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THE MARKET RISK PREMIUM FOR UNSECURED CONSUMER CREDIT RISK

Matthias Fleckenstein
Francis A. Longstaff

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ABSTRACT

We use the prices of credit card asset-backed securities to study the market risk premium associated with unsecured consumer credit risk. The consumer credit risk premium has historically been comparable to high yield corporate bond spreads, but has increased dramatically since the financial crisis. We find evidence that this increase is primarily due to balance-sheet costs imposed by recent changes in regulatory capital requirements which have effectively placed credit card securitizations back onto issuer balance sheets. These changes in capital regulation may have added hundreds of basis points to the cost of unsecured household credit.

Matthias Fleckenstein
University of Delaware
Lerner College of Business and Economics
310 Purnell Hall
Newark, DE 19716
mflecken@udel.edu

Francis A. Longstaff
UCLA
Anderson Graduate School of Management
110 Westwood Plaza, Box 951481
Los Angeles, CA 90095-1481
and NBER
francis.longstaff@anderson.ucla.edu

1. INTRODUCTION

Why is the cost of unsecured household borrowing so high? For example, the effective annual rate for consumer credit card debt—which represents one of the largest components of unsecured household debt—averaged nearly 20 percent over the past 20 years.[1] The widely-held industry view is that these high rates simply reflect the large potential credit losses associated with unsecured consumer credit. In reality, however, actual credit card charge-off rates averaged less than six percent over the same period. Thus, expected credit losses are unlikely to fully explain the high cost of unsecured consumer debt.

Could these high borrowing rates then be at least partially due to the presence of a large market risk premium for unsecured consumer credit risk? The challenge in answering this question is that relatively little is known about the size and nature of household credit risk premia. One reason for this is that consumer lending typically occurs in private transactions between households and financial institutions. Thus, market prices of consumer debt contracts are generally not directly observable in the secondary capital markets, making it difficult to measure how financial markets value unsecured consumer credit risk.

The key innovation of this paper is the use of market prices of credit card asset-backed securities (ABS) to measure the risk premium for unsecured consumer credit card risk. An important advantage of our approach is that the prices of credit card securitizations are determined purely by the actual credit risk of consumer cash flows faced by secondary market participants. This aspect allows us to directly identify the consumer credit risk premium.[2]

[1]The effective credit card APR (including both fees and card interest) averaged 19.37 percent from 2000–2020 (for the subset of issuers with available data). Recently, however, the effective APR has been increasing. For example, the effective APR averaged 20.82 percent in 2018, and 21.75 percent in 2019. For other examples of the high cost of unsecured household borrowing, see Morse (2011) and Melzer (2011).

[2]In contrast, non-price-based approaches such as attempting to infer the risk premium from the accounting margin between credit card and charge-off rates can confound the risk premium with other factors such as the economic rents earned by lenders or asymmetries in the bargaining power of consumers and lenders.

We find that the market incorporates a substantial risk premium into the prices of credit card ABS. In particular, the difference between the implied risk-neutral charge-off rate and the actual charge-off rate averages 522 basis points during the 2000–2020 sample period. This spread is almost the same as the spread on high yield corporate debt over the same period, with the unflattering implication that the market views the typical consumer credit card borrower as the equivalent of a "junk bond."

Perhaps the most striking result is that there appears to have been a major repricing of unsecured consumer credit risk beginning in 2010. The average consumer credit risk premium increased dramatically from values of about two to five percent during most of the 2000s, to more than ten percent during the past decade. Surprisingly, this dramatic increase in the consumer credit risk premium occurred as credit card charge-off rates actually declined significantly following the peak of the financial crisis.

What explains the large increase in the consumer credit risk premium since 2010? A strong possibility is the impact of major changes in the regulation of financial intermediaries following the financial crisis. Foremost among these was the requirement for issuers to reconsolidate credit card securitizations back onto their balance sheets at the beginning of 2010. Since most credit card issuers are large financial institutions subject to strict regulatory capital requirements, their securitizations now required regulatory capital. Upon reconsolidation, issuers' capital ratios declined significantly, which suggests that they faced tighter capital constraints and new costs for meeting regulatory requirements ("balance-sheet costs"). Two other major changes were the "skin-in-the-game" risk-retention requirement of the FDIC Securitization Safe Harbor Rule of 2010 and the Dodd-Frank Act which required issuers to retain a specific fraction of the credit risk of the assets underlying their securitizations.

To explore the relation between the consumer credit risk premium and the balance-sheet costs and capital constraints faced by financial intermediaries, we conduct a number of analyses. First, we rule out the possibility that the increase in the consumer credit risk premium simply reflects the pattern of credit spreads in other markets during the post-financial-crisis period. In particular, we find that while changes in the consumer credit risk premium are significantly related to changes in other credit spreads, they are also driven by additional factors that may be unique to the securitizated consumer credit markets.

Second, we find that the consumer credit risk premium is significantly higher at quarter-ends (when regulatory capital ratios are reported) relative to other months. This result is consistent with Du, Tepper, and Verdelhan (2018), Fleckenstein and Longstaff (2020a), and others, and provides evidence that intermediary balance-sheet effects play a role in the pricing of consumer credit risk.

Third, we use a panel regression framework to examine the relation between the consumer credit risk premium and the required risk-retention ratios for the pool of credit card receivables underlying the revolving master trusts of the individual issuers in the sample. We find that there is a strong positive relation between the consumer credit risk premium and the required risk-retention ratio. This provides additional evidence that the capital constraints faced by intermediaries impact asset prices. We also find that the consumer credit risk premium becomes much more sensitive to realized charge-off rates during the post-financial-crisis period. This is consistent with the increased incentives that recent capital regulation has created for intermediaries to manage their risk exposures more aggressively.

Fourth, we test whether the average consumer credit risk premium is related to exogenous measures of the costs of intermediary balance-sheet space and capital constraints. In particular, we examine the relation between the consumer credit risk premium and the He, Kelly, and Manela (2017) measure of intermediary leverage, the aggregate Tier 1 capital ratio for broker-dealers, and the Fleckenstein and Longstaff (2020a) turn-of-the-year measure of the cost of intermediary balance-sheet usage. Our results show that changes in the consumer credit risk premium are significantly related to changes in these measures of intermediary constraints. Furthermore, the consumer credit risk premium tends to increase as intermediary constraints tighten.

Finally, we make use of a natural experiment created by a major exogenous shock in the accounting/regulatory environment to study the relation between the consumer credit risk premium and intermediary constraints at a more fundamental causal level. As discussed earlier, financial intermediaries were required to reconsolidate their ABS back onto their balance sheets as of January 1, 2010 for both accounting and regulatory capital purposes. Since the credit card ABS issuers in the sample disclosed the financial impact of the reconsolidation event on their retained earnings and capital ratios, we can directly measure the marginal cost of adding an additional dollar of assets onto their balance sheet. Using this measure as an instrument for the relative intensity of balance-sheet usage across issuers, we estimate a panel regression and find that the consumer credit risk premium is directly related to the interaction between the amount of balance-sheet usage that securitization activity requires and the cost of balance-sheet usage.

In summary, these results have a number of important implications for the pricing of consumer credit risk. The results indicate that there is a substantial risk premium associated with unsecured consumer credit risk. This risk premium may represent a large component of the interest rate that consumers are charged on their credit card balances. Furthermore, this risk premium has increased significantly during the past decade even while credit card charge-off rates have

declined. The results suggest that much of this increase may be due to the additional balance-sheet costs and capital constraints that intermediaries now face in the post-financial-crisis period. In particular, recent capital regulation may have added hundreds of basis points to the overall cost of obtaining unsecured consumer credit in the credit card market. Finally, these results can provide useful historical perspective about the pricing of unsecured household credit risk.

2. RELATED LITERATURE

This paper is related to several important literatures. First, this paper contributes to the household finance literature on consumer payment behavior, credit risk, and borrowing costs. Important examples of this literature include Ausubel (1991), Livshits, MacGee, and Tertilt (2007, 2010, 2016), Elul, Souleles, Chomsisengphet, Glennon, and Hunt (2010), Vissing-Jorgensen (2016), and Keys and Wang (2019). Examples of papers that focus specifically on the cost and/or risk premia associated with secured household debt (mortgages, home equity loans, auto loans, 401(k) loans, etc.) include Schwartz and Torous (1989, 1992), Gabaix, Krishnamurthy, and Vigneron (2007), Li and Smith (2010), Mian and Sufi (2011, 2012), Abdallah and Lastrapes (2012), Beshears, Choi, Laibson, and Madrian (2012), Assuncao, Benmelech, and Silva (2014), Campbell and Cocco (2015), Corradin and Popov (2015), Chernov, Dunn, and Longstaff (2017), Diep, Eisfeldt, and Richardson (2020), and many others. Papers that focus on the costs of unsecured consumer credit (credit card debt, payday lending, personal lines of credit, etc.) include Agarwal, Skiba, and Tobacman (2009), Norden and Weber (2010), Morse (2011), Melzer (2011), Han and Li (2011), Alan and Loranth (2013), and Stango and Zinman (2016). We extend this literature by being the first to provide estimates of the risk premium associated with unsecured household borrowing.

Second, this paper is related to the rapidly-growing literature on intermediary asset pricing studying the impact of the frictions and constraints faced by intermediaries on the assets in which they make markets. Key examples of this literature include Chowdhry and Nanda (1998), Xiong (2001), Kyle and Xiong (2001), Gromb and Vayanos (2002), Krishnamurthy (2003, 2010), Brunnermeier and Pedersen (2009), Adrian and Shin (2010), Gârleanu and Pedersen (2011), He and Krishnamurthy (2012, 2013), Adrian, Etula, and Muir (2014), Kondor and Vayanos (2014), He, Kelly, and Manela (2017), Duffie (2018), and Andersen, Duffie, and Song (2019), Fleckenstein and Longstaff (2020a, 2020b), Lewis, Longstaff, and Petrasek (2020), and many others. We contribute to this literature by providing evidence that intermediary constraints impact the required premium for unsecured consumer credit risk in financial markets.

Third, this paper extends the literature on the role of securitization and the impact of changes in the regulatory and economic environment on financial markets and asset prices. Important examples of this literature include Calomiris and Mason (2004), Ayotte and Gaon (2011), Faltin-Traeger, Johnson, and Mayer (2011), Levitin (2013), Acharya, Schnabl, and Suarez (2013), Gennaioli, Shleifer, and Vishny (2013), Lemmon, Liu, Mao, and Nini (2014), Dou, Ryan, and Xie (2018), Tian and Zhang (2018), Furfine (2018), Flynn, Ghent, and Tchistyi (2019), and Daley, Green, and Vanasco (2020).

3. CREDIT CARD ASSET-BACKED SECURITIES

In this section, we begin with an overview of the credit card ABS market. We then describe some of the key characteristics and properties of credit card ABS. The Internet Appendix provides full details about the credit card ABS market.

3.1 The Credit Card ABS Market

The credit card ABS market started in the late 1980s and has since grown to become a major sector of the ABS market. As of year-end 2019, there was more than $127 billion in credit card ABS outstanding.

Credit cards are the primary source of revolving unsecured consumer credit. As of March 2020, there was over $1 trillion in revolving consumer credit outstanding, with credit card banks holding about 92% ($926 billion out of $1.01 trillion).[3] Credit cards are extensively used by consumers. The Federal Reserve reports in the Survey of Consumer Finances that about 70% of families had at least one credit card in 2013. In 2016, consumers made more than 34.3 billion transactions, amounting to a dollar volume of more than $3.1 trillion using general-purpose credit cards.[4]

The general-purpose credit card market in the U.S. is concentrated, with the top-ten issuers holding over 80% of the outstanding credit card balances, and the top-three issuers controlling more than 60% of the market. Cards issued on the Visa and Mastercard networks accounted for nearly 85% of about 544.5 million general-purpose credit cards in 2016. American Express and Discover accounted for another 99 million general-purpose cards in 2016.[5]

[3]Federal Reserve Board, G.19 Release on consumer credit at https://www.federalreserve.gov/releases/g19/Current.

[4]See, HSN Consultants, Inc. (2017), Nilson Report, no. 1104 (February).

[5]Board of Governors of the Federal Reserve System, Report to the Congress on

3.2 Securitizing Credit Card Receivables

The underlying collateral of a credit card ABS consists of receivables generated when consumers make charges on their credit cards to purchase goods and services. From the credit card issuer's perspective, credit card receivables are in effect short-term unsecured loans.[6] The issuer pools the receivables and transfers them to a separate entity (master trust), which issues series of notes to investors. The master trust receivables are not segregated by series. Instead, the pool of receivables supports all outstanding series.

To illustrate, an issuer would transfer say $1 billion of card receivables from one million accounts to a master trust, which then issues notes (certificates). The issuer can transfer additional receivables to the master trust as consumers pay off their card balances, and also issue additional series of securities. Each series has different "classes" that differ in their seniority of receiving cash flows. A typical series includes a senior A class, a mezzanine B class, and a junior C class. Each class (or tranche) has an attachment and a detachment point relative to the total credit card receivables balance. The attachment point represents the percentage of the receivables pool balance that can default before the tranche experiences first losses. The detachment point represents the level of credit card defaults that leads to total loss of the tranche.

The process by which cash flows are allocated to investors has two distinct periods: revolving, and controlled amortization (in some cases, controlled accumulation). If there are no losses, the two-period structure mimics a traditional bond in the sense that interest is distributed every month and principal is paid in a single "bullet" cash flow on the maturity date.

Specifically, upon issuance, a credit card ABS begins the "revolving period," during which investor coupon cash flows are paid from finance charge collections on the credit card accounts, and principal collections are used to purchase new receivables. Any residual cash flows after paying investor interest and write-offs is referred to as "excess spread" and, depending on the master trust, serves as credit enhancement or is released to the seller.

The revolving period continues for a predetermined length of time, and then the controlled amortization (accumulation) period begins where principal collections are distributed to investors. For instance, a credit card ABS with a five-year expected maturity might revolve for 48 months and then enter amortization for

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the Profitability of Credit Card Operations of Depository Institutions, June 2017.

[6]Consumers pay back either the full principal of this unsecured loan or make partial payment. In the latter case, the issuer finances the remaining balance and earns interest (finance charges).

the final 12 months. In the case of controlled amortization, principal cash flows are distributed in equal installments, for instance one-twelfth of the invested amount every month for twelve months. In the case of controlled accumulation, principal cash flows are deposited into a collection account (principal funding account) every month and then paid out as a single cash flow at the end of the accumulation period.

Sustained defaults or write-offs on the pool of credit card accounts trigger early amortization, independent of whether the credit card ABS is in the revolving period or in controlled amortization (accumulation). Typical early amortization trigger events include collateral performance deterioration (e.g. the three-month average excess spread falls below zero, or the collateral balance falls below the investor invested amount), seller/servicer problems (e.g. seller interest falls below the required minimum level, the seller fails to transfer new receivables into the trust when necessary), but also legal issues (e.g. breach of representation or warranties by the issuer, or default, bankruptcy, and insolvency of the seller or servicer).[7] Early amortization is in some sense similar to a default, and the credit card ABS immediately starts to amortize with principal balances being paid to investors according to their seniority.

4. THE DATA

We collect data for the credit card ABS of the ten largest U.S. credit card issuers from the Bloomberg system for the period from January 2000 to January 2020.[8] We also collect credit spreads and regulatory capital ratios for all issuers from the Bloomberg system and Capital IQ. Table A1 in the Internet Appendix describes

[7]The issuer must maintain an ownership interest in the trust (seller's interest). The minimum required seller's interest for most master trusts tends to be in the 4% to 7% range of outstanding receivables. If the seller's interest falls below this threshold, the seller must add receivables or early amortization is triggered. Since the minimum seller's interest is always at least as high as Dodd-Frank risk-retention requirements for the issuers in our sample, we use both terms interchangeably.

[8]We select these ten issuers for two primary reasons. First, these issuers hold 80% of the outstanding credit card balances (Board of Governors of the Federal Reserve System, Report to the Congress on the Profitability of Credit Card Operations of Depository Institutions, June 2017). Moreover, our data cover more than 80% of total U.S. credit charge card volume. Second, using these ten issuers, our data span two decades, allowing us to study the pricing of consumer credit both before and after the financial crisis.

the data, defines the variables, and lists all of the data sources.

Our sample consists of the credit card master trusts set up by American Express, Bank of America, Bank One, Citibank (Citi), J.P. Morgan Chase (Chase), Capital One, Discover Financial (Discover), First National Bank (First National), and World Financial Network/Alliance Data System (World Financial). Table A2 in the Internet Appendix lists the credit card master trusts for these ten issuers, along with their identifiers in the Bloomberg system.

For each master trust, we identify all credit card ABS series and classes in the Bloomberg system. Next, for each credit card ABS, we identify the issue date, the expected maturity date, the principal amount issued, whether the ABS pays fixed or floating coupon cash flows, and in the latter case the floating index (one-month or three-month Libor) plus the basis-point spread. In addition, we manually collect information from prospectus supplements about the required risk-retention by the seller (the minimum percentage of portfolio receivables the issuer is required to hold, or minimum seller's interest).[9] We also manually collect information on the subordination for each series and class by reading the prospectus documents for all master trusts which we obtain from the Bloomberg system or from regulatory filings with the SEC (Form 424-B).[10] For each credit card ABS, we collect the monthly payment rate, the portfolio yield, the charge-off rate, the excess-spread, as well as month-end prices from the Bloomberg system.

The monthly payment rate (MPR) measures the speed at which cardholders pay down the amount owed on their credit card balances and it is computed as the ratio of total cash flows into the trust each month divided by the portfolio receivables balance, expressed as a percentage. The portfolio yield is the annualized percentage gross return on the credit card receivables portfolio and it is calculated as the total monthly (gross) cash flows into the credit card master trust divided by the outstanding principal balance at the beginning of the month.[11] The charge-off rate measures the rate of default on the credit card receivables

[9]This information is unavailable from the prospectus supplements for Capital One. Similarly, this information is unavailable for Citibank prior to the second half of 2002.

[10]Specifically, for each series and each A, B, and C class, we identify the attachment and detachment points expressed in percent of the total series par amount at which the class experiences first losses or a complete loss, respectively.

[11]Gross cash inflows consist of interest on the revolving principal balances (finance charges) plus income from fees on the accounts such as late charges, card annual fees, cash advance fees, overdraft charges, and card interchange. Cash inflows include recoveries on defaulted receivables, but exclude charge-offs from the current month.

and it is calculated as the (one-month) annualized percentage rate of charge-offs on the portfolio. Credit card receivables are typically charged off after the cardholder has been delinquent in paying the revolving balance for more than 180 days.

Finally, the excess spread is the annualized percentage net return on the portfolio and it is calculated as the annualized rate of (gross) portfolio yield less servicing fees, coupon cash flows to noteholders, charge-offs, and any other trust expenses. Excess spread represents a source of credit enhancement for the notes. Intuitively, as long as the excess spread is positive, the securitization generates enough cash inflows to cover cash outflows. When the average excess spread is negative (typically calculated over a period of three months), many master trusts enter into early amortization.[12]

Table 1 presents summary statistics for the characteristics of the portfolios of credit card receivables underlying the securitizations for each of the ten issuers.[13] For all the issuers, our data cover both the pre-crisis and the post-crisis period, and for four issuers, our data cover a period of at last 15 years starting in 2000. Across all credit card issuers, average portfolio yields are significantly higher than the corresponding average charge-off rates which is reflected in high excess spreads. In fact, all issuers have average excess spreads of more than five percent over the 2000 to 2020 sample period. Nonetheless, there is cross-sectional variation in these averages. For instance, American Express has an excess spread of 12.317% compared to an average excess spread of 6.267% in the case of First National. Moreover, the data show heterogeneity in the average charge-off rates. American Express has an average charge-off rate of just over 4%, compared to an average charge-off rate of 7.178% in the case of World Financial.

Figure 1 plots the portfolio yield, excess spread, and charge-off rates. As shown, all three variables vary significantly over time. Portfolio yields and excess spreads decline substantially during the financial crisis, and charge-off rates take their highest values during that period. However, both portfolio yields and excess

[12]To illustrate how excess spread represents a source of credit enhancement, suppose a master trust generates a portfolio yield of 14.80% and experiences charge-offs of 5.50%. The trust has issued notes paying LIBOR floating each month. Assuming that the floating coupon rate equals 2.05% and that the master trust is paying a servicing fee of 2%, the excess spread is $14.80\% - 2.05\% - 2.00\% - 5.50\% = 5.25\%$. Intuitively, this means that the master trust generates about five cents for each dollar invested each month above what is required to pay investor coupon interest, servicing fees, and other trust expenses.

[13]The statistics for the individual issuers are computed by taking averages across all securitizations for each month, and then averaging the monthly averages.

spreads quickly recover from their precipitous declines after the financial crisis and charge-offs start to level off. Despite the wide range of variation, however, Figure 1 shows that the cross-sectional average excess spread is always positive, and despite the decline in the financial crisis, never drops below five percent. Moreover, while charge-offs peak during the financial crisis, the cross-sectional average tops out at around ten percent. In all, this suggests that credit card ABS were able to weather the storm from the financial crisis and portfolio yields and excess spreads quickly returned to pre-crisis levels.

Table 2 presents summary statistics for the individual A, B, and C tranches of the credit card securitizations in the sample. As shown, credit card ABS typically have maturities in the range of 2 to 4 years on average. In terms of credit support, the average attachment and detachment points of the individual tranches show that C classes absorb roughly the first 8 to 26 cents of losses (per dollar of notional amount of the ABS), whereas A classes can withstand portfolio write-offs between roughly 15 and 25 cents before experiencing first losses. Table 2 also shows that the average floating spread above Libor of the tranches varies with the credit risk of the tranches, with senior A tranches having lower spreads relative to B and C tranches of the same issuer.[14] That A classes are relatively well shielded against portfolio write-offs is also reflected in the prices of class A notes. As shown, average prices of class A notes are generally closer to par compared to the prices of class C notes. Nonetheless, the minimum and maximum prices suggest that there is substantial variation in the average prices of credit card ABS. For instance, the prices of class C notes decline to less than 50 cents per dollar of par amount during the sample period for seven of the ten issuers.

Figure 2 plots the prices for A, B, and C tranches. As shown, there is substantial time variation in the prices of A, B, and C tranches. Specifically, all prices decline precipitously during the financial crisis, but quickly rebound after the crisis. However, despite the turmoil during the crisis, the average prices of class A notes never drop to less than 80 cents per dollar of par amount. By contrast, the average prices of class C notes plummet to values close to only 50 cents per dollar of par value during the crisis.

[14]Many of the tranches in the sample pay fixed coupon rates rather than floating spreads over Libor. To put all of the tranches on a consistent basis in Table 2, we swap these fixed coupon rates into floating rate spreads using the approach described in the Internet Appendix.

5. THE MODEL

To model the consumer credit risk premium, we use a framework that parallels standard approaches for modeling corporate bond default risk. While triggering the early amortization of a credit card trust portfolio differs in some aspects from the default of a corporate bond, it can clearly be interpreted as the primary event initiating financial distress for credit card ABS. Most credit card securitizations include the provision that early amortization of the credit card master trust is triggered by the event of the excess spread becoming negative. Intuitively, this follows since the excess spread only becomes negative when the underlying portfolio of credit card receivables experiences disastrously high levels of charge-offs or defaults by cardholders.

Accordingly, the model assumes that a credit card trust is able to make all promised payments to credit card ABS investors as long as the excess spread is positive. As soon as the excess spread makes a first passage to zero, however, the credit card trust suffers an early amortization distress event, and the underlying pool of receivables may experience significant principal losses. This specification parallels that used in the structural corporate bond credit modeling literature in which corporate financial distress is triggered by the value of a firm's assets making a first passage to some critical threshold (see Black and Cox (1976), Longstaff and Schwartz (1995), Collin-Dufresne and Goldstein (2001), and others.) As in standard reduced form corporate credit models, we assume that the credit losses suffered by the portfolio upon early amortization are specified exogenously (see Jarrow and Turnbull (1995), Duffie and Singleton (1999), Duffee (1999), and others). Rather than assuming a specific "loss given default", however, we follow the CDO modeling literature by allowing for a discrete distribution of losses when early amortization is triggered (see Longstaff and Rajan (2008), Bhansali, Gingrich, and Longstaff (2008), and others).

Let ρ denote the charge-off rate on the underlying portfolio of credit card receivables. Since ρ represents the probability that any individual account defaults and cannot pay, the probability ρ may differ under the risk-neutral and objective measures. We denote the risk-neutral and objective charge-off probabilities by ρ_Q and ρ_P, respectively.

The excess spread for the underlying portfolio equals the yield on the portfolio minus debt servicing costs, servicing fees, and portfolio charge-offs. Let X denote the risk-neutral excess spread (given by subtracting off the risk-neutral charge-off rate ρ_Q rather than ρ_P). We assume that the excess spread X has the following dynamics under the risk-neutral measure

$$dX = (\alpha - \beta X)dt + \sigma dZ, \tag{1}$$

where dZ denotes the increment of a standard Brownian motion and α, β, and σ are constants. Consistent with the properties of excess spreads, these dynamics allow X to take both positive and negative values.

We consider the standard case in which a credit card master trust has securitized a common pool of credit card receivables by issuing separate A, B, and C tranches, each of which is collateralized by the receivables pool. Let N denote the percentage detachment point of the C tranche (the most-junior tranche), and $N + M$ the percentage detachment point of the B tranche (the next most-junior tranche). Also, denote the expected maturity date of the credit card securitization by T. Let F denote the risk-neutral probability that X makes a first passage to zero by time T. If a first passage does not occur by time T, portfolio losses are zero. If a first passage does occur, however, we assume that there are three different possible outcomes for the total credit losses on the underlying portfolio. Specifically, we assume that conditional on a first passage, the loss is N percent with probability c/F, $N + M$ percent with probability b/F, and 100 percent with probability a/F. Conditional on the value of X, this specification implies that there are four possible outcomes for losses on the portfolio. In particular, the portfolio loss is zero with probability $1 - F$, N percent with probability c, $N + M$ percent with probability b, and 100 percent with probability a. Since the probabilities must sum to one, $F = a + b + c$.

Given this modeling framework, identifying the consumer credit risk premium reduces to a process of solving for the probabilities a, b, and c, determining the risk-neutral first passage probability F, and then solving for the implied risk-neutral excess spread X. First, we solve for the present values of the losses impounded into the market prices of the individual tranches of a credit card securitization. This is done by taking the difference between the hypothetical prices of the tranches in the absence of credit risk—given by discounting promised tranche cash flows using riskless Treasury rates—and the actual market price of the tranches. Second, given these present values, we solve for the implied risk-neutral probability of the excess spread making a first passage to zero during the life of the tranches. Third, given the stochastic model of the dynamics of the excess spread, we invert this probability and solve for the implied risk-neutral portfolio charge-off rate. Finally, the risk premium is given by taking the difference between the risk-neutral charge-off rate and the actual charge-off rate observed for the portfolio.[15] The Internet Appendix provides full details on the

[15]This approach to estimating the consumer credit risk premium parallels that used in Chernov, Dunn, and Longstaff (2017) in which the prepayment risk pre-

model and the estimation methodology.

6. THE CONSUMER CREDIT RISK PREMIUM

Table 3 provides summary statistics for the estimated consumer credit risk premia. As shown, the average values of the risk premia are positive across all of the issuers. The average values range from 2.85% for Citibank to 10.95% for World Financial Network. Taken over all observations, the average value of the risk premium is 5.22%, the median value is 4.13%, and the standard deviation is 4.48%.

The top panel of Figure 3 plots the overall average values of the risk premium throughout the 2000–2020 sample period. As shown, there are a number of interesting patterns and trends in the average risk premia. For example, Figure 3 shows that the average risk premia vary significantly over time with values ranging from about two or three percent during the early 2000s to roughly 15 percent toward the end of the sample period.[16]

Figure 3 also indicates that there have been significant shifts in how the market prices consumer credit risk over time. Perhaps the most striking aspect of the time series of the premium is that there appears to have been a major regime shift in the pricing of consumer credit risk beginning in 2010.

As another way of illustrating the dramatic repricing of consumer credit risk, the lower panel of Figure 3 plots the ratio of the implied or risk-neutral charge-off rate to the actual observable charge-off rate, ρ_Q/ρ_P. This ratio provides a useful metric for how the market views consumer credit risk under the pricing (or Q) measure relative to the objective (or P) measure. Figure 3 shows that this ratio is consistently around 1.50 during the early 2000s. Beginning in 2010, however, the ratio increases rapidly, reaching values of about six by the end of the sample period. To put these values into perspective relative to those from other credit markets, we observe that Giesecke, Longstaff, Schaefer, and Strebulaev (2011) find that the ratio of the risk-neutral to objective credit spread for U.S. corporate bonds averages 2.09 during their 1866–2008 sample period.

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mium is identified by taking the difference between the risk-neutral prepayment rate implied from the prices of mortgage-backed securities and actual prepayment rates observed in the market.

[16]The small gap in the time series arises since there are almost no tranches during this time period that meet the maturity criteria our estimation algorithm requires.

To provide further perspective, Figure 4 plots the consumer credit risk premia along with the credit spread for high yield corporate bonds. As shown, the consumer credit risk premium is on the same order of magnitude as the spread on high yield corporate bonds. For example, the average value of the consumer credit risk premium during the sample period is 522 basis points, while the average value of the high yield spread over the same period is 548 basis points.

There is an extensive literature documenting that risk premia in credit markets increased significantly during the financial crisis of 2008. Furthermore, spreads in many sectors of the credit market remained at elevated levels for an extended period thereafter. Key examples include Bao, Pan, and Wang (2009) Beber, Brandt, and Kavaczek (2001), Gilchrist and Zakrajsek (2012), Schwarz (2019), and others. These patterns raise the question of whether the repricing of consumer credit risk beginning in 2010 could be at least partially due to the general widening of all credit spreads during the post-financial-crisis period.

To explore this possibility, we regress monthly changes in the consumer credit risk premium on changes in a number of corporate credit spreads. If the consumer credit risk premium is driven by the same factors driving other credit spreads, there should be no residual trend during the post-crisis period after controlling for the changes in the other credit spreads. Because the regression is estimated in changes, a residual upwards trend would translate into a significant positive intercept during the post-crisis period. To test this, we allow the regression intercept to differ between the 2000–2006 pre-crisis period and the 2007–2020 post-crisis period. To control for potential time series properties in the dependent variable, we also include its lagged change as explanatory variable in the regression. Table 4 presents the results from the regression.

As shown, changes in the consumer credit risk premium are directly related to changes in all of the corporate credit spreads. For example, the first lagged change in the Aaa, Baa, and high yield spreads are positive and significant. This indicates that the consumer credit risk premium has properties in common with corporate credit spreads, consistent with a scenario in which the risk premium and credit spreads are driven by similar underlying factors.

The results also suggest, however, that changes in corporate credit spreads do not fully account for the upwards trend in the consumer credit risk premium during the post-crisis period. In particular, the intercept is not significantly different from zero during the pre-crisis period, but has a much larger positive value and is statistically significant during the post-crisis period. Thus, even after controlling for changes in the other credit spreads, there is a significant upwards trend in the consumer credit risk premium during the post-crisis period. This suggests that changes in the consumer credit risk premium may also be driven by factors that are unique to this market and not shared by other credit spreads

during the post-crisis period.

7. REGULATORY CHANGES IN THE ABS MARKETS

The results in the previous section immediately raise the fundamental issue: What is the reason for the dramatic repricing of consumer credit risk beginning in 2010? In this section, we review some of the major recent changes in the regulatory environment impacting the credit card ABS markets. The credit card industry experienced many regulatory changes during the sample period, including new consumer protection laws (Card Act), changes in accounting rules for credit card ABS (FAS 166/167) and new capital requirements from the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) and the Basel Capital Accords.[17] These post-crisis regulatory reforms have fundamentally changed the economics of asset-backed securitizations and made the process of securitizing assets much more capital-intensive by turning securitization from a low-capital-usage, off-balance-sheet activity into one that consumes scarce balance-sheet space.[18]

7.1 FAS 166/167

In June 2009, the Financial Accounting Standards Board (FASB) issued FAS 166 and 167 to become effective on January 1, 2010.[19] The effect of FAS 166 and 167 was to narrow significantly the scope of transactions that qualified as off-balance-sheet for accounting purposes. In short, FAS 166/167 essentially meant that credit card ABS that were off-balance-sheet for accounting purposes had to be reconsolidated on the balance sheets of credit card issuers.[20] As a result

[17]For instance, the 2009 Card Act (H.R.627, 111th Congress) institutes a number of consumer protection and disclosure requirements for consumer credit cards. It sets regulatory limits on certain types of credit card fees, prohibits issuers from increasing the interest rate on outstanding balances without advance written notice, and restricts over-limit and late fees.

[18]Credit card banks also face indirect costs because post-crisis regulatory reforms from the Dodd-Frank Act and Basel III impose restrictions on institutional investors to hold ABS and also tighten oversight and rating criteria from credit rating agencies.

[19]Financial Accounting Standards No. 166, Accounting for Transfers of Financial Assets – An Amendment of FASB Statement No. 140, and FASB Statement No. 167, Amendments to FASB Interpretation No. 46(R).

[20]Source: https://www.fasb.org/cs/ContentServer?c=FASBContent_C&cid=11-

of FAS 166/167, U.S. banks reconsolidated $321.9 billion securitized credit card receivables in the first quarter of 2010.

The reconsolidation of credit card ABS onto issuer balance sheets was also accompanied by a dramatic reduction in securitization activity. Credit card ABS issuance declined by 92% from $40 billion in 2009 to $3.3 billion in 2010 and has remained at much lower levels during the past decade.[21] One reason for this may be that as on-balance-sheet assets, credit card ABS are subject to regulatory capital requirements.[22] As a result of FAS 166/167, credit card ABS previously held off-balance-sheet now occupy "expensive real estate" on credit card banks' balance sheets.[23]

7.2 FDIC Securitization Safe Harbor Rule

The Federal Deposit Insurance Corporation (FDIC) safe harbor rule enacted in 2000 provided bankruptcy remoteness for assets transferred into securitizations, which meant that the FDIC, as receiver or conservator of a failed bank, could not repudiate contracts, or recover or reclaim financial assets transferred in connection with securitization transactions when these assets were off-balance-sheet for accounting purposes. As a result of FAS 166/167, credit card securitizations became on-balance-sheet assets which meant bankruptcy remoteness would no longer apply to credit card ABS, and that the FDIC would have the authority to reclaim any financial assets from the credit card master trust in bankruptcy proceedings against the credit card bank. Moreover, with the bankruptcy remoteness offered by safe harbor protection, credit card ABS could receive higher credit ratings than the credit card bank originating the receivables. Thus, the loss of bankruptcy remoteness implied that securitizing credit card receivables would become substantially more costly for credit card banks, not least because investors and credit rating agencies would require additional credit enhancement on credit card ABS.

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[21]Source: https://www.federalreserve.gov/releases/h8/h8notes.htm#notes_20110429.

[22]12 CFR Part 567 at https://www.govinfo.gov/content/pkg/FR-2009-09-15/pdf/E9-21497.pdf.

[23]Given the significant economic impact on banks regulatory capital, regulators gave credit card banks the option to delay including consolidated credit card ABS in their risk-based capital ratios for two quarters, followed by an optional additional two-quarter partial implementation of FAS 167. See http://www.federalreserve.gov/newsevents/press/bcreg/20100121a.htm.

In 2010, the FDIC amended the safe harbor rule, but specified that safe harbor would be extended to consolidated securitization transactions only under a strict set of conditions.[24] Specifically, securitizations must comply with new risk-retention rules (the issuer is required to retain an unhedged minimum of 5% of the securitized assets), increased disclosure and reporting requirements, and securitizations must qualify for off-balance-sheet treatment under generally accepted accounting principles (GAAP). The net effect is that securitizing credit card receivables became more costly for credit card banks, because safe harbor protection now required stricter disclosure, reporting and risk-retention requirements.

7.3 The Dodd-Frank Act and Basel III

The Dodd-Frank Act was enacted in 2010 and significantly increased the regulation of credit card securitizations.[25] The Dodd-Frank Act requires securitizers or originators of credit card ABS to retain at least 5% of the credit risk of securitized exposures.[26] The Dodd-Frank Act restricts the interchange fees on credit card transactions, imposes stricter disclosure requirements regarding credit card receivables, and tightens credit rating standards from rating agencies. The Dodd-Frank Act also established the Consumer Financial Protection Bureau (CFPB) to regulate the terms of credit card agreements. In addition, the Dodd-Frank Act increases capital requirements on banks, and contains multiple provisions for mandatory risk-based capital requirements that apply to consolidated on-balance-sheet assets. Specifically, the Dodd-Frank Act increases the minimum required ratio of common equity to risk-weighted assets to 4.5% and introduces mandatory capital buffers which, taken together, imply a (risk-based) leverage ratio requirement of at least 7% for many large banks. The Collins Amendment to the Dodd-Frank Act makes bank holding companies (BHCs) subject to the same rules that apply to depository institutions, and effectively raises risk-weighted asset requirements for many banks and BHCs since it limits the use of internal models in reporting regulatory capital ("Collins Floor"). As a result, subordinate ABS tranches in particular now have significantly higher risk weights than in the pre-crisis period.

[24] See, Securitization Safe Harbor Rule, 12 C.F.R. § 360.6.

[25] H.R. 4173: Dodd-Frank Wall Street Reform and Consumer Protection Act, available at https://www.cftc.gov/idc/groups/public/@swaps/documents/file/hr4173_enrolledbill.pdf.

[26] See Section 941 of the Dodd-Frank Act, https://www.federalreserve.gov/newsevents/pressreleases/bcreg20110331a.htm. Risk-retention requirements were finalized in 2014 (Regulation RR, Federal Register, 79 Fed. Reg. 77601).

The Basel III framework, introduced by the Basel Committee in December 2010, redefined regulatory capital, established a global leverage ratio, and increased banks' required risk-weighted capital ratios. In addition to tightening equity and risk-weighted capital requirements, the Basel III standard introduced a non-risk-weighted leverage ratio requirement (supplementary leverage ratio (SLR)), as well as liquidity and funding requirements (liquidity coverage ratio (LCR) and net stable funding ratio (NSFR)). The net effect of the regulations from the Dodd-Frank Act and Basel III is to raise the costs of securitizing credit card receivables, since credit card banks are required to hold regulatory capital against credit card ABS assets.

8. BALANCE-SHEET COSTS AND CAPITAL REGULATION

As discussed earlier, there is an extensive literature on the relation between security pricing and the balance-sheet costs and capital constraints faced by financial intermediaries. In this section, we examine whether the dramatic increase in the consumer credit risk premium during the post-crisis period may be partially attributable to the increased balance-sheet costs imposed on financial intermediaries by the recent changes in the regulatory environment.

8.1 Quarter-End Effects

In their analysis of the covered interest rate parity (CIP) relation, Du, Tepper, and Verdelhan (2018) provide striking "smoking gun" evidence of the link between CIP violations and intermediary balance-sheet usage. Specifically, they show that the magnitude of the mispricing during the post-crisis period is directly related to the proximity to the end of a quarter (as intermediaries file quarter-end financial reports and disclose their regulatory capital positions). Following Du, Tepper, and Verdelhan (2018), Fleckenstein and Longstaff (2020b), and others, we also test whether there is a quarter-end effect in the consumer credit risk premium. In doing this, we use a panel regression framework in which we regress the consumer credit risk premium on a quarter-end dummy variable that takes value one for the months of March, June, September, and December, and zero otherwise. We also include a year-end dummy variable that takes value one for the month of December, and zero otherwise. We include annual fixed effects as control variables in the panel regression. Table 5 reports the regression results.

The results show that the level of the consumer credit risk premium is significantly higher at quarter-end than at the end of other months. In particular, Table 5 indicates that after controlling for the annual fixed effects, the consumer credit risk premium is about 33 basis points higher at quarter-end than at the end of other months. This difference is highly statistically significant and is on

the same order of magnitude as that documented by Du, Tepper, and Verdelhan (2018) during the post-crisis period. These results complement those of Du, Tepper, and Verdelhan (2018) and provide direct evidence of a link between the consumer credit risk premium and the costs faced by financial intermediaries in using their balance sheets.

8.2 Risk-Retention Requirements

Comparing Figures 1 and 3 shows that the dramatic repricing of consumer credit risk beginning in 2010 follows immediately in the wake of the historically high levels of credit card charge-offs experienced during the financial crisis. While this observation is clearly only anecdotal, it raises the possibility that the higher level of charge-offs during the recession following the financial crisis may have led market participants to revise prior beliefs about the risk of unsecured consumer credit in bad states of the world. There is an extensive literature on the role of learning in credit and other financial markets. Important examples include Routledge (1999), Pastor and Veronesi (2009), Khandani, Kim, and Lo (2010), Elul, Souleles, Chomsisengphet, Glennon, and Hunt (2010), Kuhnen (2015), An and Cordell (2017), Sirignano, Sadhwani, and Giesecke (2017), Fuster, Goldsmith-Pinkham, Ramadorai, and Walther (2018), and many others.

The "wake-up call" from the financial crisis about the risks of unsecured consumer credit could potentially have important implications for consumer credit card risk premia, particularly given a regulatory environment much more focused on asset risk and capital adequacy. This is especially true in light of the risk-retention and risk capital requirements for securitizations enacted as part of the Dodd-Frank reforms of 2010 and FAS 166/167.

To explore these possibilities, we again use a panel regression approach. Specifically, we regress the consumer credit risk premium on the realized charge-off rates for the underlying credit card receivables portfolios as well as the percentage risk-retention requirement for the issuer. An advantage of this approach is that it allows us to identify the relation between the risk premia, consumer credit risk, and the risk-retention requirements from both the variation across securitizations by different issuers, as well as from the time series variation in these measures. As a control, we include annual fixed effects in the panel regression. We estimate the panel regression for the entire sample period as well as for the pre-crisis and post-crisis periods. Table 6 presents the results.

The results in Table 6 provide strong support for the hypothesis that post-financial-crisis regulation imposed significant balance-sheet and capital costs on intermediaries holding risky positions in consumer credit. In particular, the results show that there is not a significant relation between the consumer credit risk premium and either the charge-off rate or the risk-retention requirement during

the pre-crisis period. In contrast, there is a strongly positive relation between both variables and the risk premium during the post-crisis period. The coefficient for the charge-off rate during the post-crisis period is positive and significant (t-statistic 2.33). Similarly, the coefficient for the risk-retention requirement during the post-crisis period is positive and highly significant (t-statistic 3.42). An important implication of these results is that the dramatic repricing of consumer credit risk beginning in 2010 may be partially due to both a greater focus on the amount of potential risk and major increases in the costs faced by intermediaries in holding these risky asset on their balance sheets.

8.3 Capital Regulation and Balance-Sheet Costs

As another way of exploring the relation between the consumer credit risk premium and the balance-sheet costs and capital constraints faced by intermediaries, we examine whether changes in the risk premium are correlated with changes in exogenous measures of these costs and constraints. In this subsection, we focus specifically on the time series of the average consumer credit risk premium taken across all issuers in the sample.

As measures of the constraints faced by intermediaries, we follow Adrian, Etula, and Muir (2014), He, Kelly, and Manela (2017), Fleckenstein and Longstaff (2020a), and others in using several aggregate leverage and regulatory capital ratios. In doing this, we focus on ratios that play central roles not only in the current regulatory environment, but also in the early 2000s when Basel I/II and regulation by the FDIC were the primary capital adequacy standards faced by intermediaries. This set of ratios should measure the impact of regulation on intermediaries more consistently throughout the entire sample than measures enacted after the financial crisis such as the SLR and the LCR.

As the first measure, we use the intermediary leverage ratio provided by He, Kelly, and Manela (2017) as a proxy for the funding constraints faced by intermediaries. As the second measure, we follow Fleckenstein and Longstaff (2020a) in using the aggregate Tier 1 Capital Ratio for broker-dealers in the financial markets. The Tier 1 Capital Ratio is defined as total Tier 1 capital as a percentage of total risk-weighted assets and has been a key component of capital regulation starting with the Basel I framework and the Federal Deposit Insurance Corporation Improvement Act (FDICIA) in the early 1990s. The aggregate Tier 1 Capital Ratio is a quarterly average over all broker-dealers and is based on the Z.1 flow of funds data from the Federal Reserve. We acknowledge that in using these ratios, we are relying on the assumption that changes in these ratios reflect changes in either required leverage or capital. This assumption, however, seems plausible since financial intermediaries have strong incentives to leverage their balance sheets. Thus, decreases in leverage or increases in capital ratios are likely driven by tighter regulatory capital requirements. The tighter the requirements,

the higher is the potential cost of capital regulation to intermediaries in using their balance sheets. If the consumer credit risk premium is related to intermediary capital regulation costs, then there should be a positive relation between changes in the premium and changes in the Tier 1 capital ratio, and a negative relation between changes in the premium and changes in intermediary leverage.

As a measure of the costs incurred by financial intermediaries in placing assets on their balance sheets, we follow Du, Tepper, and Verdhelhan (2017), Andersen, Duffie, and Song (2019), Fleckenstein and Longstaff (2020a), and others in using spreads observed in the market that proxy for the shadow costs of renting intermediary balance-sheet space. In particular, we use the turn-of-the-year premium in Eurodollar futures prices used in Fleckenstein and Longstaff (2020a). Eurodollar futures are contracts that settle based on the value of the three-month Libor rate at their expiration date. This means that contracts with December expirations are based on the rate for Libor loans that remain on the balance sheet at year end, while the contracts with March, June, and September expirations are not. Musto (1997), Griffiths and Winters (2005), and others show that financing rates such as three-month Libor tend to spike near the end of a year as financial institutions face additional balance-sheet-related pressure to hold cash. Thus, the size of the expected spike in year-end Libor provides a measure of the balance-sheet usage costs financial institutions face. Fleckenstein and Longstaff (2020a) identify the size of the expected spike as the difference between the futures price for a December contract and the average of the futures prices for the contracts expiring three months earlier/later (September/March). Intuitively, the turn-of-the-year premium represents the incremental cost of balance-sheet usage at year end relative to other months. Changes in these incremental costs, however, should be reflective of variation in the tightness of the balance-sheet constraints facing financial intermediaries.

Table 7 reports the results from regressing monthly changes in the average consumer credit risk premium on changes in the leverage and capital ratios as well as changes in the turn-of-the-year premium. We also include the lagged change of the risk premium in the regression as a control for the time series properties of the dependent variable.

The results also provide strong support for the hypothesis that the consumer credit risk premium is related to the balance-sheet and capital regulation costs faced by financial intermediaries. First, Table 7 shows that changes in both the broker-dealer Tier 1 capital ratio and the intermediary leverage ratio are significantly related to changes in the risk premium. In particular, changes in the Tier 1 capital ratio are positively related to changes in the risk premium and are highly significant (t-statistic 3.93). Changes in the intermediary leverage ratio are negatively related to changes in the risk premium and are also highly

significant (t-statistic -3.04). The signs of these coefficients are both consistent with the hypothesis that the consumer credit risk premium increases as financial intermediaries become more constrained.

Table 7 also shows that there is a strong relation between the risk premium and the turn-of-the-year measure of balance-sheet usage costs. The change in the turn-of-the-year premium is significantly positively related to changes in the risk premium (t-statistic 2.72). This result is very intuitive, suggesting that the average consumer credit risk premium increases precisely when participants in other important financial markets view that the cost of holding positions on their balance sheet has increased.

In summary, these results strongly suggest that intermediary balance-sheet constraints may be an important determinant of the consumer credit risk premium. If so, then increases in intermediary balance-sheet costs resulting from the extensive changes in capital regulation and other requirements during the post-crisis period could play an important role in explaining the dramatic increase in the risk premium during the latter part of the sample period. It is important to acknowledge, however, that these regression results simply document correlations between the variables, and should not be interpreted as providing direct causal evidence. We will address this issue more directly in the next subsection.

8.4 The 2010 Reconsolidation Event: A Natural Experiment

To explore the relation between the risk premium and intermediary balance-sheet costs at a more fundamental causal level, we use the mandatory reconsolidation of credit card master trusts back onto issuer balance sheets that occurred on January 1, 2010 as an exogenous identification vehicle. This reconsolidation event provides us with a natural experiment in which we can measure the impact on each issuer of placing a dollar of securitized consumer credit on its balance sheet.

8.4.1 Intermediary balance-sheet costs

Intermediary asset pricing theory suggests that the costs incurred by intermediaries in placing assets on their balance sheet depend on at least three factors. First, these costs are impacted by how binding the capital constraints faced by the intermediary are. Second, the costs also depend on the marginal cost to the intermediary of obtaining additional capital. Third, the costs should also depend on how much capital the acquisition of an asset requires. The first two of these are key elements of models such as Brunnermeier and Pedersen (2009) and are often expressed in terms of margins/haircuts and other types of leverage and capital constraints as well as the cost of unsecured debt or equity. The third plays a central role in models such as the debt-overhang model of Andersen, Duffie,

and Song (2019) in which the cost of acquiring an asset may exceed the value of the asset to an intermediary's current shareholders. Thus, the acquisition of some assets may have the effect of reducing an intermediary's regulatory capital. We designate this third factor as "capital intensity" since it reflects the direct impact on an intermediary's available capital resulting from placing assets on its balance sheet.

8.4.2 Measuring capital intensity

The implementation of FAS 166/167 required intermediaries to reconsolidate many of their securitizations back onto their balance sheets on January 1, 2010. Typically, the decision by an intermediary to acquire assets and place them on its balance sheet is an endogenous one. In contrast, the reconsolidation of credit card securitizations onto issuer balance sheets was a mandatory exogenous event. An important implication of this is that we can use the resulting impact on the issuer's capital as an exogenous instrument to measure capital intensity.

The reconsolidation event resulted in a major revision to the financial statements of all the issuers in the sample and is discussed in detail in their financial disclosures. Table 8 summarizes the impact of reconsolidation on the total assets, liabilities, loan loss reserves, retained earnings, and Tier 1 capital ratios for each of the issuers in the sample. As shown, the reconsolidation resulted in major changes in the capitalization of the issuers. For example, in the case of Citibank, the reconsolidation resulted in an increase in total assets of $ 137.0 billion, an increase in total liabilities of $ 146.0 billion, an increase in the loan loss reserve of $ 13.4 billion, a decrease in retained earnings of $ 8.4 billion, and a decline in the Tier 1 capital ratio of 1.38%. Changes of the magnitude shown in Table 8 clearly had first-order effects on the balance sheets and regulatory capital ratios of the issuers in the sample.

To measure the capital intensity of the individual issuers in placing securitized assets on their balance sheet, we take the ratio of the January 1, 2010 change in the issuer's retained earnings to the total dollar amount of assets reconsolidated. As shown in Table 8, this ratio ranges from a low of 5.13% for Bank One and Chase to a high of 12.21% for First National. We emphasize that it is the natural experiment provided by the reconsolidation of asset-backed securitizations onto issuer balance sheets that allows us to identify the capital intensity of these transactions from the perspective of the individual issuers.

8.4.3 The panel regression

In the absence of frictions, we would not expect a "technical" accounting change of the type mandated by FAS 166/167 to have fundamental economic effects on financial intermediaries or security prices. When intermediaries face frictions

and binding constraints, however, this may no longer be true. The rapidly-growing literature on intermediary asset pricing suggests that balance-sheet costs resulting from funding frictions and regulatory capital constraints can have major effects on the pricing of securities in which these intermediaries make markets. This implies that the 2010 rule change requiring asset-backed securitizations to be consolidated onto issuers' balance sheets could affect pricing if the change tightened intermediary constraints and increased their balance-sheet costs. In particular, if credit card securitizations are now capital intensive events in the sense that the issuer needs to raise additional capital just to maintain its current regulatory capital ratios, and if the issuer also faces frictions, constraints, and additional costs in raising capital, then this may impact the observed consumer credit risk premium. It is important to note that the impact occurs through the interaction between the capital constraints and costs faced by the intermediary and the capital intensity of the securitization.

In light of this, we estimate a panel regression specification for the consumer credit risk premium in which the interactions between capital constraints, capital costs, and capital intensity play the central role. In taking the model to the data, however, we first need to map issuer observables into model parameters.

First, we interpret the capital ratio for an issuer as playing a similar role as margins and haircuts in models such as Brunnermeier and Pedersen (2009), Gârleanu and Pedersen (2011), and others. This is intuitive since both margins and regulatory capital constraints have the net effect of prohibiting intermediaries from financing assets entirely with debt. To illustrate, an 8% Tier 1 capital requirement can be broadly interpreted as playing a similar role to imposing an 8% margin requirement on an intermediary. Thus, the issuer's capital ratio can be viewed as economically equivalent to the margin constraint in models such as Brunnermeier and Pedersen (2009). Second, the cost of raising additional capital can be proxied in a number of ways. A standard approach in the empirical literature is to use the CDS spread or credit spread of the issuer as a proxy for its cost of unsecured debt. We note that this cost plays a central role in models such as Brunnermeier and Pedersen (2009) and Andersen, Duffie, and Song (2019).

To examine the relation between the consumer credit risk premium and the balance-sheet costs faced by intermediaries, we estimate the following panel regression specification,

$$\begin{aligned} \text{Prem}_{it} = \ & \textstyle\sum_{j=1}^{N} \alpha_j \, I_{jt} \ + \ \beta_1 \, \text{Ratio}_{it} \times \text{Intensity}_i \\ & + \ \beta_2 \, \text{Spread}_{it} \times \text{Intensity}_i + \ \epsilon_{it}, \end{aligned} \tag{1}$$

where α and β are regression coefficients, I_{jt} are annual fixed effects dummy variables, and where Ratio, Spread, and Intensity denote the issuer's capital ratio, the issuer's credit spread, and the issuer's capital intensity measure for asset-backed securitizations. Table 9 reports the regression results.

The results provide strong support for the hypothesis that the consumer credit risk premium is directly related to intermediary balance-sheet costs. In particular, both the interaction term between the capital ratio and the intensity measure, and between the credit spread and the intensity measure, are positive and significant in the regression. This implies that the dramatic increase in the risk premium during the 2010–2020 period could be at least partially due to corresponding increases in intermediary balance-sheet costs associated with extensive new capital regulation. While the two interaction terms are significant during both the pre-consolidation and post-consolidation periods, we note that the magnitude of their regression coefficients is much higher during the latter period. This is consistent with the increase in the consumer credit risk premium resulting from both increasing balance-sheet costs and greater sensitivity to these costs.

The earlier results in Table 6 suggested that the consumer credit risk premium became more sensitive to charge-off risk, and that risk-retention rules may have played a larger role during the post-crisis period. As an alternative specification, we incorporate the charge-off rate and the risk-retention ratio into the panel regression,

$$\begin{aligned} \text{Prem}_{it} = \ & \textstyle\sum_{j=1}^{N} \alpha_j \, I_{jt} \ + \ \beta_1 \, \text{Chargeoff}_{it} \ + \ \beta_2 \, \text{Retention Ratio}_{it} \\ & + \ \beta_3 \, \text{Ratio}_{it} \times \text{Intensity}_i + \ \beta_4 \, \text{Spread}_{it} \times \text{Intensity}_i + \ \epsilon_{it}. \end{aligned} \tag{2}$$

Table 10 reports the results from this alternative specification.

As shown, the results are similar to those in Table 9. In particular, both of the interaction terms are again positive and significant. In addition, the coefficients for the interaction terms are much larger during the post-consolidation period after January 1, 2010. As in Table 6, credit card risk and the risk-retention ratio are significantly positively related to the consumer credit risk premium over the sample period. Again, these results are consistent with the interpretation of the post-financial-crisis increase in the consumer credit risk premium being driven by increases in intermediary balance-sheet costs and regulatory capital requirements.

9. CONCLUSION

We use the secondary market prices of credit card ABS tranches to study how the market values unsecured consumer credit risk. The results indicate that there is a substantial risk premium associated with unsecured household debt. The average value of the consumer credit risk premium is 522 basis points over the entire 2000–2020 sample period, but has increased to more than ten percent during the latter part of the sample period. The large risk premium associated with unsecured consumer credit risk may be a major component of the high effective rates consumers pay on their credit cards.

We examine potential explanations for the dramatic increase in the consumer credit risk premium that occurs around the beginning of 2010. We find that the consumer credit risk premium is directly related to other credit spreads, but also appears to be driven by other factors unique to the credit card securitization market. In particular, we find strong evidence that the consumer credit risk premium is related to the balance-sheet costs and capital constraints faced by financial intermediaries. For example, using the natural experiment provided by the mandatory reconsolidation of credit card ABS back onto issuers' balance sheets on January 1, 2010 as a way to identify the marginal cost of placing assets on-balance-sheet, we find that a major portion of the increase in the consumer credit risk premium during the past decade may be due to the impact of capital regulation. These results are consistent with other recent evidence about the relation between intermediary balance-sheet costs, constraints from regulatory capital requirements, and asset pricing. Finally, our results point towards the need for further research to understand the role that market credit risk premia play in determining both the cost and availability of credit to the household sector. Especially, understanding the extent to which regulation aimed at taming risk-taking on "Wall Street" could have real effects on the availability and terms of credit to "Main Street" ought to be a key priority for academics, policy makers and regulators.

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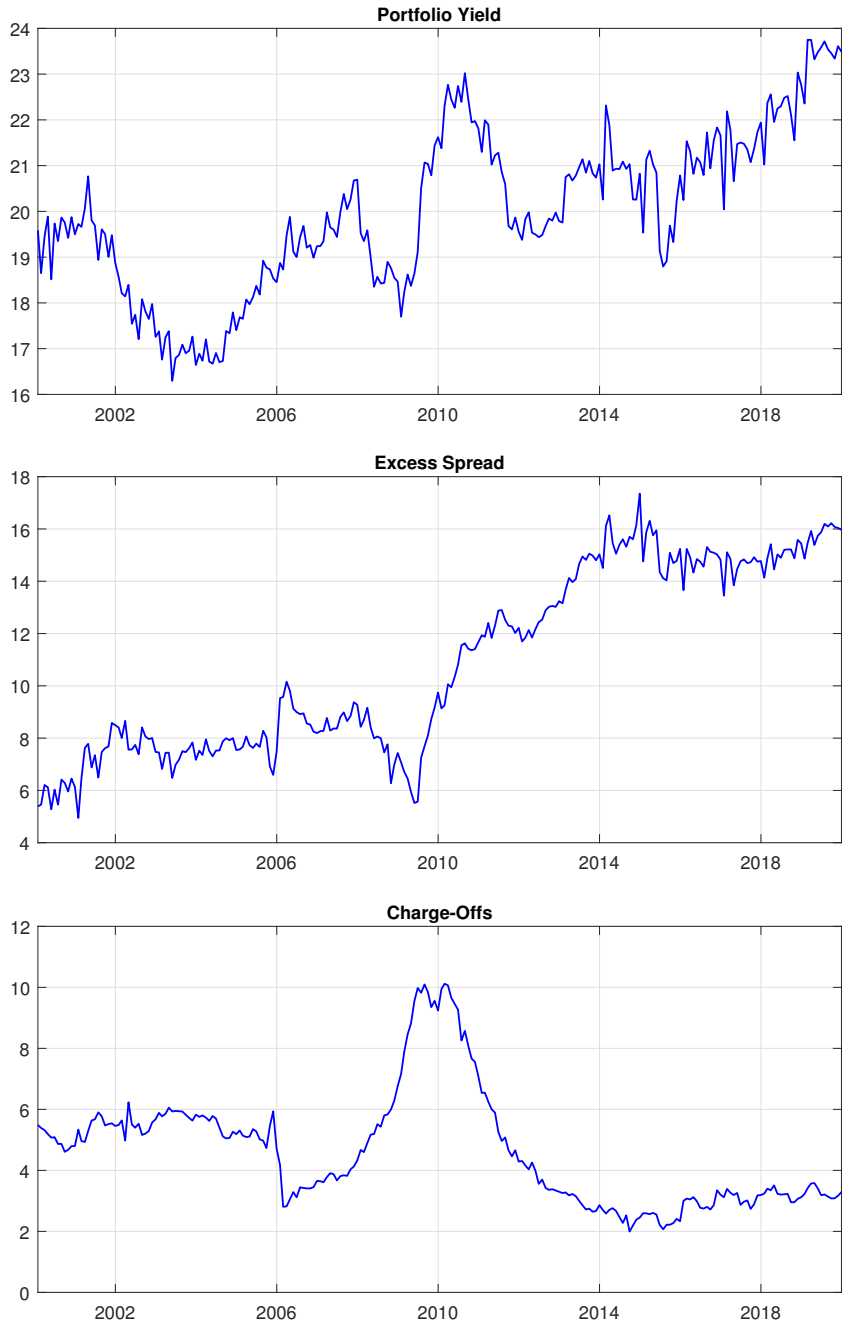

Figure 1. Average Portfolio Yields, Excess Spreads, and Charge-off Rates. This figure shows the average portfolio yield, excess spread, and charge-off rates for the issuers in the sample, where the averages are taken over the average values for each issuer in the sample for a given month.

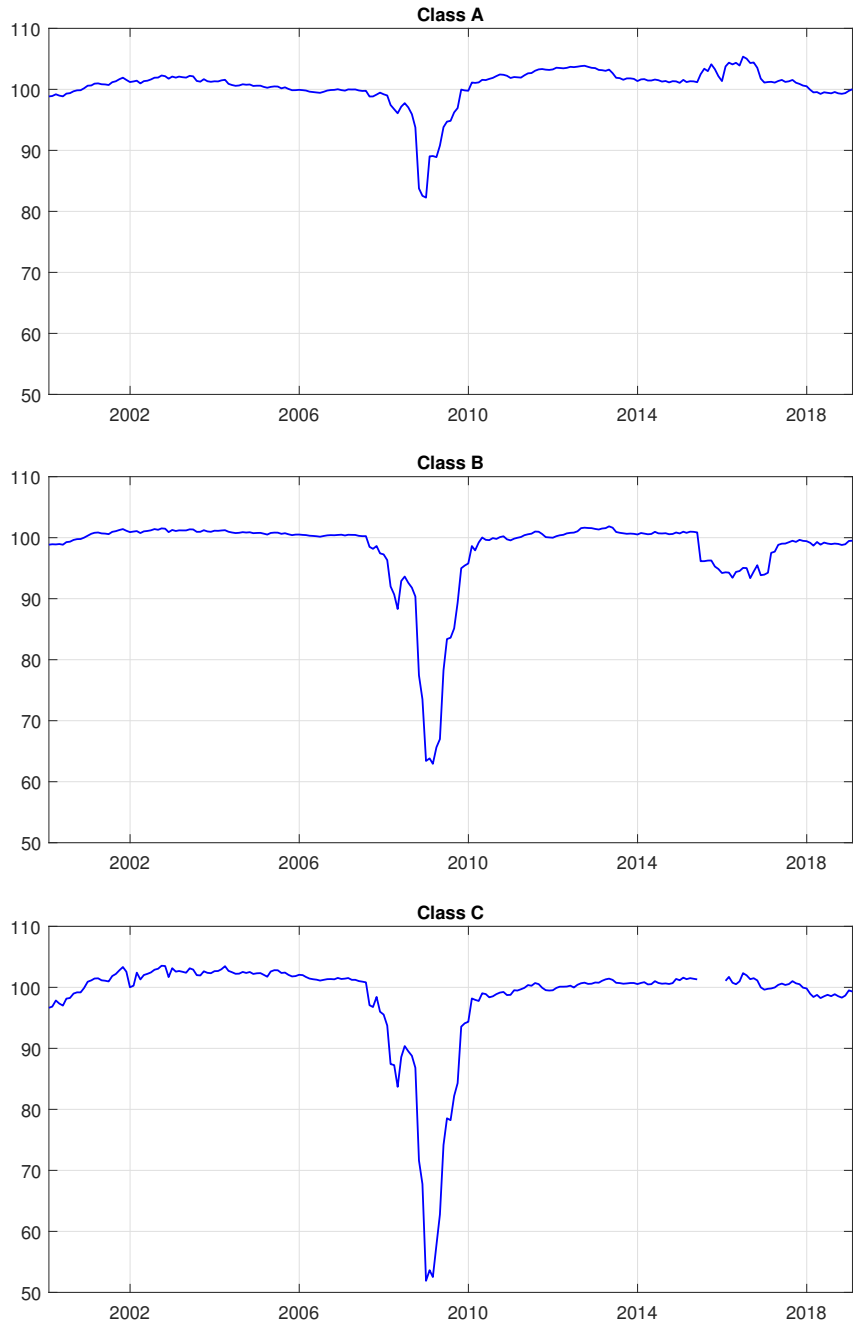

Figure 2. Average Prices for the A, B, and C Tranches. This figure shows the average prices for the A, B, and C tranches in the sample, where the averages are taken over the month-end prices of the respective A, B, and C tranches for all observations in the sample each month.

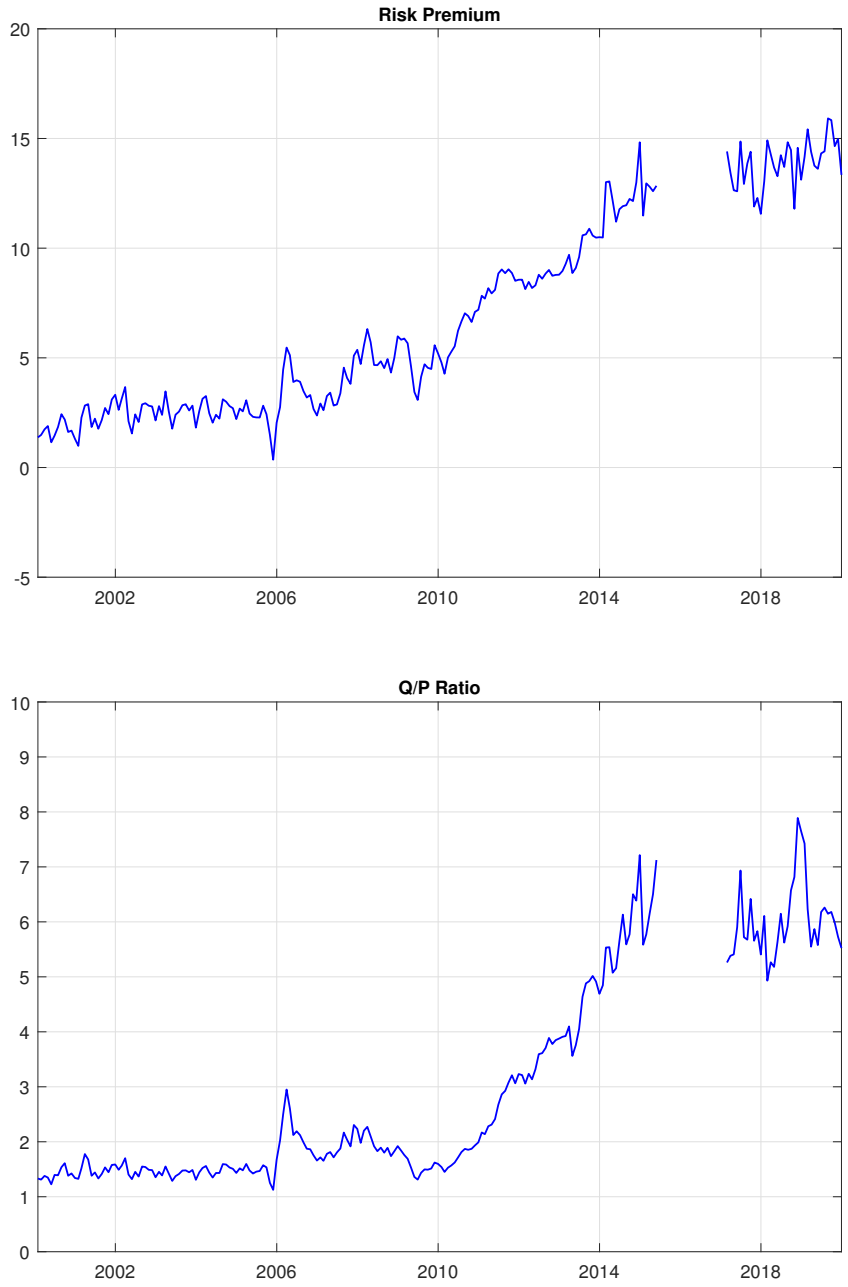

Figure 3. The Average Consumer Credit Risk Premium and the Ratio of Implied Charge-offs to Actual Charge-offs. The upper panel of the figure shows the average consumer credit risk premium, where the average is taken over the average values for each issuer in the sample for a given month. The lower panel shows the average ratio of the risk-neutral charge-off rate to the actual charge-off rate, where the average is taken over the average values for each issuer in the sample for a given month.

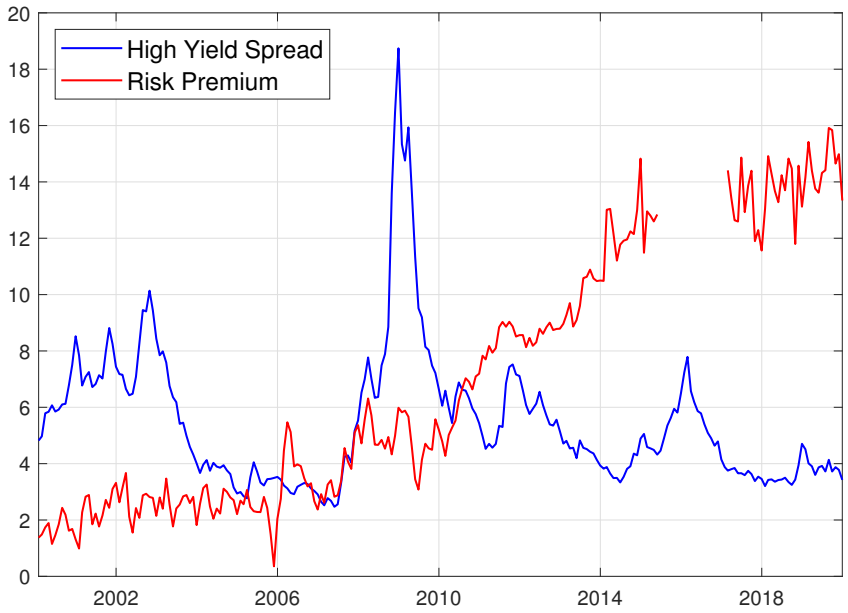

Figure 4. The Average Consumer Credit Risk Premium and the High Yield Corporate Credit Spread. This figure lots the average consumer credit risk premium and the credit spread on high yield corporate bonds. The average consumer credit risk premium is taken over the average values for each issuer in the sample for a given month.

Table 1

Summary Statistics for Credit Card Receivables Portfolio Characteristics. This table presents summary statistics for the indicated characteristics of the portfolios of credit card receivables underlying the securitizations. The statistics for the individual card issuers are computed by taking averages across all securitizations for each month, and then averaging the monthly averages. The monthly payment rate is the ratio of total cash flows collected each month divided by the portfolio balance and is expressed as a percentage. Portfolio yield is the annualized percentage gross return on the portfolio. Excess spread is the annualized percentage net return on the portfolio. The Charge-off rate is the one-month annualized percentage rate of charge-offs on the portfolio. Risk-retention denotes the minimum percentage of portfolio receivables the issuer is required to hold. N denotes the number of months. The sample period is monthly from January 2000 to January 2020.

Card Issuer	Sample Period	Monthly Payment Rate	Portfolio Yield	Excess Spread	Charge-off Rate	Risk-Retention	N
American Express	2000–2019	26.155	21.539	12.317	4.046	7.000	220
Bank of America	2000–2012	15.246	19.540	7.839	7.039	4.000	143
Bank One	2000–2013	19.056	17.498	7.537	5.642	4.162	160
Citibank	2000–2014	19.267	16.558	7.484	5.708	5.000	162
Chase	2000–2015	19.654	16.831	7.630	5.051	4.000	185
Capital One	2000–2015	19.361	20.146	10.577	4.255	5.000	185
Discover	2000–2013	19.580	17.719	8.145	5.536	7.000	159
First National	2002–2011	13.605	17.815	6.267	7.314	7.000	87
MBNA	2000–2013	15.615	19.147	8.107	6.238	4.000	162
World Financial	2000–2020	17.649	30.237	15.338	7.178	4.602	221
All	2000–2020	19.032	20.194	9.597	5.677	5.131	1,684

Table 2

Summary Statistics for Credit Card Asset-Backed Securities. This table presents summary statistics for the individual A, B, and C tranches of the credit card securitizations in the sample. Mat denotes the average maturity of the tranches in years. Sprd denotes the average floating spread above Libor of the tranches and is expressed in basis points. Attach and detach denote the average attachment and detachment points for individual tranches and are expressed as percentages of the total notional amount of the securitization. Min, Mean, and Max denote the minimum, mean, and maximum prices for the individual tranches during the sample period. The statistics for the individual card issuers are based on the daily values across all of their outstanding securitizations. The sample is daily from January 1, 2000 to January 31, 2020.

Card Issuer	Tranche	Mat	Sprd	Attach	Detach	Min	Mean	Max	N
American Express	A	3.21	30.46	15.04	100.00	63.97	99.71	110.98	3790
Bank of America	A	2.75	8.41	18.09	100.00	73.43	98.53	100.86	577
Bank One	A	2.85	12.22	15.82	100.00	95.75	100.05	102.99	427
Citibank	A	3.46	13.34	12.98	100.00	79.52	99.44	112.06	1229
Chase	A	3.07	10.58	16.27	100.00	61.57	99.83	110.29	1815
Capital One	A	3.52	13.71	20.02	100.00	55.39	101.20	114.91	1865
Discover	A	3.09	13.49	12.50	100.00	68.06	99.98	111.58	2596
First National	A	2.00	44.74	20.23	100.00	92.51	99.92	101.12	195
MBNA	A	3.66	14.16	15.28	100.00	78.47	100.79	123.67	4199
World Financial	A	2.94	33.69	24.69	100.00	59.05	100.55	108.64	1387
American Express	B	3.22	82.70	8.46	15.07	34.65	98.42	119.86	3722
Bank of America	B	2.76	64.19	9.54	18.09	40.32	96.16	101.91	584
Bank One	B	2.84	36.18	8.75	15.84	96.43	99.98	101.91	424
Citibank	B	3.43	43.49	7.78	12.98	52.66	97.29	111.14	1224
Chase	B	3.10	33.76	9.05	16.28	24.64	98.53	108.82	1851
Capital One	B	3.58	41.78	11.05	20.09	22.63	97.72	112.16	1803
Discover	B	3.11	35.61	7.50	12.50	38.32	98.42	110.76	2656
First National	B	1.93	24.53	10.69	18.09	79.58	98.02	101.63	111
MBNA	B	3.67	36.70	8.00	15.28	50.12	99.64	123.09	4216
World Financial	B	2.98	119.18	16.51	23.29	49.06	99.48	109.85	852
American Express	C	3.39	42.90	0.00	8.14	20.45	93.43	104.15	1312
Bank of America	C	2.87	152.02	0.00	10.22	41.07	93.29	110.06	395
Bank One	C	3.95	88.93	0.00	8.30	27.81	97.87	107.32	508
Citibank	C	4.01	68.96	0.00	7.76	23.27	97.12	113.54	1282
Chase	C	3.27	81.53	0.00	9.14	15.97	97.87	104.27	1558
Capital One	C	3.43	108.20	0.00	11.34	11.44	97.05	113.89	1590
Discover	C	2.00	32.44	0.00	26.86	61.40	86.44	100.20	25
First National	C	1.99	106.39	0.00	9.50	67.50	97.87	102.41	99
MBNA	C	4.00	107.10	0.00	8.13	27.22	100.38	118.83	3051

Table 3

Summary Statistics for the Consumer Credit Risk Premia. This table presents summary statistics for the consumer credit risk premia for the indicated card issuers. The statistics for the individual card issuers are computed by taking averages across all securitizations for each month, and then averaging the monthly averages. The consumer credit risk premia are expressed as percentages. The columns headings 5%, 25%, 50%, 75%, and 95% denote the respective percentiles of the distribution of risk premia. N denotes the number of months. The sample is monthly from January 2000 to January 2020.

Card Issuer	Mean	Std. Dev.	5%	25%	50%	75%	95%	N
American Express	7.536	3.338	2.753	4.451	7.446	10.479	12.412	220
Bank of America	3.767	2.788	−0.276	1.656	3.370	5.342	9.393	143
Bank One	3.016	2.558	−0.469	1.116	2.663	4.758	7.368	160
Citibank	2.847	2.446	0.181	1.323	2.140	3.662	8.812	162
Chase	3.044	2.817	−0.773	0.655	2.312	5.391	7.870	185
Capital One	6.278	2.764	2.270	4.198	5.839	8.576	10.992	185
Discover	3.958	4.496	−0.886	0.340	1.630	7.478	12.519	159
First National	2.948	2.813	−0.378	1.318	2.308	3.779	9.332	87
MBNA	3.771	2.610	0.688	2.324	3.049	4.981	9.685	162
World Financial	10.952	5.991	1.404	6.236	11.356	15.843	18.935	221
All	5.215	4.484	−0.102	1.838	4.133	7.687	13.744	1,684

Table 4

Regression of Changes in Consumer Credit Risk Premium on Changes in Corporate Credit Spreads. This table presents the results from regressing changes in the consumer credit risk premium on the indicated changes in corporate credit spreads. The pre-crisis and post-crisis intercepts apply to the 2000–2006 and 2007–2020 periods, respectively. CP spread denotes the spread on investment grade commercial paper relative to the Treasury bill rate. Aaa and Baa spreads denote the spreads on indexes of corporate bonds with the respective ratings relative to the ten-year Treasury rate. High yield spread denotes the Bloomberg Barclays index of high yield corporate (option adjusted) spreads relative to Treasury rates. The consumer credit risk premium and all credit spreads are expressed as percentages. Standard errors are based on Newey-West (1987). The superscripts * and ** denote significance at the ten-percent and five-percent levels, respectively. The sample is monthly from January 2000 to January 2020.

	Coef	t-Stat	Coef	t-Stat	Coef	t-Stat	Coef	t-Stat
Pre-Crisis Intercept	0.0083	0.14	0.0165	0.29	0.0123	0.21	0.0147	0.23
Post-Crisis Intercept	0.1209	2.77**	0.1150	2.61**	0.1167	2.60**	0.1182	2.43**
Δ Risk Premium $_{t-1}$	−0.2550	−2.62**	−0.2451	−2.68**	−0.2529	−2.72**	−0.2597	−2.79**
Δ CP Spread $_{t}$	0.2269	1.42	–	–	–	–	–	–
Δ CP Spread $_{t-1}$	−0.2418	−2.03**	–	–	–	–	–	–
Δ CP Spread $_{t-2}$	−0.1716	−0.86	–	–	–	–	–	–
Δ CP Spread $_{t-3}$	0.6445	6.36**	–	–	–	–	–	–
Δ Aaa Spread $_{t}$	–	–	0.1537	0.44	–	–	–	–
Δ Aaa Spread $_{t-1}$	–	–	0.9222	2.93**	–	–	–	–
Δ Aaa Spread $_{t-2}$	–	–	−0.5721	−1.94*	–	–	–	–
Δ Aaa Spread $_{t-3}$	–	–	0.0494	0.16	–	–	–	–
Δ Baa Spread $_{t}$	–	–	–	–	0.0703	0.26	–	–
Δ Baa Spread $_{t-1}$	–	–	–	–	0.5017	2.44**	–	–
Δ Baa Spread $_{t-2}$	–	–	–	–	−0.3817	−1.53	–	–
Δ Baa Spread $_{t-3}$	–	–	–	–	0.2150	1.08	–	–
Δ High Yield Spread $_{t}$	–	–	–	–	–	–	−0.0111	−0.15
Δ High Yield Spread $_{t-1}$	–	–	–	–	–	–	0.1781	2.80**
Δ High Yield Spread $_{t-2}$	–	–	–	–	–	–	−0.0514	−0.88
Δ High Yield Spread $_{t-3}$	–	–	–	–	–	–	0.0675	1.15
Adj. R^2		0.089		0.080		0.063		0.064
N		215		215		215		215

Table 5

Regression of Average Consumer Credit Risk Premium on Quarter-End and Year-End Indicators. This table reports the results from the regression of the average consumer credit risk premium on quarter-end and year-end indicators. The average consumer credit risk premium is expressed as a percentage. The quarter-end indicator takes value one for March, June, September, and December observations, and zero otherwise. The year-end indicator takes value one for December, and zero otherwise. Standard errors are based on Newey and West (1987). The superscripts * and ** denote significance at the ten-percent and five-percent levels, respectively. The sample is monthly from January 2000 to December 2019.

	Coeff.	t-Stat
Quarter-End Indicator	0.3270	3.90^{**}
Year-End Indicator	-0.1556	-0.59
Annual Fixed Effects		Yes
Adjusted R^2		0.972
Number of Observations		220

Table 6

Panel Regressions of Consumer Credit Risk Premia on the Charge-off Rates and Risk-Retention Requirements. This table reports the results from the panel regression of the consumer credit risk premia on charge-off rates and the required minimum issuer risk-retention ratios for the credit card securitization portfolio. The consumer credit risk premia are expressed as percentages. The charge-off rates are expressed as a percentage. The risk-retention ratios are expressed as a percentage. The pre-crisis period is 2000–2006. The post-crisis period is 2007–2020. Robust standard errors are clustered by year. The superscripts * and ** denote significance at the ten-percent and five-percent levels, respectively. The sample is monthly from January 2000 to December 2019.

	Full Sample		Pre-Crisis		Post-Crisis	
	Coef	*t*-Stat	Coef	*t*-Stat	Coef	*t*-Stat
Charge-off Rate	0.2073	1.69*	−0.0978	−0.62	0.3434	2.33**
Risk-Retention Ratio	0.2214	1.95*	0.0210	0.26	0.5161	3.42**
Time Fixed Effects		Yes		Yes		Yes
Adjusted R^2		0.586		0.073		0.479
Number of Observations		1,474		664		810

Table 7

Regression of Changes in the Consumer Credit Risk Premium on Changes in Intermediary Capital and Balance Sheet Cost Measures. This table reports the results from the regression of changes in the average consumer credit risk premium on the change in the aggregate Tier 1 capital ratio for broker-dealers, the change in the He, Kelly, and Manela (2017) measure of intermediary leverage, and the change in the Fleckenstein and Longstaff (2020) turn-of-the-year index of balance sheet costs. The consumer credit risk premium is expressed as a percentage. Tier 1 capital is expressed as a percentage. Intermediary leverage is expressed as a percentage. The turn-of-the-year index is expressed as a percentage. Standard errors are based on Newey and West (1987). The superscripts * and ** denote significance at the ten-percent and five-percent levels, respectively. The sample is quarterly from April 2000 to December 2019.

	Coeff.	t-Stat
Intercept	0.0694	0.57
Δ Risk Premium $_{t-1}$	−0.3603	−7.12**
Δ Tier 1 Capital Ratio $_t$	2.6635	3.93**
Δ Intermediary Leverage Ratio $_t$	−0.5333	−3.04**
Δ Turn-of-Year Measure $_t$	12.9620	2.72**
Adjusted R^2		0.311
Number of Observations		67

Table 8

Summary Statistics for FAS 166/167 Reconsolidations. This table presents summary statistics for the financial impact on the consolidating entity resulting from the mandatory implementation of FAS 166/167 on January 1, 2010. Assets consolidated, change in liabilities, change in loss reserve, and change in retained earnings are expressed in billions of dollars. The effect on Tier 1 capital is expressed in terms of the change in the percentage Tier 1 capital ratio. The capital intensity ratio is the ratio of the change in retained earnings to the change in assets and is expressed as a percentage.

Card Issuer	Elected To Defer	Assets Consolidated	Change in Liabilities	Change in Loss Reserve	Change in Retained Earnings	Effect on Tier 1 Capital	Effect on Tier 1 Capital Ratio	Capital Intensity Ratio
American Express	No	29.00	25.00	2.50	−1.80	−1.60	−1.20	6.21
Bank of America	No	100.40	106.70	10.80	−6.20	−9.70	−0.76	6.18
Bank One	Yes	87.70	92.20	7.80	−4.50	−4.40	−0.34	5.13
Citibank	No	137.00	146.00	13.40	−8.40	−14.20	−1.38	6.13
Chase	Yes	87.70	92.20	7.80	−4.50	−4.40	−0.34	5.13
Capital One	No	41.85	44.87	3.85	−3.02	−6.88	−3.82	7.22
Discover	No	21.10	22.43	2.10	−1.40	−1.41	−2.20	6.64
First National	No	1.31	2.54	0.33	−0.16	−0.39	−0.92	12.21
MBNA	No	100.40	106.70	10.80	−6.20	−9.70	−0.76	6.18
World Financial	No	3.40	3.70	0.50	−0.40	−0.49	−1.49	11.76

Table 9

Panel Regressions of the Consumer Credit Risk Premia on Measures of Intermediary Balance Sheet Constraints. This table reports the results from the panel regression of the consumer credit risk premia for the individual issuers on the indicated variables. The consumer credit risk premia are expressed as percentages. Ratio is the ratio of total equity to total assets for the issuer and is expressed as a percentage. Spread is the credit spread for the issuer (CDS spread or weighted-average cost of debt relative to Treasury rates) and is expressed as a percentage. Intensity is expressed as a percentage. The pre-consolidation period is 2000–2009. The post-consolidation period is 2010–2020. Robust standard errors are clustered by year. The superscripts * and ** denote significance at the ten-percent and five-percent levels, respectively. The sample is quarterly from April 2000 to December 2019.

	Full Sample		Pre-Consolidation		Post-Consolidation	
	Coef	t-Stat	Coef	t-Stat	Coef	t-Stat
Ratio × Intensity	0.0119	2.34**	0.0115	2.32**	0.0521	2.30**
Spread × Intensity	0.1356	2.94**	0.0637	3.84**	0.4132	3.62**
Time Fixed Effects		Yes		Yes		Yes
Adjusted R^2		0.639		0.326		0.551
Number of Observations		354		212		142

Table 10

Panel Regressions of the Consumer Credit Risk Premia on Measures of Credit Risk and Intermediary Balance Sheet Constraints. This table reports the results from the panel regression of the consumer credit risk premia for the individual issuers on the indicated variables. The consumer credit risk premia are expressed as percentages. The charge-off rates are expressed as a percentage. The risk-retention ratios are expressed as a percentage. Ratio is the ratio of total equity to total assets for the issuer and is expressed as a percentage. Spread is the credit spread for the issuer (CDS spread or weighted-average cost of debt relative to Treasury rates) and is expressed as a percentage. Intensity is expressed as a percentage. The pre-consolidation period is 2000–2009. The post-consolidation period is 2010–2020. Robust standard errors are clustered by year. The superscripts * and ** denote significance at the ten-percent and five-percent levels, respectively. The sample is quarterly from April 2000 to December 2019.

	Full Sample		Pre-Consolidation		Post-Consolidation	
	Coef	t-Stat	Coef	t-Stat	Coef	t-Stat
Charge-off Rate	0.1915	3.32**	−0.3062	−2.45**	0.0697	0.73
Risk-Retention Ratio	0.6700	3.28**	0.8373	4.54**	−0.0332	−0.07
Ratio × Intensity	0.0110	2.10**	0.0130	2.75**	0.0766	1.96**
Spread × Intensity	0.1284	1.83*	0.0078	0.69	0.3809	4.50**
Time Fixed Effects		Yes		Yes		Yes
Adjusted R^2		0.664		0.461		0.571
Number of Observations		300		180		120

INTERNET APPENDIX FOR

THE MARKET RISK PREMIUM FOR UNSECURED CONSUMER CREDIT RISK

Matthias Fleckenstein
Francis A. Longstaff

INTERNET APPENDIX

A.1 Data Sources

Table A1 provides a description of all the data and variables used in the study along with their definitions and corresponding sources. Table A2 lists the credit card master trusts for the ten credit card issuers in the study with their identifiers in the Bloomberg system.

A.2 Definitions

This section defines the key quantitative variables for analyzing credit card securitizations.

Base Rate: The base rate is the sum of the total monthly coupon cash flows to note holders, servicing fees and other trust expenses, as a percentage of the total receivables balance as of the first day of the month. The base rate is a measure of the monthly cash outflows from the credit card master trust.

Card Interchange: Interchange is a fee exchanged between banks in a credit card transaction and is typically expressed as a percentage of the transaction amount. Interchange fees are not paid by cardholders. This fee is typically paid by the merchant to the bank that issues the credit card to compensate the card issuer for assuming interim cardholder credit risk and fraud because the merchant is paid at the time of the sale, but the issuing bank is not until the cardholder is billed and makes payment. Interchange is often shared by the merchant's bank, the bank issuing the credit card, and Visa or Mastercard for clearing the transaction.

Charge-offs: Credit card receivables are typically charged off after the cardholder has been delinquent in paying the revolving balance for more than 180 days. The charge-off rate is the amount charged off each month divided by the total outstanding principal balance at the beginning of the month. Since the outstanding principal is reduced by the amount of principal charge-offs at the start of the next month, charge-offs diminish the collateral value backing the issued notes and the level of receivables backing the notes declines. If charge-offs reach a threshold as specified in the prospectus supplement, an early amortization of notes is triggered.

Excess Spread: The excess spread is the annualized rate of (gross) portfolio yield less servicing fees, coupon cash flows to noteholders, charge-offs, and any other trust expenses.[1] Excess spread represents a source of credit enhancement for

[1]The servicing fee is an annual fee expressed in percent and paid to the servicer

the notes. Intuitively, as long as the excess spread is positive, the securitization generates enough cash inflows to cover cash outflows. When the average excess spread is negative (typically calculated over a period of three months), many master trusts enter into early amortization.[2]

Monthly Payment Rate (MPR): The monthly payment rate (MPR) is the monthly rate of total principal cash flows during the month divided by the total principal receivables balance at the beginning of the month. The MPR is a measure of the speed at which cardholders pay down the amount owed on their credit.

Portfolio Yield: Portfolio yield is the annualized rate of total monthly cash flows into the credit card master trust divided by the outstanding principal balance at the beginning of the month. Gross cash inflows consist of interest on the revolving principal balances (finance charges) plus income from fees on the accounts such as late charges, card annual fees, cash advance fees, overdraft charges, card interchange, and discounted receivables.[3] Cash inflows include recoveries on defaulted receivables, but exclude charge-offs from the current month. The portfolio yield is a measure of the income generated by the credit card receivables.

A.3 The Credit Card ABS Market

This section discusses the credit card asset-backed securities (ABS) market and describes the mechanics of credit card asset-backed securities.

The market for securities backed by consumer credit is a very large and mature market. Credit card receivables have been securitized since the late 1980s

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of the credit card portfolio for servicing the portfolio on behalf of the master trust. It is often set as a fixed percentage of the total receivables in the credit card master trust.

[2]To illustrate how excess spread represents a source of credit enhancement, suppose a master trust generates a portfolio yield of 14.80% and experiences charge-offs of 5.50%. The trust has issued notes paying LIBOR floating each month. Assuming that the floating coupon rate equals 2.05% and that the master trust pays a servicing fee of 2%, the excess spread is $14.80\% - 2.05\% - 2.00\% - 5.50\% = 5.25\%$. Intuitively, this means that the master trust generates about five cents for each dollar invested each month above what is required to pay investor coupon interest, servicing fees, and other trust expenses.

[3]Some credit card master trusts can add receivables at a discount, typically ranging between 1% and 5%. The difference between the face value of receivables and their discount is added to finance charge collections.

and by the late 1990s securitization had become the dominant funding source for credit card receivables.[4] Annual issuance of ABS increased from just under $40 billion in 1990 to around $200 billion in 2001. Between 2002 and 2007, annual issuance was consistently in the range of $230 billion to $275 billion. The volume of ABSs backed by revolving consumer credit grew at a compound rate of about 19.79 percent between 1989 and 2009. As of year-end 2019, there were more than $127 billion in credit card ABS outstanding, and $18 billion in credit card ABS were issued in 2019. Total ABS issuance in 2019 was $306 billion across consumer credit, automobile, equipment (floorplans, leases and transportation), student loans, CDO/CLOs and other ABS (franchises, insurance, timeshares). Consumer credit ABS made up about 7.06% of total $1.8 trillion ABS outstanding as of year-end 2019.[5]

Credit cards are the primary funding source for revolving consumer credit. As of March 2020, there was over $1 trillion in revolving consumer credit outstanding.[6] As of the end of the first quarter of 2020, about 92% of revolving consumer credit is held by credit card banks ($926 billion out of $1.01 trillion).

Credit cards are widely held and extensively used by consumers. The Federal Reserve reports in the Survey of Consumer Finances that about 70% of families had at least one credit card in 2013.[7] Credit cards are offered by a variety of financial institutions, but primarily banks. Among the variety of cards offered by card issuers, common programs include premium cards that provide incentives to use the card in the form of airline miles, rewards points or cash but that may also carry higher annual fees or interest rates.

The general-purpose credit card market in the U.S. is concentrated with the top ten issuers holding over 80% of the outstanding credit card balances and the top three issuers controlling more than 60% of the market. Cards issued by Visa and Mastercard account for nearly 85% of about 544.5 million general-purpose credit cards in 2016. American Express and Discover accounted for another 99

[4]See FDIC Credit Card Securitization Manual 2007, https://www.fdic.gov/regulations/examinations/credit_card_securitization/.

[5]https://www.sifma.org/resources/research/us-abs-issuance-and-outstanding.

[6]Federal Reserve Board, G.19 Release on consumer credit at https://www.federalreserve.gov/releases/g19/Current/.

[7]Credit cards are unsecured, open-ended revolving debt obligations used to finance the purchase of goods and services as well as for cash advances. A credit card represents a contractual agreement between the credit card holder and a financial institution. The agreement defines the terms and conditions such as the card interest rate, fees, and required payments.

million general-purpose cards in 2016.[8] Over five thousand depository institutions, including commercial banks, credit unions, and savings institutions, issue Visa and Mastercard credit cards and independently set the terms and conditions on their plans. In 2016, consumers made more than 34.3 billion transactions, amounting to a dollar volume of more than $3.1 trillion using general-purpose credit cards.[9]

The underlying collateral of a credit card ABS consists of account receivables generated when consumers make charges on their credit cards to purchase goods and services. From the issuer's perspective, credit card receivables are in effect a short-term unsecured loan. Consumers pay back either the full principal of this unsecured loan or make partial payment. In the latter case, the issuer finances the remaining balance and earns interest (finance charges). Intuitively, the idea for pooling credit card receivables is to turn the volatile cash flows from individual consumers paying off their credit card debts, into a stable cash flow that in aggregate resembles a bond which can then be tranched and sold to investors.

Credit card issuers typically use "master trusts" for the process of securitizing credit card receivables and creating notes that are subsequently sold to investors. This is because the master trust structure allows an issuer to sell multiple securities from the same trust, all of which rely on the same pool of receivables as collateral. To illustrate, an issuer would transfer, say, $1 billion of card receivables from one million accounts to a master trust, then issue multiple notes in various denominations and sizes.

Even though the receivables are transferred to the master trust, the issuer (also referred to as the seller) must maintain an ownership interest in the trust. On the one hand, this "seller's interest" ensures that the issuer has some skin-in-the-game to maintain the credit quality of the pool, but it also absorbs seasonal fluctuations in credit card receivable balances so that the certificate holder's invested amount is always fully invested in credit card receivables. However, the seller's interest does not provide credit enhancement for the investors. In other words, the seller has a pari passu claim on the master trusts cash flows. The size of the seller's participation must remain at or above a minimum percentage of the trust receivables balance. The minimum required seller's interest for most master trusts tends to be in the 4% to 7% range of outstanding receivables. If the seller's interest falls below this threshold, the seller must add receivables or an early amortization event is triggered.

[8]See Board of Governors of the Federal Reserve System, Report to the Congress on the Profitability of Credit Card Operations of Depository Institutions, June 2017.

[9]See, HSN Consultants, Inc. (2017), Nilson Report, no. 1104 (February).

As consumers pay back their card balances, the issuer transfers receivables from more accounts to the master trust. Moreover, the issuer can add receivables to the trust and create additional securities which are referred to as a new "series." However, even though master trusts issue different series over time, the receivables in the master trust are not segregated to indicate which series of securities they support. Instead, all the accounts support all the securities. Master trusts offer different "classes" of securities to investors which have some parallels with a CDO structure. Specifically, in a typical transaction, the master trust issues A, B, and C classes. The class C notes are similar to a CDO equity tranche in that class C investors bear the first losses in early amortization. Class B notes are junior to class A notes and are allocated the next layer of losses after class C notes are wiped out. Finally, class A notes are senior to other classes and because class A securities have credit support from junior classes, they typically receive AAA credit ratings.

Each class can be thought of as having attachment and detachment points like a typical CDO. The class C notes have attachment points of zero and, say, 15% which means that the tranche thickness of the C class absorbs the first 15 cents of losses for each dollar of credit card receivables. Similarly, class A notes have an attachment point, say, 25%, which means that class A investors will not experience losses unless total losses in the credit card portfolio exceed 25 cents for each dollar of credit card receivables.[10]

The process of how cash flows are allocated to different investor classes has parallels to the CDO waterfall structure. Specifically, the typical setup has two different cash flow periods: revolving, and controlled amortization (in some cases, controlled accumulation). A third period, referred to as early amortization can be triggered when the master trust is incurring sustained losses. If there are no losses, the two-period structure mimics a traditional bond in the sense that interest is distributed every month and principal is paid in a single "bullet" cash flow on the maturity date.

After issuance, a credit card ABS enters the "revolving period." In this phase, all cash flows on receivables are split into finance charge collections and principal payments. Monthly finance charges are used to pay the investor coupon and servicing fees, as well as to cover any receivables that have been charged off in the month. Any residual cash flow is referred to as "excess spread" and, depending on the master trust, is used as credit enhancement or released to the seller. Cash flows from principal collections, by contrast, are not distributed to

[10]This example abstracts away other credit enhancements built into master trusts, such as cash collateral accounts, collateral invested amounts, and/or excess spread accumulation accounts.

investors, but are used to purchase new receivables or to purchase a portion of the seller's interest if there are no new receivables.

The revolving period continues for a predetermined length of time, typically from two to several years, and then the controlled amortization (accumulation) period begins where principal collections are distributed to investors. For instance, a credit card ABS with a five-year expected maturity might revolve for 48 months and then enter amortization for the final 12 months. The two primary mechanisms through which amortization is achieved are controlled amortization and controlled accumulation.

In the case of controlled amortization, principal cash flows are distributed in equal installments, for instance one-twelfth of the invested amount every month for twelve months. During this period, interest cash flows are based on declining principal balances. In the case of controlled accumulation, by contrast, principal cash flows are deposited into a collection account—referred to as "principal funding account" (PFA)—every month and then paid out as a single "bullet" cash flows at the end of the accumulation period.

Independent of whether the credit card ABS is in the revolving period or in controlled amortization (accumulation), early amortization can be triggered if there are sustained defaults or write-offs on the pool of credit card accounts. Common early amortization trigger events include collateral performance deterioration (e.g. the three-month average excess spread falls below zero, or the collateral balance falls below the investor invested amount), seller/servicer problems (e.g. seller interest falls below the required minimum level, the seller fails to transfer new receivables into the trust when necessary), but also legal issues (e.g. breach of representation or warranties by the issuer, or default, bankruptcy, and insolvency of the seller or servicer). Basically, once an early amortization event occurs, then a credit card ABS immediately starts to amortize and ABS investors begin to receive principal cash flows.

Credit card ABS have different forms of credit enhancement because as unsecured revolving debt obligations, credit card receivables offer no collateral in the event of cardholder default. Common types of credit enhancement are excess spread, a cash collateral account (CCA), a collateral invested amount (CIA), and subordination.

Excess spread is the key form of internal credit enhancement. Intuitively, excess spread is simply the residual cash flow after investor interest, servicing fees, and charge-offs are allocated to each series. Excess spread is calculated as the gross portfolio yield less charge-offs, investor coupon, and servicing fees, and is expressed as an annualized percentage of the outstanding principal balance. Typically, a negative three-month moving average excess spread for a particular

series triggers early amortization. Available excess spread is often shared with other series, deposited into a spread account as credit enhancement or released to the seller.

A cash collateral account (CCA) is a segregated cash reserve account, funded at closing and held by the trust. Amounts deposited in the CCA are used to cover shortfalls in interest, principal, or servicing expenses for a particular series if excess spread is reduced to zero. The cash to fund the CCA is usually lent by a third party and invested in high-grade short-term securities, all of which mature on or before the next distribution date. Draws on the CCA may be reimbursed from future excess spread.

A collateral invested amount (CIA) is a privately placed tranche of a series that is subordinate in payment rights to all investor certificates. It basically acts as another layer of subordination that is used to cover deficiencies if excess spread is reduced to zero. In some master trusts, the CIA has credit enhancement via a spread account and is allocated some monthly excess spread, if available. Draws on the CIA can be reimbursed from future excess spread.

The perhaps most straightforward form of credit enhancement is subordination via senior/subordinate investor certificates. For instance, senior participation is in the form of class A certificates and subordinate participation is in the form of class B and class C certificates. Class C will absorb losses allocated to class A and to class B, unless those losses can be covered by excess spread, or by draws from the CCA or CIA. Principal collections are allocated to subordinate classes only after the senior certificates are fully repaid.

Before 2010, a master trust was usually set up to satisfy the conditions to qualify as a special purpose entity (QSPE) for off-balance-sheet accounting treatment.[11] Effective on November 15, 2009, FAS 166 eliminated the concept of qualifying special purpose entity, and thus all securitization transactions became subject to the consolidation assessment. The next section discusses the impact of FAS 166/167 on credit card issuers in detail.

A.4 Regulation and Capital Requirements

This section discusses key regulatory events and capital requirements that were enacted after the 2008 financial crisis.

[11]The four conditions are a) demonstrably distinct from the transferor, b) restricted as to its permitted activities, c) limited as to the types of assets it can hold, and d) limited as to its ability to sell or otherwise dispose non-cash financial assets.

A.4.1 The Card Act

In May of 2009, Congress enacted the Credit Card Accountability Responsibility and Disclosure Act of 2009, commonly referred to as the Card Act.[12] The Card Act institutes a number of consumer protection and disclosure requirements for consumer credit cards, but does not apply to small business credit cards. Credit card issuers must follow various rules with respect to the marketing, underwriting, pricing, and billing of consumer credit cards. The Card Act sets regulatory limits on certain types of credit card fees, and requires card issuers to provide monthly credit card statements showing the costs of making only the minimum payment. Issuers are prohibited from increasing the interest rate on outstanding balances, except in limited circumstances such as when a promotional rate expires, a variable rate adjusts, or an account is seriously delinquent or completes a workout arrangement. Credit card issuers must provide a 45-day advance notice of rate increases or other significant changes to terms and must give consumers the right to opt out of significant changes to account terms. Under the Card Act, issuers cannot impose fees for transactions that would put the account over its credit limit, and cannot charge over-limit fees more than once during per billing cycle. The Card Act limits over-limit fees to the actual over-limit amount, generally prohibits late fees of more than $25 and prohibits account inactivity fees. Card issuers are also required to apply payment amounts in excess of the minimum payment first to the balance with the highest interest rate and then to balances with lower interest rates. The Card Act restricts marketing of credit cards to card holders under the age of 21 and requires that applicants for new accounts who are under the age of 21 demonstrate an independent ability to make the required minimum periodic payments. The provisions of the CARD Act took effect in three phases between August 20, 2009, and August 22, 2010.

A.4.2 Regulation AB

The SEC introduced revisions to Regulation AB in April 2010 which tightened disclosure requirements by the credit card bank originating the credit card receivables.[13] The SEC's proposal was adopted in Section 942 of the Dodd-Frank Act.[14] Under the SEC's proposal, issuers of ABS must provide standardized asset-level information at the time of issue and over time about the composition and performance of the underlying collateral. Specifically, this information must be disclosed in Schedule L at the time of issue and Schedule L-D over

[12]H.R.627 111th Congress, available at https://www.congress.gov/bill/111th-congress/house-bill/627.

[13]The financial institution is also referred to as sponsor, transferor, or seller.

[14]http://www.sec.gov/rules/proposed/2011/33-9244.pdf.

time through 8-K filings. In addition, the SEC revised public shelf registration requirements under the Securities Act Rule 415.

A.4.3 FAS 166/167

The Financial Accounting Standards Board (FASB) issued FAS 166 and 167 in June 2009 to become effective on January 1, 2010.[15] The effect of FAS 166 and 167 is to significantly narrow the scope of transactions that qualify as "off-balance-sheet" for accounting purposes. In summary, FAS 166/167 essentially required that credit card receivables that were off-balance-sheet for accounting purposes had to be reconsolidated onto the balance sheets of credit card issuers.[16]

Prior to FAS 166/167, credit card master trusts were set up as Qualifying Special Purpose Entities (QSPEs).[17] This meant that credit card loans transferred into the master trust were off-balance-sheet for accounting purposes.[18] In other words, whether or not credit card issuing banks had to consolidate the assets and liabilities of master trusts on their balance sheet required that the master trusts qualify as QSPEs. FAS 166/167 essentially eliminates the concept of QSPEs, and thus master trusts become subject to consolidation assessment as variable interest entities (VIEs). Whether or not a VIE is off-balance-sheet for accounting purposes treatment depends on whether the credit card issuing bank is deemed the "primary beneficiary," and thus the consolidator of VIE. In particular, the rules require a sponsor of a variable interest entity (VIE) to consolidate that transaction onto its balance sheet in the event it retains power to direct activities that most significantly affect performance and when the sponsor maintains either the obligation to absorb significant losses or right to receive significant benefits from the VIE. Since credit card banks have "the power to direct

[15]Financial Accounting Standards No. 166, "Accounting for Transfers of Financial Assets, An Amendment of FASB Statement No. 140", and FASB Statement No. 167, "Amendments to FASB Interpretation No. 46(R)."

[16]https://www.fasb.org/cs/ContentServer?c=FASBContent_C&cid=1176155633483&d=&pagename=FASB%2FFASBContent_C%2FNewsPage, https://www.fasb.org/cs/ContentServer?c=FASBContent_C&cid=117615563348

[17]In a typical credit card securitization transaction, the credit card issuer establishes a Qualified Special Purpose Entity (QSPE) as a separate entity and transfers the credit card receivables to the QSPE. The QSPE holds the underlying receivables and issues certificates to investors. See, Rosenblatt and Mountain (2005).

[18]The credit card issuing bank (seller) generally retains a small portion of the securitized pool of receivables in the form of the "seller's interest."

activities that most significantly impact the VIE's economics" by changing the composition of the credit card receivables transferred to master trusts and by modifying credit card contracting terms, such as interest rates and credit card fees, and because credit card banks typically retain a first loss position in terms of seller's interest, most issuers are deemed primary beneficiaries and thus must reconsolidate securitized credit card receivables onto their balance sheet effective with the first annual reporting period beginning on or after November 15, 2009.[19]

As a result of FAS 166/167, domestically chartered commercial banks reconsolidated $321.9 billion securitized credit card receivables in the first quarter of 2010.[20] Moreover, after FAS 166/167 took effect, credit card banks reduced their credit card ABS issuance by 92%, from $40 billion in 2009 to $3.3 billion in 2010.[21]

An important consequence of consolidating master trusts is that as on-balance-sheet assets, credit card receivables become subject to regulatory capital requirements.[22] In a sense, as a result of FAS 166/167, receivables previously held off-balance-sheet now occupy "expensive real estate" on credit card banks' balance sheets. To illustrate that capital charges can be significantly higher with consolidation under FAS 166/167, consider the standard minimum requirement of total capital to risk-weighted assets of 8% ("Cooke ratio") which credit card banks have to meet since the first Basel framework. As off-balance-sheet assets, credit card banks could apply a 0% risk weight to AAA-rated credit card securitizations. In contrast, with SFAS 166 consolidation, the risk weight for on-balance-sheet assets is 100%, resulting in the full 8% capital charge for the credit card ABS. Thus, capital charges are at least eight times higher because

[19]J.P. Morgan Chase adopted the new reconsolidation accounting guidance for VIEs on January 1, 2010, "as the Firm will be deemed to be the primary beneficiary of its credit card securitization trusts as a result of this guidance, the Firm will consolidate the assets and liabilities of these credit card securitization trusts at their carrying values on January 1, 2010, and credit card-related income and credit costs associated with these securitization activities will be prospectively recorded on the 2010 Consolidated Statements of Income in the same classifications that are currently used to report such items on a managed basis." See J.P. Morgan Chase, Annual Report for the fiscal year 2009.

[20]Credit card loans comprise most of revolving consumer credit measured in the Federal Reserve's Consumer Credit G19 Statistical Release. See https://www.federalreserve.gov/releases/g19/about.htm.

[21]https://www.federalreserve.gov/releases/h8/h8notes.htm#notes_20110429.

[22]12 CFR Part 567 at https://www.govinfo.gov/content/pkg/FR-2009-09-15/pdf/E9-21497.pdf.

credit card banks are also required to provision for losses associated with credit card receivables previously held in the master trusts. In the case of J.P. Morgan Chase, for instance, the firm added about $88 billion of assets (under U.S. generally accepted accounting principles (GAAP)) upon adoption of FAS 166/167 in January 2010 which implied that J.P. Morgan would need to add about $88 $\times 0.08 =$ $ 7 billion in regulatory capital to maintain its existing capital ratios. J.P. Morgan's unsecured credit spread from credit default swaps was about 80 basis points in January 2010 which suggests costs from the adoption of FAS 166/167 on the order of $56 million per year.

In aggregate, the Federal Reserve estimated that FAS 166/167 would result in $900 billion of ABS assets to be reconsolidated on banks' balance sheets. This tidal wave of securitized assets was expected to lower Tier 1 risk-weighted capital ratios by 70 basis points across all institutions in aggregate. Specifically, as of the second quarter of 2009, banks had Tier 1 capital of $1.1 trillion, and Tier 1 capital ratios were expected to decline from 10.8% to 10.1% in aggregate.[23]

Given the potential significant economic impact on banks' regulatory capital, regulators collectively issued a final rule in December 2009 and made explicit that assets reconsolidated under FAS 166/167 were to be included in banks' total assets for calculating leverage ratios and in their risk-weighted assets.[24] However, the FDIC provided banks with the option to delay the effects on their risk-based capital ratios for two quarters, followed by an optional additional two-quarter partial implementation of the effect of FAS 167 on risk-weighted assets.[25]

A.4.4 FDIC Securitization Safe Harbor Rule

The Federal Deposit Insurance Corporation (FDIC) Securitization Rule (Securitization Safe Harbor Rule, 12 C.F.R. § 360.6) provides safe harbor protection in a receivership or conservatorship of an insured depository institution if the transfer of financial assets under the securitization no longer qualifies for off-balance-sheet treatment under FAS 166/167.[26] The final rule was published in

[23]See, J.P. Morgan, Securitized Products Weekly, December 11, 2009.

[24]https://www.fdic.gov/news/board/DEC152009no2.pdf.

[25]http://www.federalreserve.gov/newsevents/press/bcreg/20100121a.htm.

[26]A "financial asset" is defined as "cash or a contract or instrument that conveys to one entity a contractual right to receive cash or another financial instrument from another entity." See 12 C.F.R. § 360.6(a)(1). "Transfer" refers to the conveyance of [a financial asset] or creation of a security interest in a financial asset to or for the benefit of the issuer. See 12 C.F.R. § 360.6(a)(11).

12 C.F.R. § 360.6; Final Rule Regarding Safe Harbor Protection for Treatment by the Federal Deposit Insurance Corporation as Conservator or Receiver of Financial Assets Transferred by an Insured Depository Institution in Connection With a Securitization or Participation After September 30, 2010.[27]

The first safe harbor rule from 2000 provided bankruptcy remoteness for assets transferred into securitizations, which meant that the FDIC, as receiver or conservator of a failed bank, could not repudiate contracts, recover or reclaim financial assets transferred in connection with securitization transactions that are off-balance-sheet for accounting purposes.[28] Specifically, under the safe harbor rule from 2000, the FDIC provided that notwithstanding a bank becoming subject to FDIC conservatorship or receivership, if the sponsor's asset transfer in a securitization constituted a "sale" under GAAP, the FDIC would not use its power to repudiate the asset transfer agreement in the securitization. In other words, if a credit card securitization meets the requirement of a "true sale" for accounting purposes. the FDIC will not reclaim any financial assets from the credit card master trust in bankruptcy proceedings against the credit card bank. Through this bankruptcy remoteness offered by safe harbor protection, credit card ABS can receive a higher credit rating than the credit card bank originating the receivables.[29]

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[27]The final rule is available at http://www.fdic.gov/news/board/10Sept27no4.pdf.

[28]The FDIC has substantial powers upon insolvency of insured depository institutions. Specifically, if the FDIC is appointed the conservator or receiver of an insured depository institution, upon its insolvency or in certain other events, the FDIC has the power: (1) to transfer any of the depository institution's assets and liabilities to a new obligor without the approval of the depository institution's creditors; (2) to enforce the terms of the depository institution's contracts pursuant to their terms; or (3) to repudiate or disaffirm any contract or lease to which the depository institution is a party, the performance of which is determined by the FDIC to be burdensome and the disaffirmation or repudiation of which is determined by the FDIC to promote the orderly administration of the depository institution.

[29]In 2009, rating agencies indicated that they may ultimately conclude that the safe harbor no longer applies and, in certain cases, that the highest rating an ABS security could receive would be based on the sponsoring bank's unsecured debt rating, rather than being based on a separate evaluation of the securitization trust. Accordingly, credit card banks were at risk that their credit card securitization would no longer receive or maintain AAA ratings under the same terms and conditions as prior to FAS 166/167.

When the Financial Accounting Standards Board's FAS 166 and 167 came into effect in November 2009, many securitization transactions were no longer off-balance-sheet for accounting purposes because they no longer qualified as "true-sales" transactions. This meant that safe harbor protection no longer applied to credit card ABS, and the FDIC would be allowed under FAS 166/167 to recover financial assets from credit card master trusts in the event that the credit card issuing bank enters bankruptcy.

However, the FDIC amended the Securitization Rule in 2010 to specify a set of conditions under which safe harbor protection still applies to asset securitization transactions. Specifically, the amended Securitization rule extends safe harbor protection to securitizations without regard to whether the transaction qualifies for sale accounting treatment under FAS 166 and 167, but it imposes stricter requirements as a condition for bank-sponsored securitizations to qualify for safe harbor. Specifically, bank-sponsored securitizations must comply with new risk-retention rules, increased disclosure/reporting requirements, and qualify for off-balance-sheet treatment under GAAP. Existing revolving trusts or master trusts with obligations outstanding as of September 27, 2010 were "grandfathered," in the sense that safe harbor continues to apply if these securitizations meet the requirements of the original safe harbor, including qualifying for sale accounting treatment under FAS 140 standards in effect prior to November 15, 2009.

Securitization transactions that do not achieve off-balance-sheet accounting treatment under GAAP (including those involving master trusts and revolving trusts that are not grandfathered), no longer have the original safe harbor protection even if they otherwise meet criteria of the Securitization Rule. Consequently, the FDIC, as receiver or conservator, has the right to repudiate a securitization agreement and to seize assets from a securitization trust under certain conditions.

A.4.5 The Dodd-Frank Act and Basel III

The post-crisis regulatory reforms via the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) and the Basel III capital accords in conjunction with FAS 166/167 fundamentally change the economics of asset-backed securitizations and make the process of securitizing assets much more capital-intensive by turning securitization transactions from being a low-capital-usage, off-balance-sheet activity into one which consumes expensive balance-sheet space. Moreover, credit card banks face indirect costs because post-crisis regulatory reforms from the Dodd-Frank Act and Basel III impose restrictions on institutional investors to hold asset-backed securities and also tighten oversight and rating criteria from credit rating agencies.

A.4.5.1 The Dodd-Frank Act

The Dodd-Frank Act significantly increases the regulation of credit card securitizations.[30] The Dodd-Frank Act was enacted in 2010 and requires securitizers or originators of credit card ABS to retain at least 5% of the credit risk of securitized exposures. It restricts the interchange fees payable on credit card transactions, imposes stricter disclosure requirements regarding the credit card receivables, and seeks to tighten credit rating standards from ratings agencies. The Dodd-Frank Act also establishes the Consumer Financial Protection Bureau (CFPB) to regulate the terms of credit card agreements. Moreover, large credit card issuing banks become subject to oversight from the Financial Stability Oversight Council (FSOC) which has the authority to require companies deemed "systemically important" to sell or transfer assets and terminate activities if the regulators determine that the size or scope of activities of the company pose a threat to the safety and soundness of the financial stability of the United States.

In addition, Section 331 of the DFA changes how FDIC assessment fees are calculated by requiring that these fees be assessed on consolidated assets instead of on deposit liabilities as had been the case pre-crisis. In conjunction with the consolidation requirement from FAS 166/167, this meant that credit card banks become subject to higher FDIC assessment fees.

The Dodd-Frank Act increases capital requirements on banks, and contains multiple provisions for mandatory risk-based capital requirements that apply to consolidated on-balance-sheet assets. Specifically, the Dodd-Frank Act increases the minimum required ratio of common equity to risk-weighted assets to 4.5 percent. In addition to raising risk-weighted capital requirements, the Dodd-Frank Act introduces a capital conservation buffer, comprised of additional Tier 1 capital of 2.5 percent of risk-weighted assets when fully implemented. Systematically important institutions also become subject to a countercyclical capital buffer on top of the capital conservation buffer. The effect of the minimum risk-weighted leverage requirement of 4.5 percent and the 2.5 percent capital conservation buffer combined implies a risk-based leverage ratio requirement of at least 7 percent for many large banks.

In addition, the Dodd-Frank Act effectively imposes stricter capital requirements by establishing new rules for determining which assets and other instruments can be included in calculating common equity Tier 1 capital, other Tier 1 capital, and Tier 2 capital. Specifically, under the Dodd-Frank Act, when credit card banks purchase credit card accounts, they are no longer allowed to include

[30]H.R. 4173: Dodd-Frank Wall Street Reform and Consumer Protection Act, available at https://www.cftc.gov/idc/groups/public/@swaps/documents/file/hr4173_enrolledbill.pdf.

the "purchase credit card relationship intangible assets," in intangible assets which reflects the amount by which the cost of net credit card assets acquired exceeds their fair value, in calculating Tier 1 capital.

The Dodd-Frank Act also introduces the framework for systematically important financial institutions (SIFIs) in 2010. Financial institutions deemed "too-big-to-fail" not only become subject to stricter capital and liquidity rules, but they also become subject to stricter risk management requirements and have to meet certain prudential standards under regulatory supervision by the Board of Governors of the Federal Reserve System. Specifically, under systemic risk rules, also referred to as the Dodd-Frank Act Stress Tests (DFAST), bank holding companies (BHCs) with $50 billion or more in assets must provide regulators with detailed additional information on their capacity to withstand financial crises and submit detailed capital plans over a nine-quarter horizon across a range of stress scenarios. These provisions affect large credit card banks including American Express, Discover, and Capital One, and Bank of America, Chase, and Citigroup.

Section 171(b) of the Collins Amendment to the Dodd-Frank Act makes U.S. BHCs and other systemically significant non-bank financial companies subject to the same capital requirements that apply to federally insured depository institutions. As a result, the capital requirements of a BHC become at least as strict as those applied to its depository subsidiary. Moreover, the Collins Amendment of the Dodd-Frank Act effectively raises risk-weighted asset requirements for many banks and BHCs because it limits the use of internal models in reporting regulatory capital ("Collins Floor"). Specifically, under the Collins Amendment to the Dodd-Frank Act, banks report their regulatory capital ratios under both bank-internal risk-management models and using a set of prespecified regulatory rules, the so-called "standardized approach." If standardized credit and market risk-weighted assets exceeded total modeled risk-weighted assets, then a bank must calculate its regulatory capital requirements in reference to the former. This matters for credit card ABS because under the Basel Securitization Framework capital requirements for securitization, exposures are assigned based on a Supervisory Formula Approach (SFA).[31] Thus, under the SFA subordinate ABS tranches have significantly higher risk weights than pre-crisis.

A.4.5.2 Basel III

The Basel III framework, introduced by the Basel Committee in December 2010, redefines regulatory capital, establishes a global leverage ratio, and increases banks' required risk-weighted capital ratios. In addition to tightening equity

[31] https://www.fdic.gov/news/news/financial/2011/fil11075.pdf.

and risk-weighted capital requirements, the Basel III standard introduces a non-risk-weighted leverage ratio requirement, as well as liquidity requirements for all banking organizations (banking organizations included credit card banks, national and state banks, savings associations, BHCs, and savings and loan holding companies).

As part of Basel III, the "fundamental review of the trading book" (FRTB) changes the treatment of securitization exposures held by banks in the trading book. In general, assets held in the trading book face lower capital charges than those in the banking book and as a result of the FRTB's "Market Risk Amendment," banks are required to hold capital against securitization exposures in the trading book as if they were in the banking book.[32]

The DFA and the Basel III capital framework introduce new liquidity regulations on banks. Specifically, in December 2010, the Basel Committee proposed two liquidity requirements in the form of the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR).[33]

The LCR is designed to ensure that banks meet short-term liquidity needs and requires banks with over $50 billion in assets to hold sufficient high-quality liquid assets (HQLA) to cover projected net short-term cash obligations over a 30-day stress period.[34] Specifically, banks must to maintain a ratio of high-quality liquid assets to net cash outflows greater than one. To qualify as high-quality liquid assets, assets have to meet certain operational requirements including that the assets be unencumbered and under the control of the treasury function.[35]

[32]http://www.bis.org/publ/bcbs193.pdf.

[33]Basel Liquidity Framework, http://www.bis.org/publ/bcbs188.htm.

[34]The scenario for this standard includes: (a) the run-off of a proportion of retail deposits; (b) a partial loss of unsecured wholesale funding capacity; (c) a partial loss of secured, short-term financing with certain collateral and counterparties; (d) additional contractual outflows that would arise from a downgrade in the bank's public credit rating by up to and including three notches, including collateral posting requirements; (e) increases in market volatilities that impact the quality of collateral or potential future exposure of derivative positions and thus require larger collateral haircuts or additional collateral, or lead to other liquidity needs; (f) unscheduled draws on committed but unused credit and liquidity facilities that the bank has provided to its clients; and (g) the potential need for the bank to buy back debt or honor non-contractual obligations in the interest of mitigating reputational risk.

[35]Section 22, p. 61530 of the U.S. final rule implementing the LCR, available at www.gpo.gov/fdsys/pkg/FR-2014-10-10/pdf/2014-22520.pdf.

Moreover, the Basel III framework implements the NSFR as a measure of a bank's liquidity needs over a one-year horizon. Basically, the NSFR is intended to promote resilience over a longer time horizon by requiring banks to fund their activities with more stable sources of funding on an ongoing basis.[36] The liquidity regulations via the LCR and NSFR, collectively, increase the costs of revolving retail credit lines to consumers and businesses, because credit card banks are required to maintain capital against "unconditionally cancellable commitments" such as credit card loans under Basel III liquidity regulations.

In addition to stricter liquidity requirements on credit card banks, the Basel framework tightens leverage requirements. The Supplementary Leverage Ratio (SLR) was first introduced in June 2012 (finalized in July 2013) and applies to large financial institutions with $250 billion or more in total consolidated assets, or $10 billion or more of on-balance-sheet foreign exposures. The SLR introduces a minimum three percent Tier 1 leverage ratio that takes into account both on-balance-sheet assets and off-balance-sheet exposures regardless of their risks. Specifically, the SLR is the ratio of Tier 1 capital to non-risk-weighted "total exposures." Total exposures are defined as the sum of on-balance-sheet assets, exposures from (off-balance-sheet) derivatives, repo-style transactions, and off-balance-sheet exposures from lending commitments, guarantees, warranties, and financial standby letters of credit. Importantly, on-balance-sheet securitizations increase the total exposure measure and thus lower the SLR.

In addition to the SLR, U.S. regulators tightened leverage requirements further in April 2014 by finalizing the Enhanced Supplementary Leverage Ratio (eSLR). The eSLR adds an additional two-percent capital requirement for globally systematically important banks (GSIBs) on top of the previous three-percent SLR requirement, making a total SLR requirement of five percent for these large institutions. Furthermore, any insured depository institution that is a subsidiary of a GSIB must maintain a minimum SLR ratio of six percent to be considered well-capitalized. The eSLR applies only to the largest, most complex U.S. BHCs, those with assets of at least $700 billion or with assets in custody of at least $10 trillion on a consolidated basis with their insured banking subsidiaries. As of 2019, J.P. Morgan Chase, Citigroup, and Bank of America are among the GSIBs.[37]

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[36]In the NSFR requirement, stable funding is defined as "the portion of those types and amounts of equity and liability financing expected to be reliable sources of funds over a one-year." See http://www.bis.org/publ/bcbs188.htm.

[37]The Financial Stability Board publishes an annual list of GSIBs at https://www.fsb.org/work-of-the-fsb/policy-development/addressing-sifis/global-systemically-important-financial-institutions-g-sifis.

There are also indirect operational costs associated with the Basel III liquidity requirements. Under the Dodd-Frank Act Stress Tests (DFAST) and the Comprehensive Capital Analysis and Review (CCAR), which became effective in 2010 and 2011, respectively, large financial institutions are required to submit detailed capital plans over a nine-quarter horizon that show their ability to maintain liquidity and funding ratio requirements across a range of stress scenarios.

A.4.6 Risk-Retention Rules

Section 941 of the Dodd-Frank Act requires that credit card banks retain meaningful risk of securitization transactions, and in April 2011, the SEC, the FDIC, and the Federal Reserve Board jointly issued a proposal implementing Section 941 of the DFA.[38] On October 22, 2014, the SEC, the FDIC, and the Federal Reserve Board finalized risk-retention requirements for credit card securitizations.[39] Regulation RR requires sponsors or a wholly-owned affiliate of the sponsor to retain an unhedged minimum of 5% of the credit risk of the securitized assets. The retained risk can be held in the form of a "seller's interest" representing at least 5% of the aggregate unpaid principal balance of all outstanding investor asset-backed security interests in the issuing entity. Moreover, the amount of risk-retention held in the form of the seller's interest can be offset by amounts in an excess funding account, but the sponsor is not permitted to sell or hedge the retained interest for the life of the transaction, and cannot pledge it for non-recourse financing. Alternatively, the sponsor can meet the risk-retention requirement via "vertical retention," where the sponsor retains a fraction of every tranche.

Prior to Regulation RR, the Federal Deposit Insurance Corporation (FDIC) adopted risk-retention requirements via the "Securitization Rule" from September 2010.[40] Specifically, the rule requires the primary originator of credit card ABS (sponsor) to retain at least five percent of the credit risk of the securitized credit card receivables.[41] The sponsor can retain either an interest of five percent in each of the tranches sold to investors or in a representative sample of the

[38] See https://www.federalreserve.gov/newsevents/pressreleases/bcreg20110331a.htm.

[39] Regulation RR, Federal Register, 79 Fed. Reg. 77601.

[40] FDIC Rule 360.6, available at https://www.fdic.gov/regulations/laws/rules/2000-7800.html.

[41] "Sponsor" includes any "person or entity that organizes and initiates a securitization by transferring financial assets, either directly or indirectly, including through an affiliate, to an issuing entity, whether or not such person owns an interest in the issuing entity or owns any of the obligations issued by the issuing entity. See 12 C.F.R. §360.6(a)(10).

securitized assets equal to not less than five percent of the principal amount of the financial assets at transfer. The FDIC provided that the retention regulations from Section 941(b) of the Dodd-Frank Act are to supersede those from the Securitization Rule once the Dodd-Frank rules become effective.

A.5 Estimating the Consumer Credit Risk Premium.

In this section, we present the consumer credit risk modeling framework used to value credit card ABS tranches. We then discuss the details of how we use this framework to estimate the consumer credit risk premium.

A.5.1 The Consumer Credit Risk Model

We begin by first considering the standard case in which a credit card master trust has securitized a common pool of credit card receivables by issuing separate A, B, and C tranches, each of which is collateralized by those receivables. The C tranche is the most junior of the three tranches and absorbs the first N percent of portfolio credit losses. Using industry terminology, the C tranche is said to attach at zero percent, detach at N percent, and have a thickness of N percent. If there are no credit losses on the underlying pool of receivables, investors in the C tranche receive all promised payments. If the total credit losses on the underlying pool of receivables equals or exceeds N percent, then investors in the C tranche lose 100 percent of their investment. The B tranche is senior to the C tranche and absorbs any credit losses on the portfolio above the initial N percent absorbed by the C tranche, up to a total of $N+M$ percent of the portfolio. Thus, the B tranche is said to attach at N percent, detach at $N+M$ percent, and have a thickness of M percent. If the total credit losses for the portfolio are less than N percent, investors in the B tranche receive all promised payments. If the total credit losses equal or exceed $N+M$ percent of the portfolio, investors in the B tranche lose 100 percent of their investment. Finally, the A tranche is the most senior tranche and absorbs all credit losses on the portfolio above and beyond the first $N+M$ percent that are collectively absorbed by the C and B tranches. Thus, the A tranche attaches at $N+M$ percent, detaches at 100 percent, and has a thickness of $100-N-M$ percent.

Let ρ denote the charge-off rate on the underlying portfolio of credit card receivables. Since ρ represents the probability that any individual account defaults and cannot pay, the probability ρ can be different under the risk-neutral and objective measures. We denote the risk-neutral and objective charge-off probabilities by ρ_Q and ρ_P, respectively.

As described in the paper, the excess spread for the underlying portfolio equals the yield on the portfolio minus debt servicing costs, servicing fees, and

portfolio charge-offs. Let X denote the risk-neutral excess spread (given by subtracting off the risk-neutral charge-off rate ρ_Q rather than ρ_P). We assume that the excess spread X has the following dynamics under the risk-neutral measure

$$dX = (\alpha - \beta X)dt + \sigma dZ, \tag{A1}$$

where dZ denotes the increment of a standard Brownian motion and α, β, and σ are constants. Consistent with the properties of excess spreads, these dynamics allow X to take both positive and negative values.

Denote the expected maturity date for the C tranche by T. Let F denote the risk-neutral probability that X makes a first passage to zero by time T. If a first passage does not occur by time T, portfolio losses are zero. If a first passage does occur, however, we assume that there are three different possible outcomes for the total credit losses on the underlying portfolio. Specifically, we assume that conditional on a first passage, the loss is N percent with probability c/F, $N + M$ percent with probability b/F, and 100 percent with probability a/F. Conditional on the value of X, this specification implies that there are four possible outcomes for losses on the portfolio. In particular, the portfolio loss is zero with probability $1 - F$, N percent with probability c, $N + M$ percent with probability b, and 100 percent with probability a. Since the probabilities must sum to one, $F = a + b + c$.

To solve for the probabilities a, b, and c, we first need to estimate the present value of the expected losses for each of the A, B, and C tranches. To do this, we first compute the hypothetical value of each tranche under the assumption of no losses. This is done by simply discounting the promised cash flows for each tranche at the riskless Treasury rate. We then calculate the present value of the expected losses by taking the difference between the riskfree value of the tranche and its actual market price. Let V_A, V_B, and V_C denote the present value of the expected losses for the respective tranches.

We next solve for the expected losses per dollar notional amount for the three tranches which we denote respectively as E_A, E_B, and E_C. Under the assumptions that losses are uncorrelated with the riskless discount rate and are realized at the expected maturity date of the tranche, then

$$E_A = V_A/D(T), \tag{A2}$$
$$E_B = V_B/D(T), \tag{A3}$$
$$E_C = V_C/D(T), \tag{A4}$$

where $D(T)$ denotes the price of a riskless zero-coupon bond with maturity T.

Finally, the expected losses for the three tranches can be expressed in terms of the probabilities a, b, and c as follows

$$E_A = a + b + c, \tag{A5}$$
$$E_B = a + b, \tag{A6}$$
$$E_C = a. \tag{A7}$$

These expressions, in conjunction with those above, imply that the probabilities a, b, and c can be determined directly from the present values of expected losses estimated from the market prices of the A, B, and C tranches.

Once the probabilities a, b, and c are determined, the value of the implied risk-neutral probability F of a first passage is given as $F = a + b + c$. Given the value of F, we can then solve for the implied value of the risk-neutral excess spread X by inverting the following closed-form expression for the first passage probability of an Ornstein-Uhlenbeck process,

$$F = -\beta \int_0^\infty \exp(\beta(w^2 - a^2)/2 - \beta\ t\ \nu_{j,a\sqrt{2\beta}}) \sum_{j=0}^{\infty} \frac{D_{\nu_{j,a\sqrt{2\beta}}}(w\sqrt{2\beta})}{D'_{\nu_{j,a\sqrt{2\beta}}}(a\sqrt{2\beta})}\ dt, \tag{A8}$$

where

$$w = -\frac{\alpha}{\beta\sigma} + \frac{X}{\sigma}, \tag{A9}$$

$$a = -\frac{\alpha}{\beta\sigma}, \tag{A10}$$

and where $D_\nu(\cdot)$ is the parabolic cylinder function with index ν, $(\nu_{j,b}), j \geq 1$ is the ordered sequence of positive zeros for $\nu \to D_\nu(b)$, and $D'_\nu(\cdot)$ is the derivative of $D_\nu(\cdot)$ with respect to its index.[42]

[42]The first passage density for the Ornstein-Uhlenbeck process is obtained directly by first using the transformation in Section 2 of Lipton and Kaushansky (2018) and then applying Theorem 3.1 of Alili, Patie, and Pedersen (2005).

Once the value of the risk-neutral excess spread X is determined, we can solve for risk-neutral charge-off rate ρ_Q directly. To see this, recall that the excess spread is defined as the portfolio yield minus debt costs, servicing fees, and the charge-off rate. Since only the charge-off rate differs between the objective and risk-neutral measures, the difference between the objective and risk-neutral excess spreads is simply $\rho_Q - \rho_P$. Thus, the value of ρ_Q is obtained immediately by adding this difference to the observed value of ρ_P.

A.5.2 The Empirical Methodology

In solving for the consumer credit risk premium for an issuer for month t, we estimate the consumer credit risk premium separately for each series of A, B, and C tranches for that issuer and then take a simple arithmetic average of the implied consumer credit risk premia over all of the series in the data set for that issuer that month. In doing this, we restrict the sample to series with at least 12 months to expected maturity and to series with 20 years or less to expected maturity.

We estimate the riskless discount function $D(T)$ using the following approach. We collect month-end values of the constant maturity Treasury (CMT) rates for 1-month, 3-month, 12-month, 2-year, 3-year, 5-year, 7-year, 10-year, and 20-year maturities from the Federal Reserve H.15 release for each month during the sample period. We then use a standard exponential spline algorithm to bootstrap the discount function and interpolate it to a vector of monthly horizons ranging from one month out to 20 years (for more details on this algorithm, see Longstaff, Mithal, and Neis (2005)).

Many of the credit card securities in the sample pay monthly fixed coupons. The other securities pay monthly floating coupon payments tied to either one-month or three-month Libor (plus a spread). For comparability, however, it is often useful to place all of the securities on a common basis by either swapping the fixed rate securities into floating, or swapping the floating rate securities into fixed. To illustrate this, we couch the discussion in terms of swapping the floating rate securities into fixed (the procedure for swapping fixed coupon securities into floating is directly analogous).

First, we swap the floating index for the securities paying coupons based on one-month Libor into three-month Libor by using a standard basis (or tenor) swap (for a discussion of the basis swap market, see Fleckenstein and Longstaff (2020)). Since this basis swap typically involves a small fixed spread of several basis points, the net effect of this is to adjust the spread on the floating rate security slightly. Second, we then swap out the floating three-month Libor cash flows for the securities using a standard fixed for three-month Libor swap. Since the fixed leg of a standard swap pays coupons on a semiannual basis, we make a

slight adjustment to the market swap rate by reannuitizing the fixed leg of the swap to correspond to monthly cash flows. The net effect of entering into this swap is to convert the net monthly cash flows from Libor plus the fixed spread to the sum of the fixed swap rate plus the fixed spread (which simply becomes a new fixed coupon once added together). We note that since the initial market values of the swaps entered into are zero, the process of swapping into fixed does not change the price of the credit card security (with the accompanying swap)—swapping the security into fixed only changes the effective net coupon rate.

The modeling framework described above is based on the assumption that data are available for all three of the A, B, and C tranches for the credit card securitization. For a subset of the sample, however, we are missing data for the junior C tranche. In these cases, we adapt the methodology slightly by making the assumption that the probability c equals b, which then allows us to solve for the probability of a first passage and the implied value of ρ_Q. To examine the robustness of this assumption, we compare the values of c and b for the observations when data on all three of the A, B, and C tranches are available. We find that the median value of the ratio of c to b is 1.04. This suggests that this assumption is probably a reasonable one.

For most of the credit card securitizations in the data set, the A, B, and C tranches are issued simultaneously as a series. For some types of credit card trusts, however, all C tranches provide subordination support for all A and B tranches, and all B and C tranches provide subordination support for all A tranches. These types of trusts are often referred to as "socialized" structures. In this situation, A, B, and C tranches need not be issued simultaneously as long as the C tranches collectively provide sufficient subordination support for the more senior tranches, and similarly for the B tranches. For these trusts, we use the following protocol. If there is data for one or more C tranches available for a given month, then we use the prices of those tranches to estimate the implied probability of a first passage. If there are no C tranches, however, we form pairs of the available A and B tranches and use the procedure described in the previous paragraph to estimate the implied probability of a first passage. In doing this, however, we only use pairs of A and B tranches where the expected maturities of the two tranches are within one month of each other.

World Financial uses a structure that differs only slightly from the other master trusts in our data. Specifically, the Word Financial Credit Card Master Note Trust issued certificates referred to as "Class-M" notes that are subordinate to the class A notes, but senior to class B notes. In this instance, we designate the Class M notes as the B tranche, but otherwise follow the same algorithm.

As discussed in the paper, a credit card ABS with an expected maturity

date of T months is generally in the revolving phase until $T - 12$ months, and then enters into a planned amortization phase in which its principal is returned to investors over a 12-month horizon in 12 equal amounts. Since capturing this feature in the modeling framework would add significant complexity without any meaningful impact on the results, we make the simplifying assumption that the credit card ABS pays off the full notional amount at time $T - 6$, unless a prior first passage has occurred.

We require estimates of the parameters α, β, and σ to implement the dynamic model for the excess spread process. Numerical estimation shows that the parameters α and β have relatively little effect on the estimated values of the consumer credit risk premia. Accordingly, we make the simplifying assumption that $\alpha = \beta = 0$. As an estimate of the volatility parameter, we use the standard deviation of month-to-month changes in the observed charge-off rate. We find that this value is remarkably stable both over time as well as across credit card master trusts. Given this, we simply use the unconditional standard deviation of changes in the charge-off rate of 0.50 percent per month as the value of σ throughout the entire estimation process. For robustness, we also use an GARCH framework to provide a time-varying estimate of the volatility of monthly changes in the charge-off rate. These results obtained using this approach are virtually identical to those we present in the paper.

Finally, for computational simplicity, we solve for the implied risk-neutral excess spread X using a simulation approach rather than numerically inverting the expression in Equation (A8). Specifically, for a given trial value of the initial value of X, we simulate 50,000 paths of the excess spread from time zero to time T and estimate the probability of a first passage by tabulating the fraction of the paths that attain negative values prior to time T. In doing this, we follow industry practice and define the first passage to occur when the implied risk-neutral excess spread is negative on average over a three-month period. We then iterate this process over values of X until the simulated first-passage probability matches the value for F implied by solving for the probabilities a, b, and c from the prices of the credit card ABS tranches.

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Table A1

Data Definitions and Sources. This table summarizes the datasets used in this study. Frequency shows at what intervals the data are available. Description and Source show the data source and its definition. The data are for the period from January 2000 through January 2020.

	Data	Frequency	Description and Source
1	Treasury CMT Data	Daily	Constant maturity Treasury rates from the Federal Reserve H.15 Selected Interest Rates Release for tenors of 1, 3, 6 months and 1, 2, 3, 5, 7, 10, 20 years.
2	Discount Function	Daily	Discount function out to 20 years bootstrapped from Treasury CMT Data as described in Liu, Longstaff, Mandell (2006).
3	Libor Interest Rate Swap Spreads	Daily	Three-month Libor into fixed interest rate swap rates. Cash flows on the fixed leg are semiannual, and the floating leg pays three-month Libor each quarter. Data from the Bloomberg system for tenors of 3, 6, 9, 12, 18 months, and 2, 3, 4, 5, 7, 10, 12, 15, 20 years.
4	Libor Basis Swap Spreads	Daily	Three-month Libor into One-month Libor interest rate basis swap rates. Cash flows on the fixed leg are at quarterly frequency, and the floating leg pays one-month Libor reset monthly each quarter. Data from the Bloomberg system for tenors of 3, 6, 9, 12, 18 months, and 2, 3, 4, 5, 7, 10, 12, 15, 20 years.
5	Libor	Daily	Three-month USD London Interbank Offered Rate (LIBOR) from the Bloomberg system.
6	Ten-year Rate	Daily	The ten-year Treasury constant maturity rate from the Federal Reserve H.15 Selected Interest Rates Release. Data from the Bloomberg system.
7	Treasury Bill Rate	Daily	The three-month Treasury bill rate from the Bloomberg system.
8	Eurodollar Futures Data	Daily	Three-month Eurodollar Futures prices for contract expirations in September, December, March, and June from Bloomberg.
9	Turn-of-Year Measure	Daily	The Fleckenstein and Longstaff (2020) turn-of-the-year index of balance sheet costs.
10	Commercial Paper (CP) Spread	Daily	The spread on investment grade U.S. commercial paper and the 3-month Treasury bill rate from the Federal Reserve Bank of St. Louis. Data from the Bloomberg system.
11	AAA Spread	Monthly	The spread between yields on AAA corporate bonds and the 10-year Treasury rate. Data from the Bloomberg system.
12	BBB Spread	Monthly	The spread between yields on BBB corporate bonds and the 10-year Treasury rate. Data from the Bloomberg system.
13	High-Yield Spread	Monthly	The Bloomberg index of High-yield corporate bond spreads relative to Treasury rates. Data from the Bloomberg system.

Table A1 — Continued

	Data	Frequency	Description and Source
14	CDS Spread	Monthly	The five-year credit default swap spread on credit card banks from the Bloomberg system.
15	Intermediary Leverage Ratio	Monthly	The He, Kelly, and Manela (2017) intermediary leverage factor. Data from the authors' webpage.
16	Monthly Payment Rate	Monthly	Monthly payment rates (MPR) of the credit card master trusts from the Bloomberg system. The monthly payment rate is the ratio of total cash flows collected each month divided by the portfolio balance, expressed as a percentage.
17	Credit Card ABS Tranche Prices	Monthly	Prices of individual A, B, and C tranches of the credit card securitizations in the sample. Data from the Bloomberg system.
18	Portfolio Yield	Monthly	Monthly portfolio yields of the credit card master trusts from the Bloomberg system. The portfolio yield is the annualized percentage gross return on the portfolio.
19	Excess Spread	Monthly	Monthly excess spreads of the credit card master trusts from the Bloomberg system. The excess spread is the annualized percentage net return on the portfolio.
20	Charge-off Rate	Monthly	Monthly charge-off rates of the credit card master trusts from the Bloomberg system. The charge-off rate is the one-month annualized percentage rate of charge-offs on the portfolio.
21	Risk Retention Ratio	Monthly	Required minimum issuer risk retention ratio for the credit card securitization portfolio. Data collected from prospectuses filed with the SEC (form 424-B filings).
22	Attachment and Detachment Points	Monthly	The average attachment and detachment points for individual tranches, expressed as percentages of the total notional amount of the securitization. Data collect from from prospectuses filed with the SEC (form 424-B filings).
23	Tier 1 Capital Ratio	Quarterly	Tier 1 capital as a percentage of risk-weighted assets. Data are averages over all banks with total assets in excess of $10 Billion provided by the FDIC (https://www.fdic.gov/bank/statistical/).
24	Capital Ratios	Quarterly	Quarterly Tier-1 capital ratios, Tier-1 leverage ratios, and equity-to-assets ratios the parent companies of the individual credit card master trusts. Data from CapitalIQ.
25	Credit Spreads	Quarterly	Weighted-average yield to maturity on bonds issued by the parent companies of the individual credit card master trusts relative to 2-year Treasury rates. Data from CapitalIQ.

Table A2

Credit Card Issuers. This table presents the credit card issuers used in the analysis along with the names of the credit card master trusts and their identifiers in the Bloomberg system.

	Issuer	Issuing Entity	Bloomberg Identifier
1	American Express	Credit Account Master Trust	AMXCA
2	Bank of America	Credit Card Trust Master Credit Card Trust	BACCT BAMT
3	Bank One	Master Trust Issuance Trust	BOMT BOIT
4	Citibank	Credit Card Issuance Trust	CCCIT
5	Chase	Credit Card Master Trust Issuance Trust	CHAMT CHAIT
6	Capital One	Master Trust Multiasset Execution Trust	COMT COMET
7	Discover	Card Master Trust Card Execution Note Trust	DCMT DCENT
8	First National	Master Note Trust	FNMT
9	MBNA	Credit Card Master Note Trust Master Credit Card Trust	MBNAS MBNAM
10	World Financial	Credit Card Master Note Trust	WFNMT