposed to runs from entities other than banks, in particular off-balance sheet ABCP conduits sponsored and supported by banks.

The relevant policy question is how, if at all, to address the possibility that the ABCP market may be an important source of instability in the future. One option is to impose standards on liquidity support. Our results suggest that extendibility and "dynamic liquidity management" were poor substitutes for more traditional support from banks. However, we also found that in the early weeks of the crisis, even programs with strong liquidity support were run. Another option would be to restrict the size of the ABCP market. Such a policy would certainly limit the potential systemic impact of the ABCP market. However, it might not be feasible, as the optimal size of the ABCP market is unknown and such a policy would likely be difficult to enforce. In addition, restricting the size of the market might crowd out efficient methods for firms to finance short-term assets. Another option proposed by Gorton (2009) for an alternative purpose of preventing destabilizing runs in the repurchase market, is to provide and require government insurance for all AAA-rated tranches of securitizations. This policy might indirectly inhibit the growth of the ABCP market, particularly programs designed to arbitrage the difference between yields on long-term, near-riskless assets and yields on short-term ABCP. Indeed, this was the main purpose of SIVs, CDOs, and securities arbitrage, segments of the ABCP market that disappeared, at least for now, during the recent turmoil. The difficulty with such a policy is the traditional moral hazard created by the provision of insurance. The insurance would have to be priced and securitization processes monitored to ensure that the resulting AAA assets indeed had little or no credit risk.

[22] This point is also made by Gorton (2007) in a discussion of the 2007 financial turmoil.

References

Acharya, Viral V., Douglas Gale, and Tanju Yorulmazer, 2009, Rollover risk and market freezes, Working Paper, New York University.

Acharya, Viral V., and Philipp Schnabl, 2009, How banks played the leverage 'game,' in Viral Acharya and Matthew Richardson (eds.), *Restoring financial stability: How to repair a failed system*, New York University Stern School of Business and John Wiley & Sons.

Arteta, Carlos O., Mark Carey, Ricardo Correa, Jason Kotter, 2009, Revenge of the steamroller: ABCP as a window on risk choices, Working Paper, Federal Reserve Board.

Brunnermeier, Markus K., 2009, Deciphering the liquidity and credit crunch 2007-2008, *Journal of Economic Perspectives* 23, 77-100.

Calomiris, Charles W., 1995, Financial fragility: Issues and policy implications, *Journal of Financial Services Research* 9, 241-257.

Calomiris, Charles W., and Joseph R. Mason, 2003, Fundamentals, panics, and bank distress during the Depression, *American Economic Review* 93, 1615-1647.

Covitz, Dan, and Chris Downing, 2007, Liquidity or credit risk? The determinants of very short-term corporate yield spreads, *Journal of Finance* 62, 2303-2328.

Demirgüç-Kunt, Asli, and Enrica Detragiache, 1998, The determinants of banking crises in developing and developed countries, *IMF Staff Papers* 45, 81-109.

Diamond, Douglas W., and Philip H. Dybvig, 1983, Bank runs, deposit insurance, and liquidity, *Journal of Political Economy* 91, 401–419.

Downing, Chris, and Steven Oliner, 2007, The term structure of commercial paper rates, *Journal of Financial Economics* 83, 59-86.

Gatev, Evan, and Philip E. Strahan, 2006, Banks advantage in hedging liquidity risk: Theory and evidence from the commercial paper market, *Journal of Finance* 61, 867-892.

Goldstein, Itay, and Ady Pauzner, 2005, Demand-deposit contracts and the probability of bank runs, *Journal of Finance* 60, 1293-1327.

Gorton, Gary, 1988, Banking panics and business cycles, *Oxford Economic Papers* 40, 751-781.

Gorton, Gary, 2007, Banks, banking, and crises, *NBER Reporter*, Number 4.

Gorton, Gary, 2009, Slapped in the Face by the Invisible Hand: Banking and the Panic of 2007, *Mimeo*.

Gorton, Gary, and Andrew Metrick, 2009, Securitized Banking and the Run on Repo, Working Paper, Yale University.

Gorton, Gary, and George G. Pennacchi, 1989, Are loan sales really off-balance-sheet? *Journal of Accounting, Auditing and Finance* 4, 125–145.

Gorton, Gary, and George G. Pennacchi, 1990, Financial Intermediaries and Liquidity Creation, *Journal of Finance* 45, 49-71.

Gorton, Gary, and George G. Pennacchi, 1995, Banks and loan sales: marketing non-marketable assets, *Journal of Monetary Economics* 35, 389–411.

Gorton, Gary, and Nicholas S. Souleles, 2005, Special purpose vehicles and securitization, NBER Working Paper No. 11190.

Han, Song and Dan Li, 2009, Liquidity Crisis, Runs, and Security Design: Lessons from the Collapse of the Auction Rate Securities Market, Working paper, Federal Reserve Board.

He, Zhiguo, and Wei Xiong, 2009, Dynamic bank runs, Working Paper, Princeton University.

J.P. Morgan Securities Inc, 2007, Short–Term Fixed Income Research Note: An ABCP Cheat Sheet, August 16.

Martinez-Peria, Maria S. and Sergio L. Schmukler, 2001, Do depositors punish banks for bad behavior? Market discipline, deposit insurance, and banking crises, *Journal of Finance* 56, 1029-1051.

Morris, Stephen, and Hyun Song Shin, 2009, Illiquidity component of credit risk, Working Paper, Princeton University.

Moody's Investors Service, 2007a, SIVs: An Oasis of Calm in the Sub-prime Maelstrom, July.

Moody's Investors Service, 2007b, ABCP Market at a Glance: ABCP Credit Arbitrage Snapshot, August.

Musto, David K., 1997, Portfolio Disclosures and Year-End Price Shifts, *Journal of Finance* 52, 1563-1588.

Figure 1: The market for asset-backed commercial paper (ABCP): aggregate amount of paper outstanding and overnight spreads

Panel A plots the weekly face value of asset-backed commercial paper outstanding in the U.S. market. Panel B plots the spread of rates on AA-rated asset-backed commercial paper over the target federal funds rate in the U.S. market. Data for both panels are from the Federal Reserve Board based on data from the DTCC.

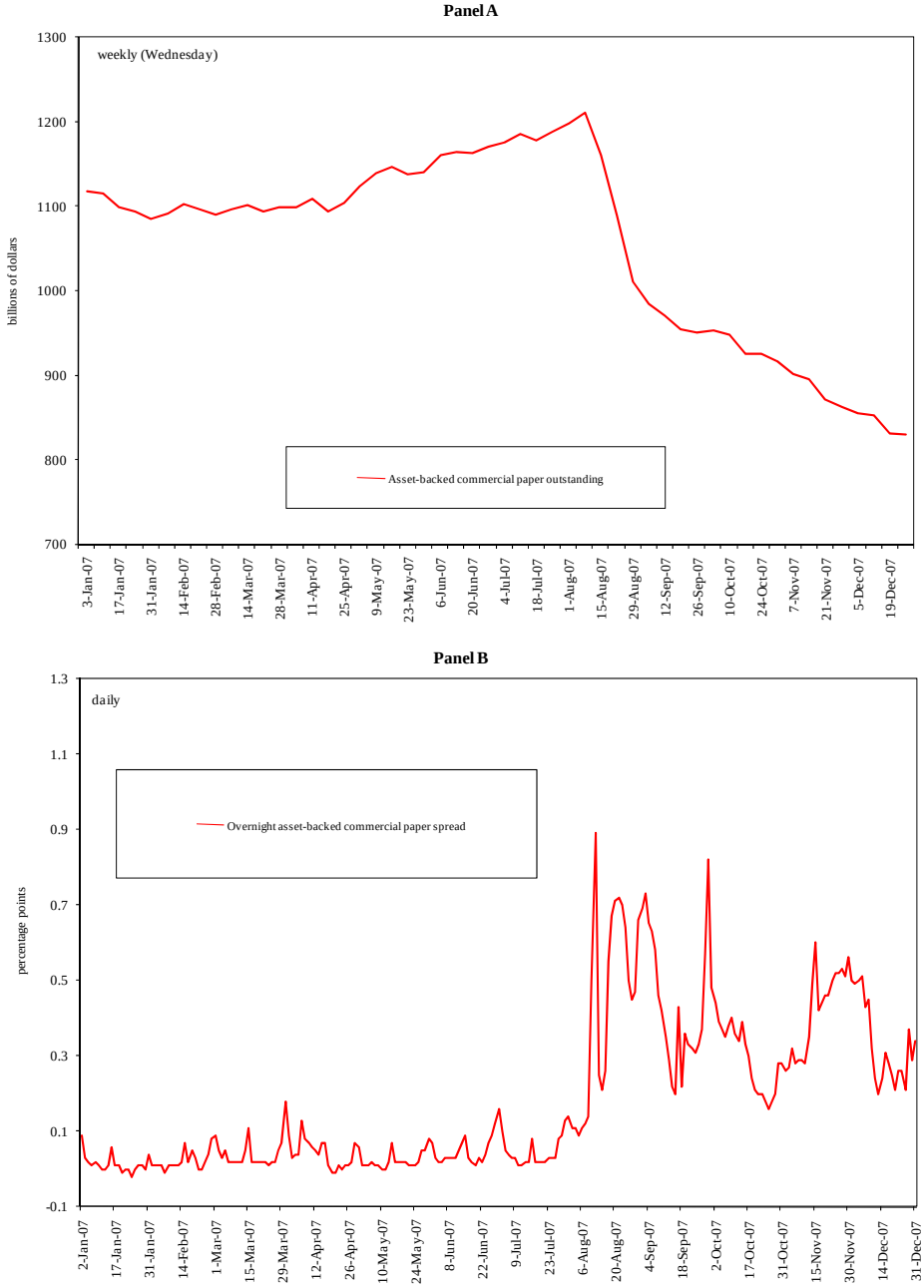

Figure 2: A stylized asset-backed commercial paper (ABCP) transaction

This figure summarizes a stylized transaction in the ABCP market. ABCP programs are set up by sponsors (for example, commercial banks) that provide asset management services in exchange for fees. Some sponsors provide liquidity and/or credit support to their programs, but some other sponsors outsource liquidity and credit support to financial institutions like commercial banks or insurers. The ABCP program (or issuer) purchases term loans, receivables, and securities from asset originators (or sellers). The ABCP program finances asset purchases by issuing commercial paper to money market investors (for example, money market mutual funds).

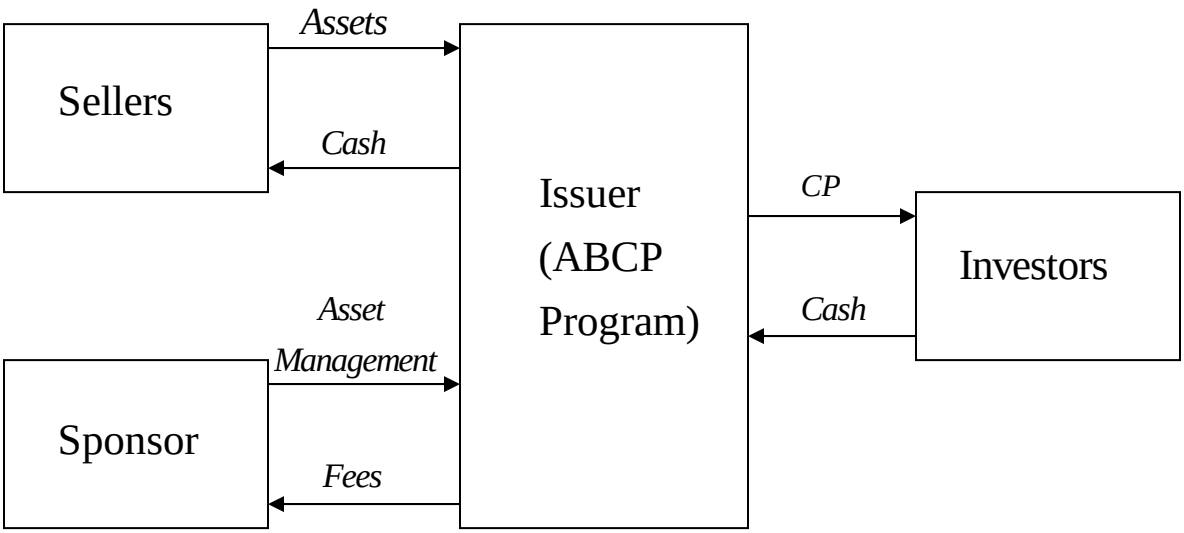

Figure 3: Risk spreads on overnight asset-backed commercial paper (ABCP) issues for selected program types

The solid line plots the spread of rates paid by multi-seller programs over the target federal funds rate. The dotted line plots the spread of rates paid by securities arbitrage programs over the target federal funds rate. The solid line with circles plots the daily spread of rates paid by structured investment vehicles over the target federal funds rate. Daily data on rates are computed using transaction-level data from the DTCC.

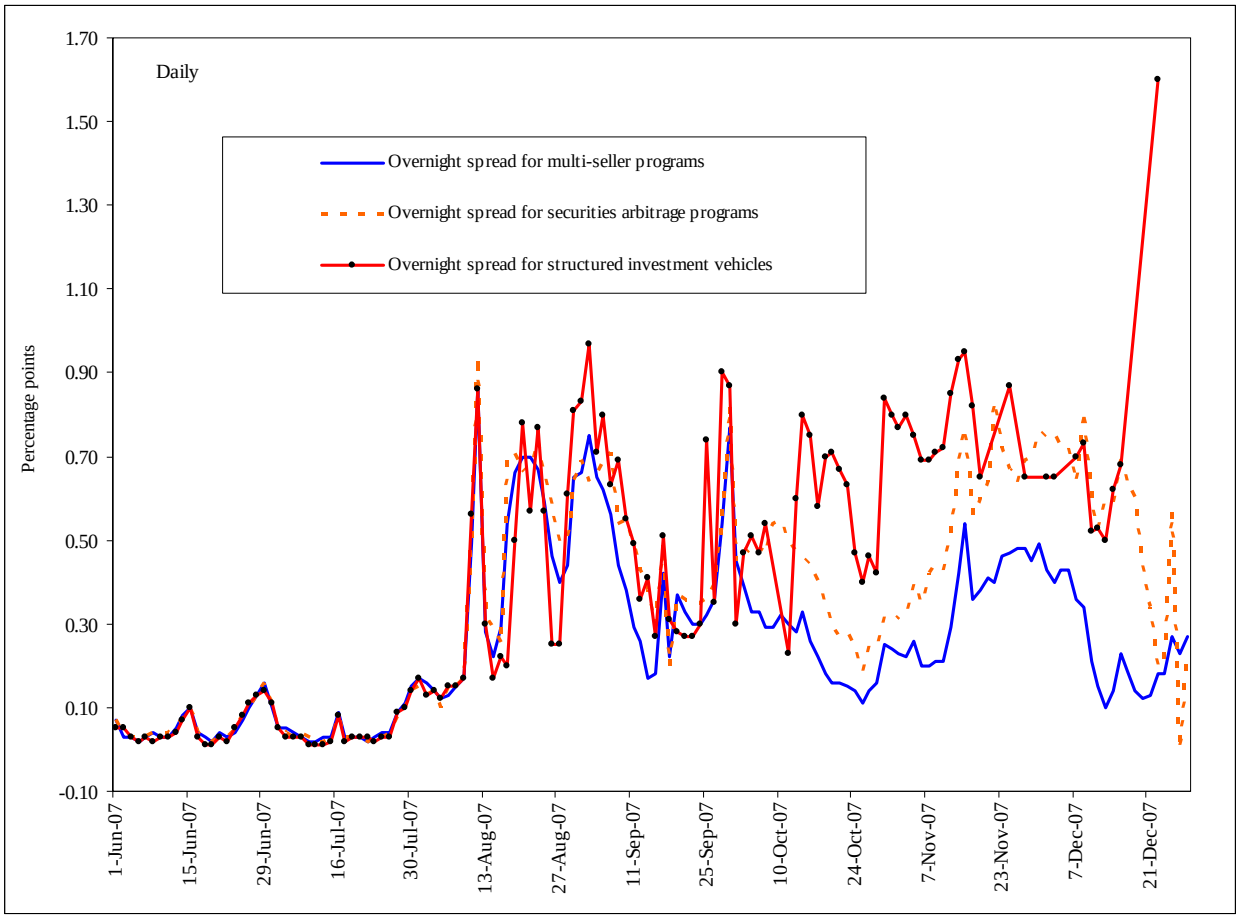

Figure 4: Runs on asset-backed commercial paper (ABCP) programs in 2007

The solid line plots the percent of programs experiencing a run. We define that a program experiences a run in weeks when it does not issue paper but has at least 10 percent of paper maturing or when the program continues not issuing paper after experiencing a run in the previous week (see equation (1) in the text). The dotted line plots the unconditional probability of not experiencing a run in a given week after having experienced a run in the previous week (i.e., the hazard rate of leaving the run state). The figure is based on weekly data from DTCC on paper outstanding, maturities, and issuance for 349 ABCP programs in 2007.

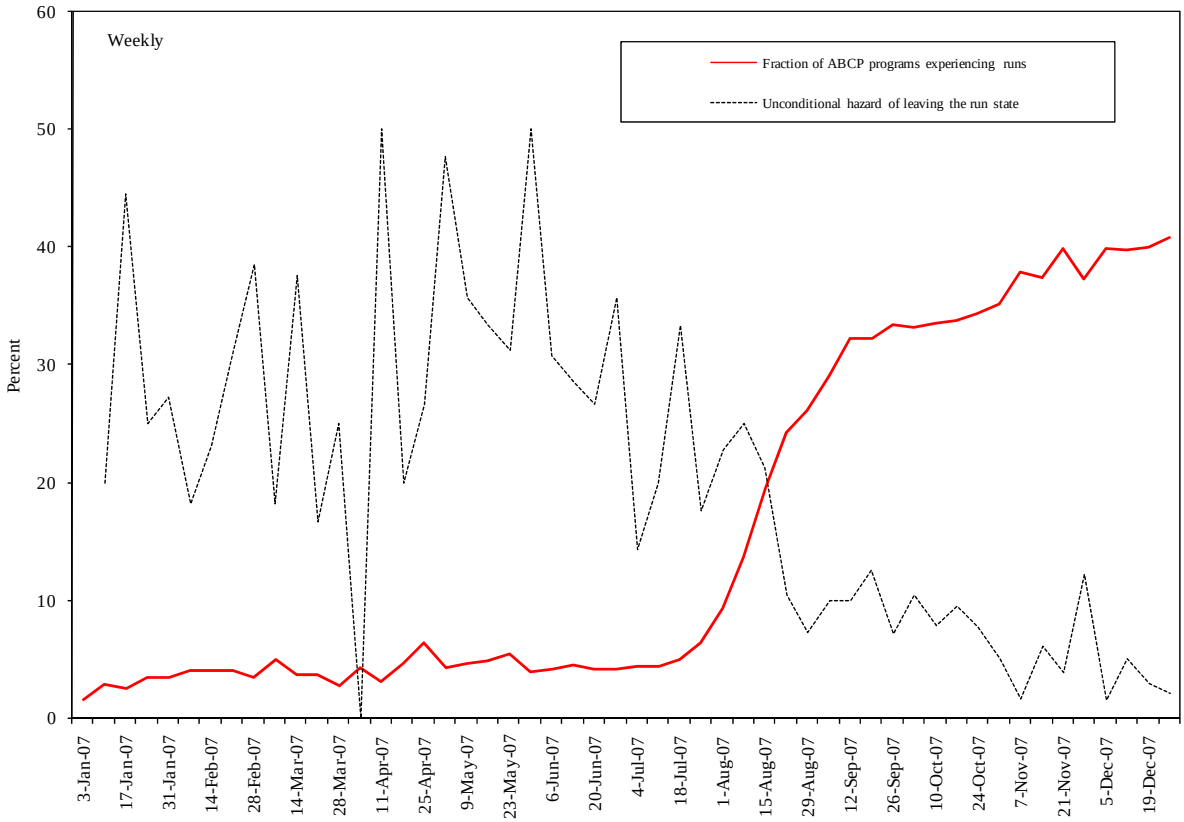

Figure 5: Aggregate variables related to stresses in the ABCP market

Panel A plots the weekly spread of 1-month U.S. Libor over comparable maturity OIS (Source: British Bankers' Association). Panel B plots the weekly return on the ABX.HE index for AAA-tranches of MBS originated in the first half of 2006 (Source: JP Morgan Chase & Co.). Panel C plots the weekly fraction of newly issued ABCP in the US market with maturities of 10 days or less (Source: Federal Reserve Board). Panel D plots the weekly fraction of ABCP outstandings in default or extension (Source: Federal Reserve Board and news searches in Factiva).

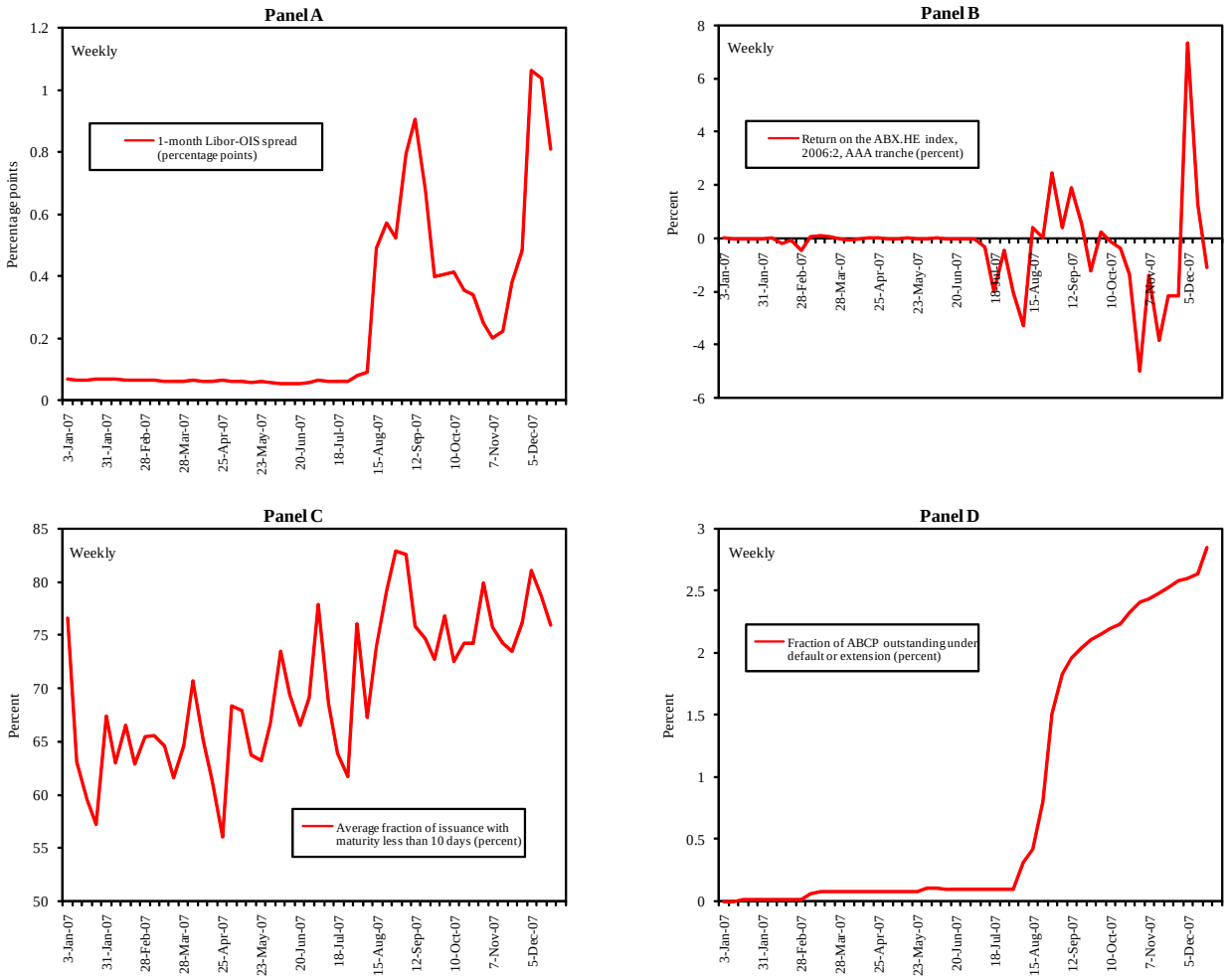

Table 1: Asset-backed commercial paper (ABCP) program types

Program Type	Assets	Liquidity Support	Number of Programs	Percent of Outstandings
Multi Seller	Receivables and loans	Full	98	45
Non-Mortgage Single Seller	Credit-card receivables and auto loans	Implicit by originator	40	11
Mortgage Single Seller	Mortgages and mortgage-backed securities	Implicit by originator	11	2
Securities Arbitrage	Highly-rated long-term securities	Full	35	13
Structured Investment Vehicle	Highly-rated long-term securities	None	35	7
CDO	Highly-rated long-term securities	Partial	36	4
Hybrid and Other	n.a.	n.a.	84	18

Notes. Number of programs and percent of market outstandings are based on data as of July 2007, when outstandings peaked.

Table 2: Asset-backed commercial paper (ABCP) outstanding in 2007, by program type

This table reports the amount of paper outstanding at the end of each month in 2007 for all program types in the U.S. asset-backed commercial paper (ABCP) market. Data on paper outstanding are from DTCC and program type classification is from Moody's Investors Service.

Billions of dollars, end of the month	Total	Multi seller	Non-mortgage single seller	Mortgage single seller	Securities arbitrage	Structured investment vehicle	CDO	Hybrid and other
2007 Jan	1,061	455	121	32	159	63	41	190
Feb	1,067	459	129	33	154	60	41	190
Mar	1,070	480	122	25	148	56	46	193
Apr	1,092	492	125	32	142	63	46	193
May	1,125	503	126	35	149	65	46	202
Jun	1,151	518	123	23	150	79	48	211
Jul	1,163	525	126	23	148	84	47	210
Aug	976	503	79	4	120	70	39	160
Sep	927	484	74	2	133	49	33	153
Oct	896	465	68	2	140	29	32	160
Nov	838	461	55	1	117	22	31	152
Dec	816	469	51	2	102	15	27	151

Table 3: Risk spreads on overnight asset-backed commercial paper (ABCP) issues, by program type

This table reports the spread of rates on overnight ABCP issues, by program type, over the target federal funds rate. Data on ABCP transactions are from DTCC and program type classification is from Moody's Investors Service. Spreads are weighted averages of spreads on individual transactions using face value of transactions as weights.

Percentage points, month average	Market average	Multi seller	Total single-seller	Mortgage single seller	Securities arbitrage	Structured investment vehicle	CDO	Hybrid and other
2007 Jan	0.02	0.02	0.00	0.05	0.02	0.01	0.02	0.02
Feb	0.02	0.02	0.01	0.04	0.03	0.01	0.03	0.03
Mar	0.05	0.05	0.06	0.07	0.04	0.04	0.10	0.04
Apr	0.05	0.05	0.05	0.06	0.04	0.04	0.09	0.04
May	0.03	0.03	0.03	0.06	0.03	0.02	0.04	0.03
Jun	0.06	0.06	0.07	0.09	0.06	0.05	0.07	0.05
Jul	0.06	0.06	0.05	0.08	0.05	0.05	0.07	0.05
Aug	0.47	0.44	0.42	0.76	0.47	0.44	0.51	0.55
Sep	0.49	0.41	0.71	1.22	0.53	0.55	0.41	0.65
Oct	0.34	0.24	0.83	1.51	0.42	0.55	0.50	0.47
Nov	0.44	0.35	1.01	1.75	0.57	0.76	0.54	0.50
Dec	0.53	0.41	0.91	1.92	0.69	1.11	0.75	0.53

Table 4: Regressions of the probability of experiencing a run

This table reports the results of estimating equation (2) from the text using a probit model with a panel of weekly observations of ABCP programs from August to December 2007:

$$\Pr(\text{Run}_{it}=1)=$$

$$F\left(\alpha+\sum_j\sum_m \beta_{j,m}\text{Program Type}_{ji}+\sum_m \delta_m \text{Extendibility}_i+\sum_m \theta_m \text{Rating}_{it}+\sum_k\sum_m \gamma_{k,m}\text{Sponsor Type}_{ki}+\sum_t \tau_t D_t\right)$$

The dependent variable is the probability of experiencing a run as defined in equation (1). *F* denotes the cumulative distribution function of a standard normal variable. Program Type$_{ji}$, equals 1 if program *i* is type *j* and equals 0 otherwise. The set of *j* program types includes multi-sellers, non-mortgage single-seller conduits, mortgage single-seller conduits, securities arbitrage programs, SIVs, CDOs, and other programs (the omitted category). Extendibility$_i$ equals 1 for programs that issue paper with the option of extending maturity at the issuer's request, and Rating$_{it}$ is an indicator variable that equals 1 for programs rated P2 or P3 by Moody's Investors Service (i.e., the two lowest prime short-term ratings). Sponsor Type$_{ki}$, equals 1 if program *i* is sponsored by an institution of type *k* and equals 0 otherwise. The set of *k* sponsors includes large U.S. banks (the omitted category), small U.S. banks, non-U.S. banks, and nonbanking institutions. All program-specific variables are allowed to vary by month, denoted by *m*. D_t denotes a weekly time dummy. Each column reports the marginal effects of a program-level variable for a given month in the sample. Standard errors clustered by program are reported in brackets.

Dependent variable: Probability of experiencing a run						
Program variables		Interaction with the dummy variable for the month of				
		August	September	October	November	December
Program type variables	Multi seller	-0.086	-0.151**	-0.130**	-0.144**	-0.103
		[0.075]	[0.063]	[0.064]	[0.063]	[0.070]
	Non-mortgage single seller	0.074	-0.050	0.009	-0.043	-0.053
		[0.119]	[0.102]	[0.117]	[0.109]	[0.109]
	Mortgage single seller	0.288*	0.315	0.284	0.366**	0.448**
		[0.161]	[0.200]	[0.202]	[0.183]	[0.195]
	Securities arbitrage	-0.058	-0.204***	-0.168**	-0.137	-0.091
		[0.107]	[0.067]	[0.080]	[0.095]	[0.111]
	Structured invest. vehicle	0.265**	0.200**	0.363***	0.494***	0.566***
		[0.112]	[0.102]	[0.091]	[0.085]	[0.071]
	CDO	0.224*	0.105	0.122	0.086	0.157
		[0.136]	[0.118]	[0.126]	[0.132]	[0.131]
Contractual features	Extendibility	0.347***	0.406***	0.431***	0.453***	0.492***
		[0.081]	[0.082]	[0.078]	[0.078]	[0.072]
	Rating	0.462***	0.485***	0.304**	0.366**	0.529***
		[0.112]	[0.117]	[0.140]	[0.161]	[0.150]
Sponsor type variables	Small U.S. bank sponsor	0.005	0.095	0.223	0.085	0.179
		[0.130]	[0.155]	[0.190]	[0.199]	[0.196]
	Non-U.S. bank sponsor	0.050	0.209*	0.232*	0.236*	0.274**
		[0.122]	[0.116]	[0.120]	[0.121]	[0.131]
	Nonbanking sponsor	-0.070	0.081	0.160	0.168	0.180
		[0.106]	[0.103]	[0.106]	[0.112]	[0.123]
Time effects		Week-fixed effects				
		August	September	October	November	December
	Dummy for the first week of the month	-	0.152*	0.142	0.190*	0.121
			[0.090]	[0.098]	[0.112]	[0.121]
	Dummy for the second week of the month	0.033	0.205**	0.124	0.173	0.123
		[0.039]	[0.092]	[0.096]	[0.115]	[0.120]
	Dummy for the third week of the month	0.109**	0.211**	0.134	0.206*	
		[0.048]	[0.091]	[0.097]	[0.114]	
	Dummy for the fourth week of the month	0.184***	0.245***	0.127	0.172	
		[0.053]	[0.091]	[0.094]	[0.116]	
	Dummy for the fifth week of the month	0.247***		0.162*		
		[0.051]		[0.098]		
	Observations	4734				
	Number of programs	303				
	Pseudo R-squared	0.221				
	Chi-squared test for program variables, p-value	0.000				

Table reports marginal effects of a probit model. Robust standard errors in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Calendar of events and time dummies in the regression analysis

The calendar of events below is organized around for weeks ending Wednesday. The second column of the table reports the corresponding week dummy in the panel regression on the probability of a run in Table 4. For example, the week ending on Wednesday, August 1, 2007 corresponds to the dummy variable for the first week of the month of August in Table 4.

Month	Week time dummy	Events in Money Markets
July 2007		• Countrywide's disappointing earnings announcement (July 24)
August 2007	Week 1 (ending Aug 1)	
	Week 2 (ending Aug 8)	• American Home Mortgage declares bankruptcy (Aug 6) • Three single-seller mortgage ABCP programs extend the maturity of their paper (Aug 6)
	Week 3 (ending Aug 15)	• BNP halts redemptions at two affiliated funds (Aug 9) • ECB injects liquidity in money markets (Aug 9) • Federal Reserve provides liquidity (Aug 10) • Canadian ABCP market seizes up (Aug 14)
	Week 4 (ending Aug 22)	• Countrywide taps on its credit lines (Aug 16) • Federal Reserve cuts primary credit rate 50 basis points (Aug 17) • An ABCP program affiliated with KKR Financial extends the maturity of its paper (Aug 20) • Two SIV programs default on their ABCP (Aug 22-23)
	Week 5 (ending Aug 29)	• A second ABCP program affiliated with KKR Financial extends the maturity of its paper (Aug 23) • Clarification that investment-quality ABCP is accepted as discount-window collateral at the Federal Reserve (Aug 24)
September 2007	Week 1 (ending Sept 5)	• An SIV program sponsored by Cheyne Capital Management draws on its credit lines (Aug 30). • Moody's downgrades or places under review the ratings of several ABCP programs issued by SIVs (Sept 5)
	Week 2 (ending Sept 12)	• SIFMA, the American Securitization Forum, and the European Securitization Forum recommend disclosure of holdings by ABCP programs (Sept 12)
	Week 3 (ending Sept 19)	• Federal Reserve cuts the target federal funds target rate by 50 basis points (Sept 18)
	Week 4 (ending Sept 26)	

Table 5: Calendar of events and time dummies in the regression analysis (continued)

Month	Week time dummy	Events in Money Markets
October 2007	Week 1 (ending Oct 3)	
	Week 2 (ending Oct 10)	
	Week 3 (ending Oct 17)	• Citigroup, Bank of America, and JP Morgan Chase propose the M-LEC to backstop paper issued by SIVs (Oct 15) • An SIV program sponsored by Cheyne Capital Management defaults (Oct 17)
	Week 4 (ending Oct 24)	• An SIV program sponsored by IKB Credit Management defaults (Oct 18)
	Week 5 (ending Oct 31)	• Federal Reserve cuts the target federal funds rate by 25 basis points (Oct 31)
November 2007	Week 1 (ending Nov 7)	• Moody's Investors Service downgrades and places under review several SIVs (Nov 7)
	Week 2 (ending Nov 14)	
	Week 3 (ending Nov 21)	
	Week 4 (ending Nov 28)	
December 2007	Week 1 (ending Dec 5)	
	Week 2 (ending Dec 12)	• S&P downgrades many SIVs (Dec 7) • Federal Reserve cuts the target federal funds rate by 25 basis points (Dec 11) • Federal Reserve establishes Term Auction Facility (TAF) and coordinates foreign exchange swap lines with other major central banks (Dec 12)
	Week 3 (ending Dec 19)	• Citigroup announces that it will support its own-sponsored SIVs (Dec 13) • First TAF auction (Dec 17)
	Week 4 (ending Dec 26)	• Citigroup, Bank of America, and JP Morgan Chase abandon the idea of M-LEC (Dec 21)

Table 6: Regressions of the probability of experiencing a run and aggregate variables

This table reports the marginal effects of the aggregate (non-program-specific) variable in the following generic equation estimated with a probit model:

$$\Pr(\text{Run}_{it}=1)=$$

$$F\left(\alpha+\sum_j\sum_m\beta_{j,m}\text{Program Type}_{ji}+\sum_m\delta_m\text{Extendibility}_i+\sum_m\theta_m\text{Rating}_{it}+\sum_k\sum_m\gamma_{k,m}\text{Sponsor Type}_{ki}+\text{Aggregate}_t\right)$$

The dependent variable is the probability of experiencing a run as defined in equation (1). *F* denotes the cumulative distribution function of a standard normal variable. Program Type$_{ji}$, equals 1 if program *i* is type *j* and equals 0 otherwise. The set of *j* program types includes multi-sellers, non-mortgage single-seller conduits, mortgage single-seller conduits, securities arbitrage programs, SIVs, CDOs, and other programs (the omitted category). Extendibility$_i$ equals 1 for programs that issue paper with the option of extending maturity at the issuer's request, and Rating$_{it}$ is an indicator variable that equals 1 for programs rated P2 or P3 by Moody's Investors Service (i.e., the two lowest prime short-term ratings). Sponsor Type$_{ki}$, equals 1 if program *i* is sponsored by an institution of type *k* and equals 0 otherwise. The set of *k* sponsors includes large U.S. banks (the omitted category), small U.S. banks, non-U.S. banks, and nonbanking institutions. All program-specific variables are allowed to vary by month, denoted by *m*. Estimated marginal effects are reported for regressions using one of four aggregate variables and for the full sample (August-December, 2007) and two subperiods (August-September, 2007 and October-December, 2007). For compactness, the coefficients on program-specific variables are omitted from the table. In the first row, Aggregate$_t$ is the weekly average spread of the 1-month U.S. Libor over the comparable maturity OIS rate. In the second row, Aggregate$_t$ is the weekly return on the ABX index (2006:H2, AAA tranche). In the third row, Aggregate$_t$ is the fraction of market issuance of ABCP with maturities less than 10 days, computed from data published by the Federal Reserve Board. In the fourth row, Aggregate$_t$ is the lagged fraction of ABCP market outstandings under default or extension. Standard errors clustered by program are reported in brackets.

Dependent variable: Probability of experiencing a run

	Full sample period	Subperiods	
	August-December 2007	Subsample: August-September 2007	Subsample: October-December 2007
Equation 1: Aggregate variable is the spread of 1-month LIBOR over OIS	0.096***	0.128***	-0.047
	[0.036]	[0.041]	[0.056]
Observations	4734	2042	2692
Number of programs	303	291	295
Pseudo R2	0.217	0.186	0.220
Equation 2: Aggregate variable is the return on the ABX.HE index, 2006:2	0.007**	0.022***	-0.002
	[0.003]	[0.005]	[0.002]
Observations	4734	2042	2692
Number of programs	303	291	295
Pseudo R2	0.217	0.188	0.220
Equation 3: Aggregate variable is the fraction of market-wide issuance with maturity of less than 10 days	0.006***	0.007***	0.002
	[0.002]	[0.002]	[0.002]
Observations	4734	2042	2692
Number of programs	303	291	295
Pseudo R2	0.217	0.186	0.220
Equation 4: Aggregate variable is the lagged fraction of market-wide outstandings in default or extension	0.103***	0.141***	0.053
	[0.031]	[0.028]	[0.085]
Observations	4425	1949	2476
Number of programs	288	282	272
Pseudo R2	0.183	0.157	0.186

Table reports marginal effects of a probit model. Robust standard errors in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Robustness Checks

Panel A reports the marginal effects of the fraction of short-term issuance variables after estimating the following probit model using a panel of weekly observations of ABCP programs:

$$\Pr(\text{Run}_{it}=1)=$$
$$F\left(\begin{array}{l}\alpha+\sum_j\sum_m \beta_{j,m}\text{Program Type}_{ji}+\sum_m \delta_m \text{Extendibility}_i+\sum_m \theta_m \text{Rating}_{it}+\sum_k\sum_m \gamma_{k,m}\text{Sponsor Type}_{ki} \\ +\text{Fraction of short-term issuance by program type}_{it}+\text{Fraction of market-wide short-term issuance}_t\end{array}\right)$$

Panel B reports the marginal effects of the fraction of the lagged fraction of outstanding in default or extension after estimating the following probit model using a panel of weekly observations of ABCP programs:

$$\Pr(\text{Run}_{it}=1)=$$
$$F\left(\begin{array}{l}\alpha+\sum_j\sum_m \beta_{j,m}\text{Program Type}_{ji}+\sum_m \delta_m \text{Extendibility}_i+\sum_m \theta_m \text{Rating}_{it}+\sum_k\sum_m \gamma_{k,m}\text{Sponsor Type}_{ki} \\ +\text{Fraction of defaults and extensions by program type}_{i(t-1)}+\text{Fraction of market-wide defaults and extensions}_{t-1}\end{array}\right)$$

The dependent variable is the probability of experiencing a run as defined in equation (1). *F* denotes the cumulative distribution function of a standard normal variable. Program Type$_{ji}$, equals 1 if program *i* is type *j* and equals 0 otherwise. The set of *j* program types includes multi-sellers, non-mortgage single-seller conduits, mortgage single-seller conduits, securities arbitrage programs, SIVs, CDOs, and other programs (the omitted category). Extendibility$_i$ equals 1 for programs that issue paper with the option of extending maturity at the issuer's request, and Rating$_{it}$ is an indicator variable that equals 1 for programs rated P2 or P3 by Moody's Investors Service (i.e., the two lowest prime short-term ratings). Sponsor Type$_{ki}$, equals 1 if program *i* is sponsored by an institution of type *k* and equals 0 otherwise. The set of *k* sponsors includes large U.S. banks (the omitted category), small U.S. banks, non-U.S. banks, and nonbanking institutions. All program-specific variables are allowed to vary by month, denoted by *m*. D_t denotes a weekly time dummy. Each column reports the marginal effects of a program-level variable for a given month in the sample. Standard errors clustered by program are reported in brackets.

Dependent variable: Probability of experiencing a run			
	Full sample period	Subperiods	
	August-December 2007	Subsample: August-September 2007	Subsample: October-December 2007
Panel A: Equation 1			
Fraction of issuance with maturity of less than 10 days by program type	0.001 [0.001]	0.001 [0.001]	0.001 [0.001]
Fraction of market-wide issuance with maturity of less than 10 days	0.005*** [0.002]	0.006** [0.002]	0.002 [0.002]
Observations	4734	2042	2692
Number of programs	303	291	295
Pseudo R2	0.217	0.186	0.220
Panel B: Equation 2			
Lagged fraction of outstandings in default of extension by program type	0.004*** [0.001]	0.009 [0.007]	0.003*** [0.001]
Lagged fraction of market-wide outstandings in default of extension	0.098*** [0.031]	0.130*** [0.029]	0.034 [0.086]
Observations	4425	1949	2476
Number of programs	288	282	272
Pseudo R2	0.183	0.157	0.186

Table reports marginal effects of a probit model. Robust standard errors in brackets.
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Regressions of risk spreads on overnight ABCP issues

This table reports the results of estimating equation (3) from the text using monthly panels of daily observations:

$$\text{Spread}_{it} = \alpha + \sum_j \beta_j \text{Program Type}_{ji} + \gamma \text{Extendibility}_i + \delta \text{Rating}_{it} + \sum_k \theta_k \text{Sponsor Type}_{ki} + \sum_t \tau_t \text{D}_t + \varepsilon_{it}.$$

The dependent variable, Spread_{it}, is the spread over the target federal funds rate paid by program *i* on day *t* to issue overnight paper. Program Type_{ji}, equals 1 if program *i* is type *j* and equals 0 otherwise. The set of *j* program types includes multi-sellers, non-mortgage single-seller conduits, mortgage single-seller conduits, securities arbitrage programs, SIVs, CDOs, and other programs (the omitted category). Extendibility_i equals 1 for programs that issue paper with the option of extending maturity at the issuer's request, and Rating_{it} is an indicator variable that equals 1 for programs rated P2 or P3 by Moody's Investors Service (i.e., the two lowest prime short-term ratings). Sponsor Type_{ki}, equals 1 if program *i* is sponsored by an institution of type *k* and equals 0 otherwise. The set of *k* sponsors includes large U.S. banks (the omitted category), small U.S. banks, non-U.S. banks, and nonbanking institutions. D_t denotes a daily time dummy. Standard errors clustered by program are reported in brackets.

Dependent variable: Overnight spread over fed funds target rate (percentage points)								
	Coefficient	June 2007	July 2007	August 2007	September 2007	October 2007	November 2007	December 2007
Program type	Multi seller	-0.014	0.001	-0.035	-0.130	-0.128**	-0.094**	-0.050
		[0.020]	[0.008]	[0.037]	[0.079]	[0.051]	[0.039]	[0.053]
	Non-mortgage single seller	-0.046	-0.033	-0.023	0.009	-0.040	-0.021	0.094
		[0.036]	[0.035]	[0.077]	[0.154]	[0.105]	[0.085]	[0.104]
	Mortgage single seller	0.012	0.027**	0.144**	0.344***	1.015***	1.219***	1.379***
		[0.024]	[0.012]	[0.069]	[0.112]	[0.129]	[0.076]	[0.033]
	Securities arbitrage	-0.013	0.005	-0.098	-0.097	-0.077	-0.040	0.062
		[0.021]	[0.009]	[0.071]	[0.126]	[0.083]	[0.070]	[0.107]
	Structured invest. vehicle	-0.017	0.004	-0.009	0.015	0.162	0.313***	0.227***
		[0.019]	[0.008]	[0.053]	[0.115]	[0.138]	[0.060]	[0.078]
	CDO	0.008	0.026***	-0.169***	0.118	0.585***	0.000	0.412***
		[0.022]	[0.010]	[0.042]	[0.138]	[0.047]	[0.000]	[0.037]
Contractual features	Extendibility	0.039***	0.054***	0.248***	0.364***	0.064	0.179	0.226
		[0.012]	[0.009]	[0.079]	[0.134]	[0.089]	[0.134]	[0.149]
	Rating	0.095***	0.086***	0.378***	0.355**	0.362**	0.286***	0.042
		[0.007]	[0.009]	[0.067]	[0.176]	[0.182]	[0.108]	[0.038]
Sponsor type	Small U.S. bank	0.046***	0.042***	0.355***	0.597***	0.411***	0.345***	0.439***
		[0.011]	[0.010]	[0.068]	[0.093]	[0.071]	[0.048]	[0.086]
	Non-U.S. bank	0.012*	0.008*	0.163***	0.209**	0.127*	0.095*	0.131
		[0.007]	[0.005]	[0.058]	[0.106]	[0.066]	[0.052]	[0.083]
	Nonbanking Institution	0.026***	0.022***	0.159***	0.252***	0.103**	0.131***	0.213***
		[0.008]	[0.006]	[0.047]	[0.078]	[0.044]	[0.039]	[0.056]
	Constant	0.010	0.004	0.544***	0.489***	0.164***	0.439***	0.230***
		[0.017]	[0.009]	[0.114]	[0.094]	[0.056]	[0.049]	[0.065]
	Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Observations	2208	2261	2429	1884	2025	1775	1110
	R-squared	0.053	0.354	0.427	0.294	0.432	0.508	0.386
	F test Time dummies = 0, p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1