# Regulating Consumer Financial Products: Evidence from Credit Cards*

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**Abstract**

We analyze the effectiveness of consumer financial regulation by considering the 2009 Credit Card Accountability Responsibility and Disclosure (CARD) Act in the United States. Using a quasi-experimental research design and a unique panel data set covering over 150 million credit card accounts, we find that regulatory limits on credit card fees reduced overall borrowing costs to consumers by an annualized 1.7% of average daily balances, with a decline of more than 5.5% for consumers with the lowest FICO scores. Consistent with a model of low fee salience and limited market competition, we find no evidence of an offsetting increase in interest charges or reduction in volume of credit. Taken together, we estimate that the CARD Act fee reductions have saved U.S. consumers $12.6 billion per year. We also analyze the CARD Act requirement to disclose the interest savings from paying off balances in 36 months rather than only making minimum payments. We find that this "nudge" increased the number of account holders making the 36-month payment value by 0.5 percentage points.

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# 1 Introduction

The recent financial crisis triggered a surge of interest in regulating consumer financial products (e.g., Campbell et al., 2011; Posner and Weyl, 2013). In the United States, the Dodd-Frank "Wall Street Reform and Consumer Protection Act" of 2010 established a Consumer Financial Production Bureau to monitor and regulate mortgages, students loans, credit cards, and other similar products. In July 2013, the European Commission followed suit and proposed new consumer financial protection legislation to simplify disclosures and tighten guidance requirements related to financial products.

Proponents of this type of regulation argue that consumer financial markets have become increasingly unfair. Firms take advantage of consumers' behavioral biases—such as myopia, present bias and inattention—to earn large profits, especially from unsophisticated and poor consumers.[1] These proponents suggest that regulation and additional information provision can protect less sophisticated consumers and reduce borrowing costs for consumers in aggregate.

Critics have expressed skepticism about the effectiveness of consumer financial regulations. While limits on hidden fees, for example, can shift surplus from more to less sophisticated consumers (Gabaix and Laibson, 2006), there is less evidence that regulators can bring about an across-the-board reduction in consumer costs. Regulators, these critics attest, are naively playing a game of regulatory Whac-A-Mole—efforts to limit certain fees will simply lead firms to offset reduced revenue with higher prices on other product dimensions and to restrict the supply of credit (American Bankers Association, 2013).[2] Even proponents of regulating late fees, such as Mullainathan, Barr and Shafir (2009), worry that "the reduced revenue stream to lenders from these fees would mean that other rates and fees would be adjusted to compensate."

The success of regulation meant to influence the behavior of consumers, such as "nudging" them to make larger payments, is also subject to debate. While countries such as the United Kingdom have set up "Nudge Units" to "encourage people to make better choices for themselves," there has been skepticism as to whether nudges in isolation can make a "real difference to society's biggest problems" (House of Lords, 2011).[3]

[1] Senator Chris Dodd, lead sponsor of the CARD Act in the U.S. Senate, has noted that "My colleague from New York, Senator Schumer, has called this 'trip-wire pricing,' saying the whole business model of the credit card industry is not designed to extend credit but to induce mistakes and trap consumers into debt. I think he is absolutely right, unfortunately. This is an industry that has been thriving on misleading its consumers and its customers." (U.S. Senate, 2009*a*)

[2] Whac-A-Mole is an arcade game in which the objective of hitting a mechanical mole with a mallet causes another mole to appear. This concept is similar to the "waterbed effect," which is used to describe the price offsets in two-sided markets.

[3] The report finds that nudges, "used in isolation, will often not be effective in changing the behaviour of the population.

This paper aims to advance this debate in the context of the Credit Card Accountability Responsibility and Disclosure (CARD) Act of 2009, which was drafted to "implement needed reforms and help protect consumers by prohibiting various unfair, misleading and deceptive practices in the [U.S.] credit card market" (U.S. Senate, 2009*b*). We focus on analyzing the effectiveness of two key aspects of the CARD Act: (i) regulatory limits on the ability of banks to charge certain types of credit card fees, which became effective in February and August of 2010, and (ii) attempts to affect consumers' repayment behavior by installing requirements that credit card bills provide clear information on the costs of only making the minimum payment, which became effective in February 2010.

We conduct a quantitative analysis of the effects of the CARD Act's provisions using a unique dataset on a near universe of credit card accounts held by the eight largest U.S. banks. These data, assembled by the Office of the Comptroller of the Currency (OCC), provides us with account-level information on contract terms, utilization and payments at the monthly level from January 2008 to December 2012. We observe fees at a disaggregated level, allowing us to isolate effects on categories such as over-limit and late fees. Our data cover 150 million consumer and small business accounts and a significant share of total industry assets during our period of study.

We show that in the pre-CARD Act period (April 2008 to January 2010), for each dollar borrowed in average daily balances (ADB), the average consumer paid an annualized 21.9% in interest payments and fees, cost the bank 15.6% in charge-offs, and generated a net profit of 1.6%.[4] Given the leverage of the U.S. commercial banking sector, this implies a return on equity for the credit card portfolio of at least 10%, about five times the U.S. commercial banking sector's average return on equity over the same period. Consumers with low FICO scores (<620) paid about 43.9% per dollar borrowed in interest and fees and generated a net profit of 7.9%.[5] Consistent with the view promoted by supporters of enhanced regulation, banks seem to be earning significant profits, even during the depth of the financial crisis, and earn the most from the consumers with the lowest FICO scores.[6]

Instead, a whole range of measures—including some regulatory measures—will be needed to change behaviour in a way that will make a real difference to society's biggest problems." It concludes that "a lot more could, and should, be done to improve the evaluation of interventions. This is not only good practice but would help to build a body of research that could inform effective policies targeting population-level behaviour change."

[4]The balance of the bank's revenue is derived from interchange income, which is roughly proportional to the transaction volume on the credit cards, and contributed 3.2% income per unit of borrowing. The other costs for the banks were the cost of funds (2.3% of ADB), rewards and fraud expenses (2.2% of ADB) and operational costs (3.4% of ADB).

[5]We use the term "borrow" to refer to average daily balances (ADB). As we discuss in Section 2, ADB do not include purchase volume that is paid off before the end of the consumer's grace period.

[6]It is conceivable the these consumers are also gaining the most consumer surplus from credit access through credit cards. A responsible policymaker would consider both consumer and producer surplus when evaluating the merits of this segment of the market.

We estimate the intended and unintended consequences of the CARD Act using a difference-in-differences research design that compares changes in outcomes over time for consumer credit cards, which were subject to the new regulations, to changes in outcomes for small business credit cards, which were not covered by the law. The identifying assumption is that, in the absence of the CARD Act, outcomes for consumer and small business accounts would have maintained parallel trends. This approach filters out macroeconomics events, and allows us to interpret differential changes in outcomes for consumer cards (the "treatment" group) relative to small business cards (the "control" group) as evidence on the effects of the CARD Act.

We argue that our identifying assumption is valid for two reasons. First, consumer and small business credit cards are institutionally similar and are issued by the same business division of most banks. Second, and more important, we show that outcomes for consumer and small business cards follow parallel trends during the pre-CARD Act period. To strengthen our interpretation, we also conduct placebo tests using high FICO score consumer accounts, which were largely unaffected by the CARD Act, and find no differential response for these account holders.

Using this difference-in-differences strategy, we find that regulations to limit fees were highly effective. For borrowers with a FICO score below 660, over-limit fees dropped from an annualized 3.3 percent of average daily balances to virtually zero in February 2010, and late fees dropped 1.5 percentage points over the February 2010 and August 2010 implementation phases, leading to an overall decrease in total fees of 5.5 percentage points of average daily balances. Account holders with a FICO score above 660 had lower pre-CARD Act fees levels, and experienced qualitatively similar but smaller declines in fees, with a total drop over the implementation phases of 0.5 percentage points of average daily balances. Combined across the the low and high FICO score accounts, the CARD Act reduced overall fee costs by an annualized 1.7% of borrowing volume. Given an outstanding credit card volume of $744 billion in the first quarter of 2010 (Federal Reserve Bank of New York, 2013), this translates into annual cost savings for U.S. credit card users of $12.6 billion per year.

The CARD Act also included provisions to affect the repayment behavior of credit card borrowers. In particular, it required credit card statements to prominently display the cost to repay the balance when only making minimum payments, and to compare this amount to the cost if the card holder repaid the current balance within 36 months. The aim was to "nudge" consumers towards paying off a larger fraction of their balance and reduce their overall interest payments (Thaler and

Sunstein, 2008). While the impact of these types of disclosure regulations has been studied in small, experimental settings (Navarro-Martinez et al., 2011), the CARD Act provides a rare opportunity to analyze the impact of framing in financial decision making in a nationally representative and economically important context.

We find that these disclosure requirements had a small but significant effect on borrowers' repayment behavior. The number of account holders paying at a rate that would repay the balance within 36 months increased by 0.5 percentage points. Cyclical and seasonal variation in repayment behavior makes it hard to determine conclusively whether this shift came from borrowers who had previously been making higher or lower payments. To provide an upper bound on the resulting change in interest payments, we assume that these account holders would have counterfactually been making no payments. Under this assumption, we calculate that the nudge reduced interest payments in aggregate by no more than 0.01% of ADB, or approximately $71 million.

We next examine possible unintended consequences of the CARD Act on credit card pricing and credit volume. We start by making a conceptual point that for limits on fees to be offset by increases in interest charges or other prices, it is sufficient for (i) markets to be perfectly competitive or (ii) fees to be perfectly salient. If markets are perfectly competitive, then aggregate prices inclusive of all fees will be forced down to marginal costs, and any regulation that reduces a certain fee will be offset with a similarly sized increase in another pricing dimension. If all fees and prices are perfectly salient, then demand is only responsive to the aggregate price, and demand will be unresponsive to an equally sized reduction in one fee and increase in another. If, however, markets are not perfectly competitive and the fee is at least partially non-salient, then regulators can be successful in lowering aggregate consumer costs.

Our model also makes predictions about the effect of the CARD Act on the equilibrium quantity of credit. If fees are perfectly salient, then consumers will be fully aware of the one-for-one offset of interest charges for fees, and equilibrium quantity will not change. If fees are non-salient, and the offset is large, then consumers will only observe a large increase in interest charges and overall quantity will decline. If, however, fees are non-salient and markets are not perfectly competitive, then the offset can be small and equilibrium volume may not change.

We find little offsetting response in terms of pricing. Using the difference-in-differences approach described above, we show that there is not evidence of a sharp increase in interest charges during

the CARD Act implementation period or a gradual increase over a longer time horizon. We also examine interest charges on new accounts, for which banks are less constrained in their ability to adjust contract terms, but find no evidence of an uptick or gradual increase in this sample. Our point estimate for the offset is approximately zero and we can rule out an offset of greater than 57% with 95% confidence. In addition, we find no evidence of an offsetting increase in other sources of credit card income (e.g., interchange fees) or a reduction in measures of costs (e.g., marketing expenses).

Using the same difference-in-differences design, we find no effect of the CARD Act on the volume of credit as measured by credit limits, the number of new accounts opened, and average daily balances. These findings are consistent with the model which predicts no change in the volume of credit when the offset is zero. Taken together, we interpret the results as demonstrating that regulation of "hidden fees" can bring about a substantial reduction in borrowing costs without necessarily leading to an offsetting increase in interest charges or a reduction in access to credit. While the results do not speak to the persistence of these savings, even over a modest time horizon the estimated annual savings of $12.6 billion are quantitatively significant.

Our paper contributes to a literature analyzing credit card usage and pricing (Ausubel, 1991; Calem and Mester, 1995; Gross and Souleles, 2002; Agarwal et al., 2006; Kuchler, 2013; Stango and Zinman, 2013) and the debate about regulating consumer financial products (Campbell, 2006; Bar-Gill and Warren, 2008; Mullainathan, Barr and Shafir, 2009; Cooley et al., 2009; Heidhues and Kőszegi, 2010; Campbell et al., 2011). Our paper also adds to a body of research that analyzes the effectiveness of nudges and default options in influencing consumer decision-making (Madrian and Shea, 2001; Thaler and Benartzi, 2004; Choi, Laibson and Madrian, 2005; Carroll et al., 2009; Mitchell et al., 2009).

To our knowledge, Debbaut, Ghent and Kudlyak (2013) and Jambulapati and Stavins (2013) are the only other papers empirically analyzing the CARD Act. Debbaut, Ghent and Kudlyak (2013) focus on the restriction of lending to borrowers under the age of 21, and find that young borrowers are, in fact, less likely to default. Jambulapati and Stavins (2013) consider whether banks closed consumers credit card accounts or otherwise restricted access to credit in advance of the CARD Act. Consistent with our findings, they do not find evidence that banks closed credit card accounts or increased interest rates between the time when the CARD Act was signed and when its provisions became law.

The rest of the paper proceeds as follows: Section 2 provides background on the U.S. credit

card industry and describes the key provisions of the 2009 CARD Act. Section 3 describes the data, and establishes some basic facts about profitability in the pre-CARD Act period sample. Section 4 describes our research design and our approach to conducting inference. Section 5 examines the intended consequences of the CARD Act, first examining the effect on fees and then turning to the effect of the disclosure nudge. Section 6 examines unintended consequences, starting with the model of offsets and the presenting results on the response of interest charges and credit volume. Section 7 concludes.

## 2 Credit Cards and the 2009 CARD Act

### 2.1 Credit Cards

Account holders use credit cards to make purchases and to borrow. When an account holder carries a balance from the previous period billing cycle, interest charges for the current cycle are given by

$$\text{Interest Charges} = \text{ADB} \times \frac{\text{APR}}{365} \times \text{Days in Billing Cycle}$$

where the right-hand side is the product of the average daily balance (ADB), defined as the arithmetic mean over the billing cycle of end-of-day balances; the daily interest rate, defined as the annual percentage rate (APR) divided by 365; and the number of days in the billing cycle.[7,8]

Account holders who do not carry a balance into the current period have the possibility of repaying current period purchase volume without incurring interest charges. If an account holder pays off their purchase volume completely, interest charges typically fall within a "grace period" and are not assessed by the bank. If an account holder does not pay their balances in full, the account holder is charged interest starting from the date of purchase.

The APR and the credit limit are two of a credit card's most important contract characteristics. Many credit cards have initial interest rates of zero that jump to pre-specified amounts after a pre-set number of months. Credit limits place an upper bound on consumer purchases and borrowing. Con-

[7]The APR measure does not account for compounding. For instance, a consumer with an APR of 15% that carries an ADB of $1,000 for 12 consecutive 30-day months would have their balance grow to $1,158 = 1,000 \times (0.15/365 \times 30 + 1)^{12})$ instead of $1,150 = 1,000 \times (0.15 + 1)$.

[8]In the past, some credit card issuers used a method known as "double cycle billing" to calculate interest payments. This method calculated average daily balances over two cycles, rather than just considering the current cycle. Double cycle billing sometimes added significant interest charges to customers whose average balance varied greatly from month to month. This method was banned by the CARD Act.

sumers who exceed their credit limit are assessed an over-limit fee or can have transactions declined. Credit cards have a number of other fees that we discuss below.

Credit card borrowing is not secured by collateral, though lenders may garnish the wages or seize assets of account holders who default. Recovery rates are low, in part because credit card debt is junior to all forms of secured borrowing. To manage and price this default risk, most credit card issuers screen applicants using both FICO scores and internally generated risk measures. Credit cards are marketed to consumers through a number of channels, including direct mail, TV advertisements and cross-promotion. Credit cards often provide consumers with cash back or reward points, which scale with purchase volume, and can be used with airlines, gas stations, or other affiliated stores.

For some of our analysis, we compare outcomes for consumer credit cards (referred to in the industry as "general purpose" credit cards) and small business credit cards. These types of cards are institutionally similar. Like consumer credit cards, small business cards are guaranteed by the personal financial assets of the account holder. Applicants for both types of cards are screened on their FICO scores.[9] Like consumer cards, small business cards have features like rewards, balance transfers and zero introductory rate, and are marketed by direct mail and TV advertisements. Because of the similarities in underwriting and promotion, consumer and small business credit cards are issued by the same business unit and regulars conduct joint assessments of consumer and small business credit card lending. The main difference between consumer and small business cards is that small business account-holders must claim to use their cards for "business" and "commercial" purposes only. Banks in most circumstances do not monitor this behavior and survey evidence indicates that a significant percentage of charges are used for personal expenditure (Federal Reserve Board of Governors, 2010).

### 2.2 The 2009 CARD Act

The Credit Card Accountability Responsibility and Disclosure Act of 2009 or CARD Act was introduced in the 111th United States Congress (H.R. 627).[10] On April 30, 2009, it passed the House with a significant majority (357-70). The Senate passed an amended version of the bill on May 19, 2009, also with an overwhelming majority (90-5). President Obama signed the bill into law on May 22, 2009.

[9] Small business cards are also secured by firm assets. However, for many small business card holders, personal assets such home and vehicle equity tend to be much more important than business assets.

[10] Congress had previously drafted consumer financial regulation that included many of the same provisions as the CARD Act. The most recent attempt, also sponsored by Carolyn Maloney, was known as the "Credit Cardholders' Bill of Rights Act of 2008," and was introduced in the 110th Congress as H.R. 5244. While the bill had passed 312 to 112 in the House, it was never given a vote in the Senate.

The CARD Act primarily amended the Truth in Lending Act (TILA) and instituted a number of new substantive consumer protection and disclosure requirements for consumer credit cards. The regulation excluded small business credits cards.[11] The provisions of the CARD Act were scheduled to take effect in three phases between August 20, 2009 and August 22, 2010.

### 2.3 Phase 1 - August 20, 2009

On August 20, 2009, the first wave of CARD Act provisions came into effect. The most important change required banks to provide a 45-day advance notice to consumers of rate increases or any other significant changes to terms and conditions. Lenders were also required to (i) inform consumers in the same notice of their right to cancel the credit card account before the increase or change goes into effect and (ii) mail or deliver periodic statements for credit cards at least 21 days before payment is due.

### 2.4 Phase 2 - February 22, 2010

The bulk of CARD Act provisions came into effect on February 22, 2010. A key requirement was that no fees could be imposed for making a transaction that would put the account over its credit limit unless the cardholder explicitly "opts in" for the credit card company to process rather than decline over-limit transactions. Furthermore, an over-limit fee may be imposed only once during the billing cycle when the limit is exceeded, not once for each transaction that exceeds the credit limit. The new provisions also prohibited creditors from charging a fee for making a payment, except for payments involving an expedited service by a creditor representative. Other restrictions regulated the issuance of credit cards to borrowers below age 21.

The CARD Act also introduced regulation detailing repayment disclosures required in monthly credit card statements. In particular, it required statements to show important repayment information including:

1. The number of months (rounded to the nearest month) that it would take to pay the outstanding balance, if the consumer only pays the required minimum monthly payments and no further

[11] Legislation has recently been proposed to extend the CARD Act provisions to the small business category. The Small Business Credit Card Act of 2013 (H.R. 2409), amends the CARD Act definition of consumer to include small business credit cards. It was introduced in the House Financial Services Committee on June 18, 2013 but as of December 2013 has not advanced.

advances are made;

2. The total cost to the consumer, including interest and principal payments, of paying that balance, if the consumer only pays the required minimum monthly payments and no further advances are made; and

3. The monthly payment amount that would eliminate the outstanding balance in 36 months, if no further advances are made, and the total cost to the consumer, including interest and principal payments, of paying that balance in full.

Figure 1 provides an example of the way this information is displayed on credit card statements.[12]

The CARD Act also included a restriction on interest rate increases for new transactions within the first year of opening the card. It also limited the application of increased rates to existing balances, except if the prior rate was temporary (e.g., an introductory rate) lasting at least six months or if the minimum payment has not been received for 60 days. For cards with multiple interest rates (e.g., a balance-transfer and a new-purchase rate), issuers were required to apply payments to the highest-rate balances first.

Finally, the CARD Act regulated payment due dates and times. Credit card issuers are no longer allowed to set early morning or other arbitrary deadlines for payments. Any payments received before 5 p.m. on the payment due date have to be accepted. If payments are due on a day during which lenders do not receive payments by mail (including weekends and holidays), a payment received on the next business day cannot be treated as late.

### 2.5 Phase 3 - August 22, 2010

The third phase of the CARD Act further regulated the fees banks can charge by requiring them to be "reasonable and proportional." Under the new rules a credit card company generally cannot charge a late fee of more than $25 unless one of the last six payments was late (in which case the fee may be $35). Second, the late fee cannot be larger than the minimum payment. Similarly, over-limit fees were capped at the actual over-limit amount. An additional provision prevented issuers from charging more than one penalty fee based on a single violation of account terms per period (such as

[12]This new information might be less salient for individuals who do most of their banking online. Rather than alerting consumers to the minimum payment warnings when they log on, many banks limited the changes to monthly statements. That means cardholders have to view a PDF copy of their full statements to see the minimum payment warnings.

a late payment). The CARD Act also prohibited the charging of inactivity fees for not using the credit card for a period of time. Finally, it required lenders to re-evaluate any new rate increases every six months.

# 3 Data and Pre-CARD Act Industry Overview

## 3.1 Data

Our main source of data is the Credit Card Metrics (CCM) dataset assembled by the U.S. Office of the Comptroller of the Currency (OCC). The OCC charters, supervises and regulates nationally chartered banks and federal savings associations.[13] In 2008, the OCC initiated a request to the nine largest banks that issue credit cards to submit data on general purpose, private label and small business cards. The purpose of the data collection was to have more timely and complete information for ongoing supervision, which includes quarterly risk assessments, supervisory strategy and continuous monitoring. The OCC worked diligently with industry to develop standard data definitions for the types of accounts assessed.

The CCM dataset has two components. The main dataset is account-level information on credit card utilization (e.g. purchase volume, ADB), contract characteristics (e.g. interest rates, credit limits), charges (e.g. interest, assessed fees) and performance (e.g. charge-offs, days overdue) for the near-universe of credit card accounts at these banks. The second dataset is portfolio-level information for each bank on items such as operational costs and fraud expenses for the entire general purpose credit card portfolio managed by the bank. Both datasets are submitted monthly. Reporting started in January 2008 and continues through the present, although there is incomplete reporting in the first few months of 2008. Due to mergers and other reporting issues, we observe entry and exit of banks during the time period.

To obtain a balanced panel of banks, while maintaining a sufficiently wide window around the CARD Act implementation dates, we drop a small bank that enters and exits the sample and restrict our time period from Q2 2008 to Q4 2011. We also restrict attention to "general purpose" and small business credit card accounts. Our sample does not include private label cards, which can only be

[13] As of 2012, the OCC supervised and regulated 1,955 institutions (46 large banks, 47 midsize banks, 47 federal branches and 1,815 community banks). Total assets of the OCC-regulated banking institutions represent about $10 trillion or 69 percent of all U.S. commercial banking assets.

used at the issuing retailer's stores. The sample does include affinity and co-branded cards.[14]

Table 1 presents an overview of our sample by reporting quarter. The sample contains data from eight banks and approximately 150 million consumer accounts and 7 million small business accounts, covering roughly 40% of all outstanding U.S. credit card accounts over this period.[15]

Panel A of Table 2 shows annualized summary statistics for key account-level variables for consumer and small business accounts. For the pooled sample, the average account carries an average daily balance of $\$1,278$ and has an annualized purchase volume of $\$1,986$. Multiplying by the number of accounts implies that these data account for about $210 billion in average daily balances, or 30% of total outstanding U.S. credit card debt over this period (Federal Reserve Bank of New York, 2013). The sample also covers an annualized $250 billion in purchase volume (relative to total U.S. consumption expenditure of approximately $10 trillion). The average account holder pays about $162 in interest charges per year, and incurs $53.69 in fees. Fees for late payment ($23.22 per year), fees for exceeding a credit limit ($7.70 per year), and annual fees for the card itself ($5.80) are the three largest constituents of total fee costs. Banks charge off an average $166 per account per year, of which $137 is a charge-off of loaned principal and $29.18 is a charge off of unpaid interest charges and fees.[16] Lenders only manage to recover $6.06 per account per year or 3.6% of total charge-offs. We use the term "net charge-offs" to indicate total charge-offs minus recoveries.

In addition to the income and cost figures observed at the account level, there are other important drivers of credit lending profitability that we only observe at the portfolio level. Panel B of Table 2 shows account-level averages for these variables, which we construct using the portfolio data and data from other sources. (See Appendix A for details on these calculations.) Interchange fees are charged to merchants for processing credit card transitions and scale with purchase volume. We assess account-level interchange income as a constant 2.0% of purchase volume, or $39.72 per account annually.[17] In the portfolio data, we also observe rewards expenses, fraud expenses and operational

[14] In addition, we exclude cards from portfolios purchased from third parties, a very small number of joint credit card accounts backed by more than one individual, and an equally small number of secured credit cards (since we want to focus on the overwhelming role of credit cards as a means of unsecured borrowing). We also drop accounts that do not report a FICO score at origination.

[15] The sample does not have the exact same number of accounts in each period. We do not restrict the analysis to a balanced panel of accounts because doing so would require us to drop accounts, for example, that were closed in mid-sample due to delinquency and thereby create sample selection bias.

[16] "Charge-offs" refer to an expense incurred on the lender's income statement when a debt is considered sufficiently long past due that it is deemed uncollectible. For an open-ended account such as a credit card, regulatory rules usually require a lender to charge off balances after 180 days of delinquency.

[17] Figure A2 shows that this ratio of 2% is very similar to what we find when considering the ratio of interchange income to imputed purchase value, where we impute the portfolio-level purchase volume by scaling portfolio-level measures of

costs aggregated to the bank-month level. Reward and fraud expenses correspond to about 1.4% of purchase volume on average, or approximately $27.80 per account per year. We calculate operational costs as a percent of ADB by month in the portfolio data and estimate account-level operational costs assuming they scale proportionally with ADB. Operational costs are $47.12 per account per year. Finally, banks report the total interest expense for funding their credit card liabilities at the portfolio level by month. This expense scales with average daily balances, and varies significantly over time (see the top panel of Appendix Figure A1). Over the sample period it cost banks $21.62 to fund the average account's credit card receivables for one year.

### 3.2 Pre-CARD Act Industry Overview

Proponents of increased regulation of the credit card industry often claim that lenders earn significant profits, with especially large profits earned from fees charged to the most vulnerable consumers. We assess this claim by analyzing data on average credit card issuer income and costs across the FICO score distribution for the pre-CARD Act period sample (April 2008 to January 2010). Table 3 shows key summary statistics on account-level credit card utilization and profitability grouped by FICO score at account origination.[18] About 17.3% of accounts have FICO scores below 620, which the industry classifies as subprime. The median FICO score is approximately 720. Consumers with FICO scores of 760 or higher constitute the top 26.8% of the distribution.

Panel A describes credit card utilization and capacity. Average daily balances are hump-shaped in FICO score, rising from $804 for borrowers with FICO scores below 620 to $2,029 for borrowers in the 660-719 range, then falling to $1,110 or less for account holders with scores above 760, who usually pay off their balances by the end of the billing cycle. Credit limits increase from $2,025 for account holders with FICO scores below 620 to $12,400 for borrows in the 760-799 range, then tail off moderately. Purchase volume rises over much of the FICO score distribution, increasing from an annualized $730 for account holders with a FICO score below 620 to $2,892 for account holders in the 760-799 range. Overall, the share of people using credit cards to borrow rather than to facilitate transactions declines as FICO scores rise.

ADB with the ratio of purchase volume to ADB derived from the account-level data. Appendix A describes this procedure in detail.

[18] We use FICO scores at account origination to avoid the reverse casualty that could arise if an account is assigned a low FICO score precisely because it missed a payment and now has to pay a late fee. Using FICO scores at origination introduces some measurement error if the object of interest is profitability by contemporaneous FICO score.

We next examine components of profitability by FICO score. To compare across different components of profits, we report all variables as an annualized percent of ADB. For example, given monthly data on total fees and ADB, we calculate

$$\text{Total fees as an annualized percent of ADB} = \left(\frac{\text{Total fees}}{\text{ADB}} + 1\right)^{12} - 1. \tag{1}$$

For an account holder with a constant interest rate, interest charges as an annualized percent of ADB is simply the interest rate. Our measure can be interpreted as an interest rate equivalent for different components of income and costs.

We define profits for a credit card account as the difference between total income and total costs. Total income for an account is the sum of interest payments, fee payments and interchange fees. The most basic measure of total costs includes realized net charge-offs, the cost of funds, rewards and fraud expenses and operational costs. We call this measure realized costs.

Panel B of Table 3 examines the components of profits as a percent of ADB. Borrowers with a FICO below 620 pay an annualized 20.6% of ADB in interest charges and 23.3% of ADB in total fees. Interest charges decline modestly in FICO score, falling to 15.2% of ADB for FICO scores between 660-719 and less than 9.3% of ADB for account holders with FICO scores above 760. Total fee payments decline precipitously, dropping to 4.1% for account holders with FICO scores in the 660-719 range and to less than 2.5% for higher FICO scores. Interchange income is not quantitatively important, except for the highest FICO score borrowers, who generate interchange income of more than 9.5% of ADB.[19]

The main component of realized costs is net charge-offs. During our time period, account holders with FICO scores below 620 incurred annualized net charge-offs of 30.8% of ADB. This number declines to 15.8% for account holders with FICO scores between 660-719, and 6.3% or less for consumers with FICO scores of 760 and above. Similar to interchange income, rewards and fraud costs as a fraction of ADB are more significant for higher FICO account holders, who generate more purchase volume per unit of borrowing.

The income and costs data combine to produce a U-shaped distribution of realized profits by FICO score. Account holders with FICO scores below 620 generated realized profits of 7.9% of ADB.

[19]This is not surprising given the ratio of purchase volume to average daily balances for different FICO score groups. The highest FICO score account holders primarily use credit cards to facilitate transactions, not to borrow. Hence, interchange income relative to overall receivables managed by the bank increases significantly as FICO rises.

Realized profits bottom out at -1.6% of ADB for accounts with FICO scores in the 660-719 range. They rise to above 1.5% for account with the highest FICO scores. Overall profitability averages 1.6% of ADB.

Figures 2 and 3 provide graphical evidence on the relationship between FICO scores, grouped in buckets of 5, and key income and cost components. Figure 2 shows that fee income drops much more sharply in FICO score than income from finance charges. Figure 2 also shows that interchange income is only quantitatively important for consumers with FICO scores above 760.[20] Figure 3 shows that the largest realized profits are generated by the subprime segment of the market, although there are relatively fewer account holders in this FICO score range.

The realized profits calculations imply that banks seem to earn significant profits from credit cards relative to measures of average industry profitability. The top panel of Appendix Figure A3 shows total U.S. commercial banking sector ROA over the 2000 to 2013 period, with ROA $= \frac{\text{Earnings}}{\text{Assets}}$. Average ROA is 0.2% during the pre-CARD Act period, and 1% over the entire timeframe. We estimate that credit cards generated a net profit of 1.6% and an ROA of 1.1% after adjusting for taxes.[21,22] This implies an ROA about five times the industry average during the pre-CARD Act period. The bottom panel of Appendix Figure A3 shows the leverage of the U.S. commercial banking sector. Given an ROA of over 1% and average leverage of about 10, this suggests a return on equity (ROE) for credit card lending of about 10%.

While these realized profit numbers do not account for ex ante risk, the data suggest that credit cards are a particularly profitable segment of the banking industry, with credit card issuers earning a significant return on equity at the height of the financial crisis. Indeed, at the same time that bank divisions making subprime home or auto loans were losing large amounts of money, credit card issuers were earning their largest profits from the subprime segment of the market.

[20] We do not show the cost of funds and operational expenses because they are defined as a constant fraction of ADB for all accounts in the data.

[21] We use the average tax rate for U.S. commercial banks of 32% from Lee and Rose (2010).

[22] Our measure of net profits subtracts out financing costs and other expenses. The other adjustment one might want to make is to include some of the purchase volume that gets repaid at the end of the period. This value would not show up in ADBs, but would still be part of the bank's assets during the month. Table 3 shows that this adjustment would not make a large quantitative difference. An upper bound on the assets we would miss is the total purchase volume divided by 2 (i.e. assuming that it gets built up evenly throughout the month). Since the number presented in Table 3 is annualized, including purchase volume in the total assets would add about $75 or about 6% to total assets. This is an upper bound on the total amount, since the fraction of purchase volume that is not repaid at the end of the month might already be included in average daily balances.

# 4 Research Design

Having established basic facts about the importance of fee revenue in the pre-CARD Act period, we turn to evaluating the intended and unintended consequences of the consumer protections that were implemented by the CARD Act.

## 4.1 Identification Strategy

We estimate the effects of the CARD Act using a difference-in-differences research design, where we compare outcomes for consumer credit cards (treatment group) and small business cards (control group) during the different phases of the CARD Act implementation. The role of the control group is to establish the counterfactual of what would have happened to consumer credit cards if the CARD Act had not been implemented. The identifying assumption is that, in the absence of the CARD Act, outcomes for consumer credit cards and small business cards would have maintained parallel trends.

We argue that the parallel trends assumption is likely to be valid for two reasons. First, as we discussed above, consumer and small business cards are institutionally very similar. For instance, since both types are cards are run out of the same business division, changes in management philosophy or an update to underwriting algorithms are likely to be jointly rolled out to consumer and small business credit cards.

The second, and more compelling, reason is that outcomes for consumer and small business credit cards move in parallel trends in the pre-CARD Act period. We show that both types of cards exhibit parallel trends in revenue from the different types of fees and revenue from interest charges. We show that measures of credit volume such as average daily balances, credit limits and the number of new accounts move together in the pre-CARD Act period.

In addition, we conduct placebo tests using high FICO score accounts that were largely unaffected by the CARD Act and demonstrate that there is no evidence of spurious effects for these account holders.

## 4.2 Econometric Model

Below we present the econometric model. We specify the model at the account level. Because our panel dataset of 160 million accounts over 57 months has nearly 9 billion observations, we estimate

the model on data collapsed to means within groups that represent the full interaction of the categorical variables in our specifications. As we show in Appendix Section B, difference-in-difference regressions with these collapsed data allows us to recover the parameters of interest from the account-level specification.

Our baseline econometric model is a difference-in-differences specification where we allow for the coefficient on the treatment group to evolve non-parametrically by month. Plotting the coefficient of interest over time allows us to visually establish whether there are spurious pre-trends in the outcomes as well as to examine the timing of the response to the law.

Let $y_{it}$ be an outcome for account $i$ in month $t$. Let $C_i$ be a treated indicator that takes a value of one if the account is a consumer credit account. The difference-in-differences specification with treated $\times$ month-specific coefficients is given by

$$y_{it} = \sum_{t \neq \text{May 2009}} \beta_t C_i + X_{it}' \delta_X + \delta_t + \epsilon_{it} \tag{2}$$

where $X_{it}$ is a vector of possibly time-variant covariants including an indicator for consumer credit cards, $\delta_t$ are month fixed effects, and $\epsilon_{it}$ is the error term that we assume is uncorrelated with unobserved determinants of the outcome. The coefficients of interest are the $\beta_t$'s.

To increase our statistical power, we also estimate an econometric model in which we pool over the implementation phases of the CARD Act. This regression specification is given by

$$y_{it} = \beta_1 \; C_i \cdot 1_{t \in \text{Phase 2}} + \beta_2 \; C_i \cdot 1_{t \in \text{Phase 3}} + X_{it}' \delta_X + \delta_t + \epsilon_{it} \tag{3}$$

where as before $X_{it}$ is a vector of possibly time-variant covariants including an indicator for consumer credit cards, $\delta_t$ are month fixed effects, and $\epsilon_{it}$ is the error term. The indicator $1_{t \in \text{Phase 2}}$ takes a value of one for the months between the implementation of Phase 2 and the implementation of Phase 3 (March 2010 to August 2010) and the indicator $1_{t > \text{Phase 3}}$ takes a value of one for the months after the implementation of Phase 3 (after August 2010).[23] The time period prior to Phase 2 is the omitted group so the coefficients can be interpreted as the differential effect relative the pre-implementation mean. For some outcome variables, we also include a consumer account $\times$ anticipation period inter-

[23] We drop February 2010 and August 2010 from the sample because Phase 2 and Phase 3 came into effect part way through these months.

action term to capture anticipatory responses that take place between the month when the bill was passed and the month when Phase 2 came into effect (May 2009 to February 2010).

### 4.3 Inference

We conduct statistical inference using two complementary strategies.[24] We construct our standard errors to account for (i) serial correlation in outcomes within accounts over time and (ii) correlation in outcomes across accounts which have the same type credit card and therefore have interest rates and other contract characteristics jointly determined. Our first approach to inference is to account for these correlations by specifying cluster-robust standard errors at the bank $\times$ card type level, where we define card type as the interaction of the consumer card indicator and a product type variable which determines whether the card is co-branded, oil and gas, affinity, student type, or other. We view this approach as conservative because many banks have multiple types of, for example, co-branded cards that have contract characteristics that are adjusted individually.

Our second approach is to construct p-values using a permutation test where we compare our estimate of the actual CARD Act to estimates of placebo reforms specified at other periods of time. This approach is sometimes referred to as randomization inference (Conley and Taber, 2011). In our setting, we specify separate placebo CARD Act implementation dates for consumer accounts in each month in the data and restrict the sample to the month before and after theses placebo implementation dates. We then compare estimates at the actual implementation dates to the distribution of estimates from the placebo implementation periods. For many of the outcomes we examine, the true effect is larger in absolute value than effects estimated at each of the 56 placebo implementation dates. This allows us to bound the p-value for the true effect below $p < 0.02 = 1/56$.

## 5 Intended Effects

In this section we examine the intended effects of the CARD Act. We first examine the effects of the fee regulations and then turn to examining the effect of the disclosure nudge.

[24] We thank Christian Hansen and Jesse Shapiro for helpful conversations on approaches to conducting inference in our setting.

### 5.1 Fees

The CARD Act had two primary elements that were targeted at reducing credit card fees. These regulations, described in more detail in Section 2.2, aimed at significantly reducing over-limit fees and late fees. Because fee payments vary substantially by FICO score (see Section 3.2), we separately estimate the effects of these regulations on accounts with FICO scores below and above 660 at origination, approximately the 30th percentile of the FICO score distribution in our data.

Figures 4 and Figure 5 examine the effect of the regulation of over limit fees. The vertical axis in these plots show over limit fee revenue as an annualized percent of ADB, calculated in the same manner as the values in Panel B of Table 3. The horizontal axis shows months, with the vertical bars in May 2010, February 2010 and August 2010 indicating the dates when the CARD Act was passed, and when Phase 2 and Phase 3 of the provisions came into effect.

Panel A of Figure 4 plots average over limit fees as a percent of ADB for consumer and small business accounts with FICO scores below 660 at origination. Over limit fees for consumer and small business accounts move together over the pre-CARD Act period, in accordance with the parallel trends identifying assumption. In February 2010, when the the law requires consumer accounts to "opt-in" to the processing of over limit transactions, over limit fees for consumer accounts drop from 3.8% to virtually zero. Over limit fees for small business accounts, which were not affected by the CARD Act, trend smoothly through this implementation date.

Panel B of Figure 4 plots the coefficient on the consumer account $\times$ month interactions from a difference-in-differences regression specification (Equation 2) on the same sample of low FICO score accounts. In this plot, we normalize the coefficient on the month when the bill was passed to the pre-CARD Act consumer credit card mean. We show coefficients from a baseline specification where we include consumer account and month fixed effects, and fully interacted fixed effects for bank, product type, and FICO score group. The difference-in-difference specification confirms the sharp drop we observed in the means.

Figures 5 shows the exact same plots for accounts with FICO scores of at least 660 at origination. The effects are smaller in size but qualitatively identical. Mean over limit fees for consumer and small business account move together in the pre-CARD Act period, and consumer account's over limit fees drop to almost zero in February when the law was implemented. Over limit fees for high FICO score accounts are only 0.4% of ADB in the pre-CARD Act period, compared to 3.8% for low FICO score

accounts, and the resulting 0.3 percentage point drop for these accounts is one-tenth of the size of the drop for account holders with FICO scores below 660.

Table 4 show the corresponding differences-in-differences regression specifications. Column 1 shows the baseline difference-in-differences specification which has consumer card by Phase 2 (March 2010 to August 2010) and Phase 3 (after August 2010) interaction terms, and consumer card and month fixed effects. The pre-February 2010 period is the omitted category so that the effects can be interpreted relative to the outcomes prior to implementation of the CARD Act. Column 2 adds fully interacted fixed effects for bank, product type, and FICO score group to this specification. Panel A shows outcomes for accounts with FICO scores below 660 and Panel B shows outcomes with FICO scores above this level. The point estimate of the decline in over limit fees is 3.3 percentage points for accounts with FICO below 660 and 0.3 percentage points for accounts with a FICO this level or above. The estimates are highly stable across specifications, and are statistically distinguishable from zero at conventional levels.

Appendix Figure A4 examines the effects of the CARD Act on late fees and an "other fees" category that combines all categories except over limit and late fees. The plots show the coefficient on consumers $\times$ month interaction from the baseline difference-in-differences specification (Equation 2) with late fees and other fees as the dependent variable are are constructed in the same manner as the plots discussed above. Panels A and B show effects on the sample with a FICO score below 660 at origination and Panels C and D show effects on the sample with FICO scores of 660 or higher.

Panels A and C show suggestive evidence of a small decline in late fees in February 2010, and a sharper drop in August 2010, when the $25 maximum for late fee limit came into effect. The estimates seem to diminish over time. By the end of our sample, the point estimates are almost indistinguishable from the pre-regulation levels. One potential reason for this is that the regulation allowed credit card issuers to increase late fees to $35 if the account holder had been late on one of the last six payments, thus the rise in late fees might be due to an steady increase in the number of accounts eligible for this increased late fee. The regression estimates for late fees, shown in Columns 3 and 4 of Table 4, confirm these results. For accounts with FICO score below 660, late fees decline 1.5 percentage points over both implementation phases, from a base value of 5.9 percentage points. The drop for high FICO score account holders is 0.3 percentage points off a pre-CARD Act mean of 1.3 percent and more precisely estimated.

Panels B and D show the other fees do not respond to the CARD Act. Some industry observers conjectured that credit card issuers would respond to the loss in over limit fee revenue by increasing annual fees. The plots show there there is no evidence of an offsetting increase of an economically significant magnitude. The pooled regressions estimates, shown in Columns 5 and 6 of Table 4, confirm that other fee categories are unaffected on average by the regulation.

Figure 6 brings the analysis of these different fee categories together by showing the effect of the CARD Act on total fees. The plots show regression coefficients constructed in the same manner as before using total fees as a percent of ADB as the dependent variable. Panel A shows estimates for the sample of accounts with FICO scores below 660 at origination. Panel B shows estimates for the sample with FICO scores of this level or above. The coefficient estimates, shown in Columns 7 and 8 of Table 4, indicate that over the implementation phases, total fees dropped by 5.5 percentage points for low FICO score account holders and by 0.5 percentage points for high FICO score accounts. Both estimates are statistically distinguishable from zero with p-values of 0.04 and 0.01 respectively.

As an alternative approach to conducting inference, Appendix Figure A5 shows the results from a perturbation exercise where we show the estimates that uses the Phase 2 (solid line) and Phase 3 (dashed line) implementation dates and a histogram of estimates that use placebo implementation dates of each other month in the data. The true over limit fee estimate is well outside the range of placebo estimates in the data. In particular, because the true estimate is smaller than all 56 placebo experiments, the resulting Phase 2 p-value is less than $0.02 = 1/56$, which is similar to the p-value of p=0.03 in Table 6. The permutation test p-values for late fees of 0.06 for Phase 2 and 0.02 for Phase 3 are also similar to the less price clustered standard errors for these estimates. The total fees p-values of 0.02 and 0.06 are also very similar.

The analysis above shows that the CARD Act brought about a sharp drop in late and overall fees, with drops of 5.5 percentage points of average daily balances for accounts with a FICO score below 660 and 0.5 percentage points for accounts with a FICO score above this level. Low and high FICO score cards account for 24.0% and 76.0% percent of borrowing in our data, so if we take a weighted average, we calculate a reduction of 1.7% as an annualize percent of ADB. Given an outstanding credit card volume of $744 billion in the first quarter of 2010 (Federal Reserve Bank of New York, 2013), this implies that the CARD Act's fee regulation reduced annual credit card borrowing costs for U.S. consumers by $12.6 billion per year.

## 5.2 Payoff Nudge

In addition to regulating the fees charged by banks, the CARD Act also introduced rules requiring certain repayment disclosures in monthly credit card statements. Debt repayment decisions involve the choice between (i) repaying less today and having more resources for current consumption or (ii) repaying more today and reducing future interest payments. To properly evaluate this trade-off, the relative cost of these choices must be fully salient (Mullainathan, Barr and Shafir, 2009). The aim of the CARD Act's disclosure requirements was to provide information on the consequences of making only the minimum payment, as well as information on the reduction in interest payments that could be achieved by making payments that would eliminate the balance within 36 months. Indeed, some have argued that information such as the 36-month payment amount might be understood by consumers as a payment recommendation or nudge, anchoring repayment at this level (Navarro-Martinez et al., 2011).[25] However, it is not obvious that this nudge would actually lead to a shift in behavior, both because it is unclear if the nudge would be sufficiently powerful and because current repayment levels might already be optimal.[26]

### 5.2.1 Pre-CARD Act Payoff Behavior

We begin by documenting credit card payoff behavior in the pre-CARD Act period. For this analysis we restrict the sample to consumer credit cards and exclude accounts that do not have a positive cycle-ending balance. The top panel of Figure 7 shows the share of account holders making full payments by FICO score. About 10% of borrowers with a FICO scores below 620 fully repay their balance. This share rises monotonically in FICO score, with about 25% of borrowers with a FICO score of 720 and about 75% of borrowers with a FICO score above 800 making the full payment. On average 30.1% of account holders pay their cycle-ending balance in full, and do not carry balances from month to month.

The bottom panel of Figure 7 shows the share of account holders making only minimum pay-

[25] Using experimental evidence from the United Kingdom, Stewart (2009) shows that presenting a minimum payment requirement on credit card statements has the effect of anchoring repayment behavior at that level, and reduces overall willingness to repay.

[26] This point was made by Warren (2011), who argued that "changes that make the credit card market more transparent can echo throughout our economy. [...] Some consumers may respond by deciding to purchase less, to use a different card, or to pay with cash or another financial instrument. Others may pay down more of their credit card debt. Of course, some may go the other way: With confidence that they can assess the real cost of their credit cards going forward, some consumers may choose to borrow on their card more frequently. In any case, clear information about prices and risks would make it easier for consumers to sort through their options."

ments or less by FICO score. About 60% of borrowers with a FICO score below 620 pay the minimum or less. The number of account holders making the minimum payment or less declines monotonically, with about 25% of borrowers with a FICO score of 720 and 10% of borrowers with a FICO above 800 making payments of the minimum or less. We calculate that on average 12.7% of borrowers only make the minimum payment and 13.4% of account holders make no payment whatsoever.

### 5.2.2 Payoff Nudge

The CARD Act mandates the disclosure of the monthly payment that would eliminate an account-holders cycle-ending balance if the account holder makes constant payments and avoids new purchases. Let $T$ be the number of months it would take to pay off a cycle-ending balance for a constant payment amount:[27]

$$T = 1 - \frac{\ln\left(1 - \frac{\text{APR}}{12}\frac{\text{Cycle-Ending Balance} - \text{Payment}}{\text{Payment}}\right)}{\ln(1 + \frac{\text{APR}}{12})} \tag{4}$$

Full repayment is indicated by $T = 1$. At the average pre-CARD Act interest rate of 16.5%, $T = 5$ implies a payment of 20.5% of the cycle-ending balance; $T = 10$ implies a payment of 10.6% of the balance; and $T = 83$ implies a payment of 2% of the balance, which is a typically minimum payment in our data. The CARD Act requires a disclosure of the payment that would result in $T = 36$. At the average interest rate, this implies a payment of 3.7% of the cycle-ending balance. Appendix Figure A6 shows a histogram of $T$ in the year preceding the implementation of the CARD Act disclosure requirement, both for consumer credit cards and small business credit cards.[28] We top-code $T$ at 99 months and let $T = 100$ denote account holders that make no payment.

Figure 8 shows the distribution of months-to-payoff $T$ in the year before and after the CARD Act for both consumer and small business cards. Following the implementation of the CARD Act, there was a small but significant increase in the share of consumer credit card holders that choose payment amounts that would repay their balance at the target 36-month value. No such change can be detected for small business card holders, who were not shown the payoff disclosure.[29]

[27] This equation obtains from re-arranging the standard monthly payment formula for a series of payments starting in the *current* month: $\text{Payment} = \left(\frac{\text{APR}/12}{1-(1+\text{APR}/12)^{-(T-1)}}\right)(\text{Cycle-Ending Balance} - \text{Payment})$.

[28] There is seasonality in repayment behavior, so analyzing the 12 months prior to the CARD Act is more representative than analyzing the entire pre-CARD Act period.

[29] We would expect increases in a small range around 36-months for a number of reasons. The most important is that

We next use the difference-in-differences approach to quantify the impact of the nudge, comparing the change in repayment behavior before and after the February 2010 implementation date for consumer and small business credit cards. The dependent variable in these specifications is the percent of account holders making payments within a given range of values for $T$. Table 5 shows the results of these regressions. Columns 1 and 2 show the effect on the share of account holders repaying their balance in a range around the 36-month value ($31 \leq T \leq 37$). The results show that the nudge increased the share of account holders making the target payment by 0.5 percentage points on a base of 4.1 percent. The effects are precisely estimated and stable to the inclusion of card type specific time trends. Columns 3 and 4 show the effect on account holder make payments of less than the target amount ($T > 37$). The estimates are imprecise, leaving us unable to conclude whether the shift in payments results from account holders increasing or decreasing their payments.

We use these estimates to construct an upper bound of the effect of the nudge on annualized interest payments. Assume that the nudge (i) shifted account holders from making no payment to paying at the 36-month value and (ii) did not impact the cycle-ending balance of these account holders. The one-month change in interest payments for account holders that shift their behavior is given by the product of the change in the percent of balance paid, the cycle-ending balance, and the monthly interest rate:

$$\Delta \text{ Interest Payments} = \Delta \text{ \% of Balance Paid} \times \text{Cycle-Ending Balance} \times \frac{\text{APR}}{12} \tag{5}$$

Account holders making no payment had a pre-CARD Act average cycle-ending balance of \$2,957 and an average APR of 21.7%. Plugging this average APR into Equation 4 implies a change in the percent of balance paid from 0% to 3.7%.[30] Taking the product of these numbers and multiplying by 12 to annualize yields an estimated \$24.00 reduction in annualized interest payments for account holders that shifted their repayment behavior in response to the nudge.

While a reduction in interest payments of this amount would be non-negligible for the account

we use the current interest rate for our calculation of $T$, while banks are required to account for contractually determined changes in interest rates over the 36-month period. In particular, if the interest rate in effect on the date on which the disclosure is made is a temporary rate (such as an introductory rate) that will change under a contractual provision applying an index or formula for subsequent interest rate adjustment, the creditor is required to apply the interest rate in effect on the date on which the disclosure is made for as long as that interest rate will apply under that contractual provision, and then apply an interest rate based on the index or formula in effect on the applicable billing date.

[30] Assuming that these account holders were making positive pre-CARD Act payments would directly reduced this value.

holders that shift their behavior, the fact that few account-holders respond to the nudge leads us to estimate a small upper bound for the aggregate effect. The estimate of $24.00 annualized savings for 0.5% accounts that switch translates to aggregate savings of 0.0096% (= $\frac{0.5\% \times \$24.00}{\$1,251}$) of aggregate average ADB. If we extrapolate these results to the entire $744 billion national credit card market, we estimate an upper bound for the nudge of $71 million (= $744 billion $\times$ 0.0096%) in annualized savings.

# 6 Unintended Consequences

In this section, we assess possible unintended consequences of the CARD Act, in particular focusing on whether lenders responded to the decline in fee revenue by increasing other costs such as interest charges, or by restricting access to credit. We start by presenting a model of such offsetting prices. The model shows that the extent to which fee limits are offset and credit supply is adjusted is determined by (i) the degree of competition in the market and (ii) the salience of the regulated fee. We then examine the response of interest charges and the volume of credit in the data.

## 6.1 Model

Consider a setting in which $n$ identical firms compete to offer a credit card with a salient price $p_1$ (e.g., interest rate) and a potentially non-salient price $p_2$ (e.g., over-limit fee).[31] Since firms are identical, they charge the same prices in equilibrium. Aggregate demand is given by the function $q(p_1 + \psi p_2)$ where $\psi \in [0, 1]$ parameterizes the degree of salience of $p_2$. A value of $\psi = 1$ indicates perfect salience; a value of $\psi = 0$ indicates that consumers are completely oblivious to the price. Following Heidhues, Kőszegi and Murooka (2012), we assume that there is a maximum $\bar{p}_2$ that is determined by regulation or some other factor.[32]

Firms have identical costs structures, which include both the cost of financing consumer lending and the cost of default. Assume for now that lending to consumers has constant marginal costs $c$. In Appendix Section C we show that the results are similar when we allow for marginal costs to vary, as they would in an environment with adverse or advantageous selection.

[31] See Stango and Zinman (Forthcoming) and Bar-Gill and Bubb (2012) for discussions of the salience of credit card fees. Bordalo, Gennaioli and Shleifer (2012) provide a model of choice among goods with different attributes, which may include prices. They analyze decisions by a consumer who overweighs the most salient attributes of each good in making a choice.

[32] Alternatively, one could specify demand as a function of $q(p_1 + \psi(p_2))$ where $\psi(\cdot)$ is increasing and convex and has the property $\psi'(\bar{p}_2) = 1$. This would result in the firm setting $p_2 = \bar{p}_2$ in equilibrium.

It is optimal for firms to set the potentially non-salient price $p_2$ to the maximum allowable amount $\bar{p}_2$. To see this, suppose a firm sets a $p_2 < \bar{p}_2$. The firm can increase profits by decreasing the salient price by $\psi dp_2$ and increasing the non-salient price by $dp_2$. This pricing change has no effect on demand because $q\left(p_1\psi - dp_2 + \psi(p_2 + dp_2)\right) = q(p_1 + \psi p_2)$ but raises total profits by $(1-\psi)\, dp_2\, q(p_1 + \psi p_2) > 0$. This means that $p_2 < \bar{p}_2$ cannot be an equilibrium.[33]

Following Weyl and Fabinger (2013), we characterize the first order condition for the salient price $p_1$ as

$$p_1 + p_2 - c = \theta\, \mu(p_1 + \psi p_2) \tag{6}$$

in which the markup of price over marginal cost is set equal to the product of a market competitiveness parameter $\theta \in [0, 1]$, which indexes the degree of competition in the market (see Bresnahan, 1989) and an absolute markup function $\mu(p_1 + \psi p_2)$, which is equal to $p$ times the inverse elasticity of aggregate demand: $\mu(p_1 + \psi p_2) \equiv -\frac{q}{q'} = \frac{p}{\varepsilon_{p_1}}$, where $\varepsilon_{p_1}$ is the aggregate elasticity of demand.[34]

The specification is flexible and nests a number of standard cases. Monopoly is given by $\theta = 1$, which simplifies the equation to the standard Lerner Index for optimal pricing $p_1 + p_2 - c = \frac{1}{\varepsilon_{p_1}}$. This means that another way to think about $\mu(p_1 + \psi p_2)$ is that it is the absolute markup that would be charged by a monopolist. Perfect competition is given by $\theta = 0$ and simplifies the first order condition to the standard "price equals marginal cost" condition $p_1 + p_2 = c$. Differentiated product Nash-in-prices competition is given by $\theta = 1 - A$, where $A = -\frac{\sum_{j \neq i} \partial q_j / \partial p_i}{\partial q_i / \partial p_j}$ is the aggregate diversion ratio, which is defined as the sum of consumers lost by firms $j \neq i$ divided by the consumers gained by firm $i$ for a change in firm $i$'s price $p_1$. Cournot competition is given by $\theta = 1/n$, where $n$ is the number of firms. See Bresnahan (1989) and Weyl and Fabinger (2013) for extended discussions of the micro-foundations of this specification.

### 6.1.1 Pricing Offset

Next consider a regulation that decreases the maximum allowable price $\bar{p}_2$. We want to know how much of the decline in $p_2$ is offset by an increase in $p_1$. For small changes in $p_2$, this offset is given by $\omega \equiv -\frac{dp_1}{dp_2}$. We will say there is a full offset if $\omega = 1$ and no offset if $\omega = 0$. In principle, the offset can

[33] If $p_2$ is perfectly salient ($\psi = 1$), the equilibrium is described by a single price $p^* \equiv p_1 + p_2$ and firms are indifferent between all combinations of $p_1$ and $p_2$ that sum to this $p^*$, including the combination with $p_2 = \bar{p}_2$.

[34] The second order condition for $p_1$ is $\theta\, \mu' < 1$. We assume that at the optimal price this condition is satisfied.

be greater than full, with $\omega > 1$.

Assume that $\theta$ and $\psi$ are invariant to the price. Totally differentiating the first order conditions (Equation 6) with respect to $p_2$ and rearranging yields

$$\omega = \frac{1 - \psi\,\theta\,\mu'}{1 - \theta\,\mu'} \tag{7}$$

where we have suppressed the arguments of $\mu$ for notational simplicity. To gain intuition for the offset formula, consider two special cases.

**Special Case 1.** *(Perfect Competition) If there is perfect competition ($\theta = 0$), then a limit on $p_2$ will be fully offset by an increase in $p_1$ ($\omega = 1$).*

Since competition drives price to marginal cost, any decrease in $p_2$ must be fully offset by an increase in $p_1$ to maintain zero markup in equilibrium.

**Special Case 2.** *(Perfect Salience) If $p_2$ is perfectly salient ($\psi = 1$), then a limit on $p_2$ will be fully offset by an increase in $p_1$ ($\omega = 1$).*

If $p_2$ is perfectly salient, consumers view both prices as equivalent and firms can maintain their desired level of demand by increasing $p_1$ one-for-one with the decline in $p_2$.[35]

Intuitively, the offset can be less than one-for-one when there is both imperfect competition ($\theta > 0$) and imperfect salience ($\psi < 1$). Taking derivatives of Equation 7 with respect to $\theta$ and $\psi$ yields the following proposition:

**Proposition 1.** *(Offset) The offset is converging toward full ($\omega \to 1$) as (i) the market becomes more competitive ($\theta \to 0$) and (ii) $p_2$ becomes more salient ($\psi \to 1$).*

The offset is converging from below for many standard parameterizations of demand, but can also converge from above for some parameterizations. Technically, the offset converges from below when $\mu' < 0$ or equivalently if log demand is concave, since $(\log q)'' = \mu'/\mu^2 < 0 \iff \mu' < 0$. See Fabinger and Weyl (2013) for more on the slope of the $\mu$ parameter.[36]

[35] In Appendix Section C, we show that the offset is relatively larger when there is adverse selection (i.e., marginal costs increasing in price) and relatively smaller when there is advantageous selection (i.e., marginal costs decreasing in price). The offset is similarly larger when marginal cost is increasing in price due to an effect in which higher prices increase debt levels and lead to higher probabilities of default. The reason the offset is larger with adverse selection is that a higher $p_1$ brings in higher marginal cost consumers, requiring a further increase in the price.

[36] Fabinger and Weyl (2013) prove that $\mu' < 0$ if demand is linear or if it is based on an underlying willingness-to-pay

### 6.1.2 Volume Response

The model also provides guidance on how the equilibrium volume of credit will respond to a regulation that decreases the maximum allowable price $\bar{p}_2$. For small changes in $p_2$, this volume effect is given by $\nu \equiv -\frac{dq}{dp_2}$. Totally differentiating $q$ with respect to $p_2$ and using the identities $\omega = -\frac{dp_1}{dp_2}$ and $\frac{\partial q}{\partial p_1} = \psi \frac{\partial q}{\partial p_2}$ to simplify yields:

$$\nu = \frac{\partial q}{\partial p_1}(\omega - \psi)$$

The quantity response is largest when $p_2$ is non-salient ($\psi = 0$) and markets are competitive ($\theta = 0$) because firms fully offset the $p_2$ decline ($\omega = 1$, see Special Case 1) but consumers only observe the increase in $p_1$ and reduce their demand accordingly. There is no quantity response when $p_2$ is perfectly salient ($\psi = 1$) because even though firms fully offset the $p_2$ decline ($\omega = 1$, see Special Case 2 above), consumers observe this one-for-one tradeoff between $p_2$ and $p_1$ and do not change their demand. More broadly, the volume response is increasing in the size of the offset ($\omega$) and decreasing in the salience of the non-salient price ($\psi$).

### 6.1.3 Relationship to Pass-Through

Finally, it is useful to establish a link between the offset of a reduction in the non-salient price and the pass-through of an increase in marginal costs. Let $\rho \equiv \frac{dp_1}{dc}$ denote the pass-through of a increase in marginal costs. Differentiating the first order conditions with respect to $c$ yields: $\rho = \frac{1}{1-\theta\,\mu'}$. We can then write the offset as a function of the pass-through rate:

$$\omega = \rho + \psi\,(1 - \rho) \tag{8}$$

When $p_2$ is non-salient ($\psi = 0$), the offset is equal to the pass-through rate ($\omega = \rho$). When $p_2$ is fully observed ($\psi = 1$), the offset is full ($\omega = 1$). When $p_2$ is partially salient, we can think of consumers as observing part of the reduction in the non-salient price, leading the firm to pass through some of the reduction like a cost shock and the other part like a reduction in a fully observable price.

distribution that is normal, logistic, Type I Extreme Value (logit), Laplace, Type III Extreme Value, or Weibull or Gamma with shape parameter $\alpha > 1$. They show that $\mu' > 0$ if demand is based on a willingness-to-pay distribution that is Pareto (constant elasticity), Type II Extreme Value, or Weibull or Gamma with shape parameter $\alpha < 1$. They show that $\mu$ switches from $\mu' < 0$ to $\mu' > 0$ for a log-normal distribution of willingness-to-pay.

This equation is useful because it places restrictions on the relationship between the offset $\omega$, pass-through rate $\rho$, and salience parameter $\psi$. In Section 6.4, we provide an ancillary test of our estimate of $\omega$ using this relationship along with estimates of $\rho$ and $\psi$ from the literature. In a related paper, Agarwal et al. (2014) argue that $\rho$ and $\psi$ are "sufficient statistics" that can be used to estimate the consumer benefits from regulating hidden fees in a wide range of settings, and illustrate the applicability of this approach by assessing a hypothetical regulation of airline baggage fees.

### 6.2 Interest Charges

We next examine the extent to which lenders offset the observed reduction in fee revenue with increased revenue from interest charges. We restrict the sample to accounts with a FICO score below 660 since the CARD Act fee restrictions mainly impacted these account holders.

Panel A of Figure 9 shows mean interest charges as an annualized percent of ADB for consumer and small business accounts with a FICO score below 660. Interest charges for both types of cards move together in the pre-CARD period and continue to move together over the rest of the time period. There is no evidence of anticipatory increases for consumer accounts after the May 2009 date passage date and no evidence of any increase during the implementation periods.

Panel B shows coefficients on consumer account $\times$ month interactions from a difference-in-differences regressions specification (Equation 2) with interest charges as a percent of ADB as the dependent variable. The plot is constructed analogously to the plots for fees (e.g., Panel B of Figure 4) with the coefficient normalized to zero during the month when the bill was passed and the pre-CARD Act mean reinserted as a point of reference. The plot shows coefficients from the baseline specification where we include the consumer account and month fixed effects, and fully interacted fixed effects for bank, product type, and FICO score group. We dashed horizontal line shows the increase in interest charges that would be required to offset the 5.5 percentage point decline in fee revenue. The difference-in-difference coefficients show that there is no evidence of an offsetting increase in interest charges.

Table 6 shows the corresponding difference-in-differences regression specifications. We show coefficients on consumer cards interacted with indicators for the Anticipation (June 2009 to January 2010), Phase 2 (March 2010 to August 2010) and Phase 3 (after August 2010) time periods. The pre-May 2009 period is the omitted category so that the effects can be interpreted relative to the outcomes

prior to the passage of the CARD Act. Column 1 shows the baseline specification with the interaction terms and consumer card and month fixed effects. Column 2 adds fully interacted fixed effect for bank, product type, and FICO score group. The regression estimates confirm the finding that the CARD Act had at most a limited effect on interest charges. Columns 1 and 2 of Table 6 show that the point estimates for the effect on interest charges is approximately zero across the different phases.

Columns 3 and 4 covert these estimates into an implied offset ($\omega$) which we calculate as the interest rate estimates from this table divided by the Phase 3 estimate of the drop in fee revenue from Table 4 with the same controls.[37] The standard errors and corresponding p-values for the offset are calculated using the Delta Method assuming no covariance in the error terms. The Phase 3 estimates provide the longest adjustment period and represent our preferred estimates of the medium-run effects of the law. The Phase 3 estimate of -0.08 from Column 4 allows us to rule out offset effects of greater than 0.57 with a 95% confidence interval.

Credit card issuers in principle have wide latitude to increase interest rates on account holders. The CARD Act did somewhat reduce this flexibility with a set of provisions that came into effect in August 2009, which (i) required lenders to notify consumers 45 days in advance of rate changes and (ii) limited lender's the ability to change interest rates on existing accounts, in particular in the first year after origination. Lenders, of course, could announce rate changes 45 days in advance, so the main practical effects of this provision were to make post-August 2009 rate increases more salient and slow down implementation of rate increases. Nevertheless, we examine interest charges for new accounts to provide additional evidence from a setting whether banks face less constraints in their pricing.

Appendix Table A1 shows difference-in-differences estimates of the effect on interest charges as a percent of ADB for new accounts. Columns 1 and 2 repeat the estimates on the set of all accounts with FICO scores below 660 from Table 6 for reference. Columns 3 and 4 show estimates for the sample of low FICO score new accounts, defined as accounts in their first full month since origination. Interest charges for new accounts are noisy because promotional rates and marketing campaigns by a single bank can have a meaningful effect of monthly outcomes. However, the estimates clearly indicate that interest charges for new accounts did not rise by the 5.5 percentage points needed to offset the reduction in fee revenue. The preferred Phase 3 estimates with fully interested controls, shown in

[37] We use the Phase 3 fee estimate from Column 7 of Table 4 to construct the offset estimates in Column 3 and the Phase 3 fee estimate from Column 8 of Table 4 construct the estimates in Column 4.

Column 4, shows a point estimate of 0.05 and we can reject an increase of a full 5.5 percentage point offset with a p-value of $p < 0.01$.

Appendix Figure A7 shows interest charges as an annualized percent of ADB for account holders with FICO scores of 660 or above. Panel A shows means for consumer and small business accounts. Panel B shows on consumer account $\times$ month interactions from a difference-in-differences regressions specification with interest charges as a percent of ADB as the dependent variable. These specifications can be viewed as placebo tests of the interest charge response. Since fee revenue barely declines for high FICO account holders, a large change in interest charges would suggest that there are other contemporaneous effects that are not being captured by the difference-in-difference specification. The plots show no evidence of differential effect of the CARD Act on high FICO score consumer accounts. Columns 5 to 6 of Appendix Table A1 show difference-in-differences regression specifications that confirm this finding.

### 6.3 Total Income and Costs

The reduction in fee revenue and lack of offsetting interest charge response suggest that the CARD Act reduced bank's total income. Recall from Section 3.2 that we define total income as the sum of fee payments, interest payments and interchange fees. While the evidence discussed above shows a drop in fees, and no change in interest charges, the reduction in fee revenue could lead to what is called a "waterbed effect" where credit card issuers offset the reduction in fees with higher interchange fee revenue from merchants.

Columns 5 and 6 of Table 6 examine this directly by showing difference-in-differences specifications for the sample of low FICO score accounts with total income as a percent of ADB as the dependent variable. The point estimates show a Phase 3 drop in total income of 6.7 percentage point, similar to the 5.5 percentage point decline in fees. Appendix Figure A2 shows that interchange income as a share of purchase volume was a stable 2 percent over the entire time period. Thus the combination of the decline in fee revenue and flat interest charges and interchange income translates directly to a substantially decline in total income from low FICO score account holders.

Another way banks could mitigate their exposure to the CARD Act is by reducing their spending on awards, marketing, or other credit card costs. We examine this potential response by estimating difference-in-difference specifications where the dependent variable is costs excluding charges-offs,

defined using information on the cost of funds, rewards and fraud expenses and operational costs.[38] The estimates, shown Columns 7 and 8 of Table 6, show no evidence of an economically significant decline in costs.[39]

### 6.4 Ancillary Evidence

While perhaps surprising, we do not view the limited non-response of interest charges as unlikely or implausible. Indeed, it is fully consistent with the theoretical model and prior evidence on (i) the limited pass-through of borrowing costs and (ii) the low salience of fees in the credit card market.

Recall from Section 6.1 that the relationship between the offset ($\omega$) and pass-through ($\rho$) is given by the equation $\omega = \rho + \psi\,[1-\rho]$. Intuitively, banks will pass-through the decrease in fee revenue by at least as much as marginal cost shock, and by more if consumers are salient to the change in fees. In a classic paper, Ausubel (1991) examines the time-series correlation between the cost of funds and interest rates in the credit card market. He finds that interest rates are extremely sticky, with credit card issues passing-through through essentially zero of the large changes in the cost of funds he observes over the 1980s time period. Similarly, there is significant evidence that late fees and over limit fees have only limited salience to consumers (Sunstein, 2006; Bar-Gill and Warren, 2008; Mullainathan, Barr and Shafir, 2009; Stango and Zinman, Forthcoming). If we assume, as a starting point, that banks pass-through $\rho = 0.1$ of changes in the cost of funds and a salience parameter of $\psi = 0.1$, then the model indicates that every dollar in fee reduction, credit card issuers will increase prices by about 19 cents ($\omega = \rho + \psi\,[1-\rho] = 0.1 + 0.1[1-0.1] = 0.19$), a value that is squarely within the confidence interval of our offset estimate.

### 6.5 Credit Volume

In this final part of the paper, we examine the effects of the CARD Act on equilibrium credit volume. As discussed in Section 6.1.1, the absence of an offsetting increase in interest charges indicates that fees are non-salient and hence that the decline in fees due to the CARD Act had no effect on demand. This implies that we can interpret any equilibrium response in credit volume as resulting from a

[38] We exclude charge-offs because contemporaneous charge-offs because they are not controlled in the short term by actions taken by credit card issuers.

[39] As additional piece of evidence, Appendix Figure A1 shows that the ratio of rewards / fraud expenses to interchange income was constant over the sample and therefore that these costs were approximately constant.

change in supply. We assess the effects on the supply of credit by examining whether the CARD Act affected (i) credit limits, (ii) the number of new accounts (iii) and average daily balances.

Figure 10 examines the effect on credit limits for accounts with FICO scores below 660 at origination. Panel A shows mean credit limits for consumer and small business cards. Panel B shows coefficients on the consumer account $\times$ month interactions from a difference-in-differences regressions specification (Equation 2) with credit limits as the dependent variable. The plot is constructed analogously to the plots for fees and interest charges (e.g., Panel B of Figure 4). Both plots provide clear evidence that the CARD Act did not bring about a differential reduction in credit limits for consumer accounts.

Table 7 show the corresponding differences-in-differences regression coefficients for the sample of low FICO score accounts with credit limits as the dependent variable. Like the plots, the specifications in this table are analogous to the baseline fee and interest charges regression (e.g., Table 4). Column 2 shows that the Phase 3 point estimate with full controls indicates an economically insignificant \$151 change in credit limits or 5% of the \$2,808 pre-CARD Act mean. A 95% confidence interval allows us to rule out a drop in credit limits of more than \$520 or 18% of the pre-CARD Act mean.

Figure 11 examines the effect on the number of new accounts originated, which we measure as a percentage of the average pre-CARD Act number of accounts in the data.[40] As before, we focus on the sample of accounts with FICO scores below 660. Panel A shows that the percent of consumer and small business new accounts follows a strong U-shaped pattern over the time period. New consumer and small business accounts drop in parallel by approximately 1 percentage points between the start of our data (April 2008) and depths of the financial crisis (early 2009), before recovering over the final two years of our data.

Panel B shows the coefficients on the consumer account $\times$ month interactions from the difference-in-differences regressions specification (Equation 2) with the percent of new accounts relative to the pre-CARD Act level as the dependent variable. Columns 3 and 4 of Table 7 show the corresponding different-in-difference regression estimates. The sample is restricted to accounts with a FICO score below 660. There is considerable noise in the month-to-month estimates, reflecting the fact that the percent of new accounts can be shifted by large promotional or marketing campaigns at a single

[40] We use the average pre-CARD Act level of accounts as the denominator, instead of the contemporaneous number of accounts, to minimize noise that arises from bank decisions to write off accounts in blocks, which makes the denominator drop in discrete increments over time.

bank. However, the plot of regression coefficients shows no evidence of a differential downturn in the number of new consumer credit cards, and the preferred Phase 3 point estimate of 0.02 from Column 4 of Table 7 indicates that there is virtually zero differential change in the number of new consumer accounts, although the standard error of 0.28 prevents us from ruling out meaningful effects in either direction.

Figure 12 shows the same figures for average daily balances for accounts with FICO scores below 660 at origination. Panel A shows mean ADB for consumer and small business cards. Panel B shows coefficients on the consumer account $\times$ month interactions from a difference-in-differences regressions specification (Equation 2) with ADB as the dependent variable. The plots show no evidence of a differential change in consumer credit card ADB. Columns 5 and 6 of Table 7 shows regression estimates that confirm this result.

The non-response of credit volume is fully consistent with the prediction of the model. Recall from Section 6.1 that the effect of a decrease in fees $p_2$ on credit volume is given by $\nu = \frac{\partial q}{\partial p_1}(\omega - \psi)$. Thus, our finding of zero offset ($\omega = 0$) and the implied non-salience of fees ($\psi = 0$) implies that the CARD Act should not affect the equilibrium quantity of credit ($\nu = 0$). As a result, we think the findings on credit volume are not only independently interesting but should be interpreted as further validation of our model and offset result.

## 7 Conclusion

The recent financial crisis has focused considerable attention on regulating consumer financial products, with the newly-created CFPB and other federal agencies given an explicit mission to "promote fairness and transparency for mortgages, credit cards, and other consumer financial products and services." We agree with Campbell et al. (2011) that an important priority for economic research is to "evaluate both potential and existing regulations to determine whether interventions actually deliver the desired improvements in the metrics for success."

This paper aims to take a step in this direction, by providing a quantitative analysis of the impact of the CARD Act, argued by some to be the most significant piece of credit card legislation in a generation (Levitin, 2010). We find that the CARD Act was successful at reducing borrowing costs, in particular for borrowers with the lowest FICO scores. We find no evidence for offsetting increases in other costs or a decline in access to credit, although our estimates of the effect on the number of

accounts are too imprecise to rule out meaningful effects in either direction. In addition, we find that the disclosure requirements of the CARD Act had a small by significant impact on borrower's repayment behavior.

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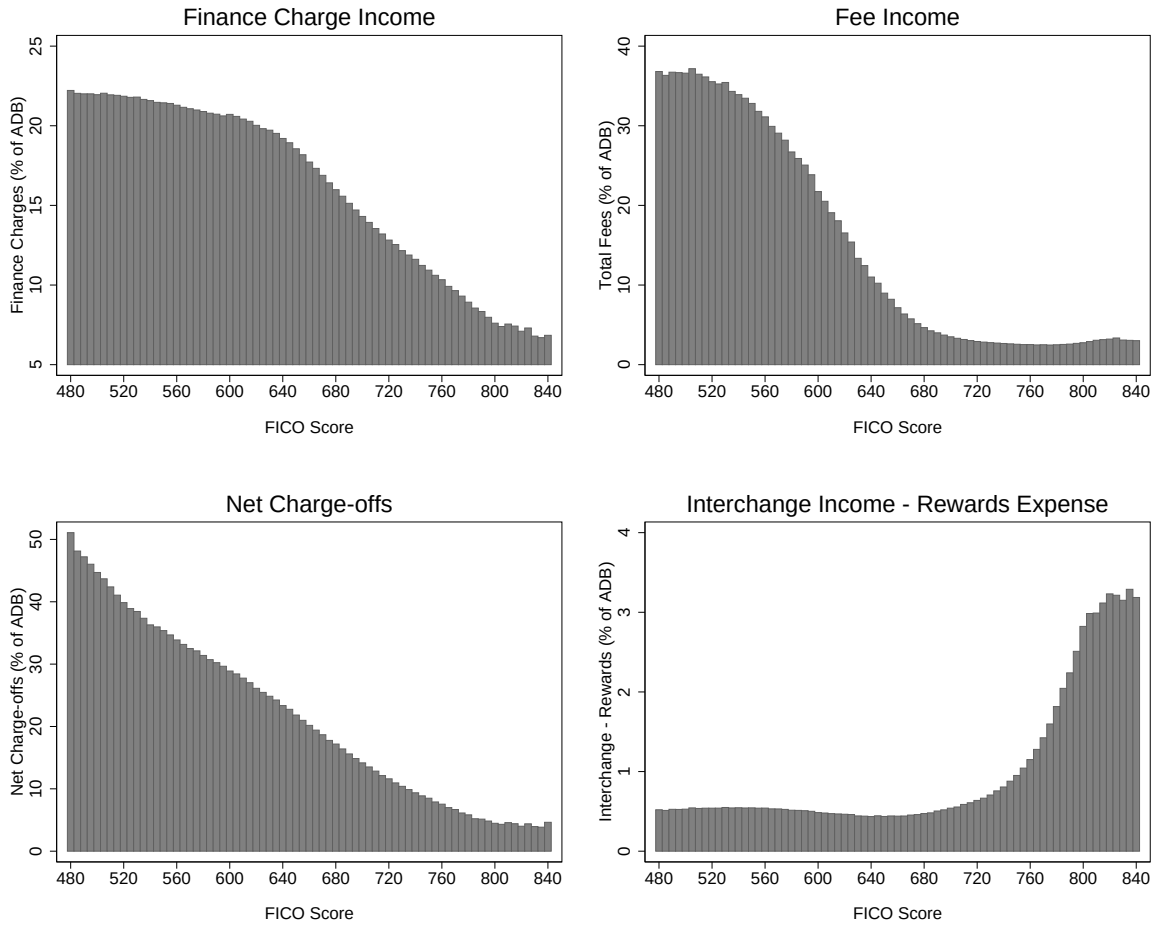
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**Figure 1:** Payoff Disclosure

| If you make no additional charges using this card and each month you pay … | You will pay off the balance shown in this statement in about … | And you will end up paying an estimated total of … |
|---|---|---|
| Only the minimum payment | 10 years | $3,284 |
| $62 | 3 years | $2,232<br>(Savings of $1,052) |

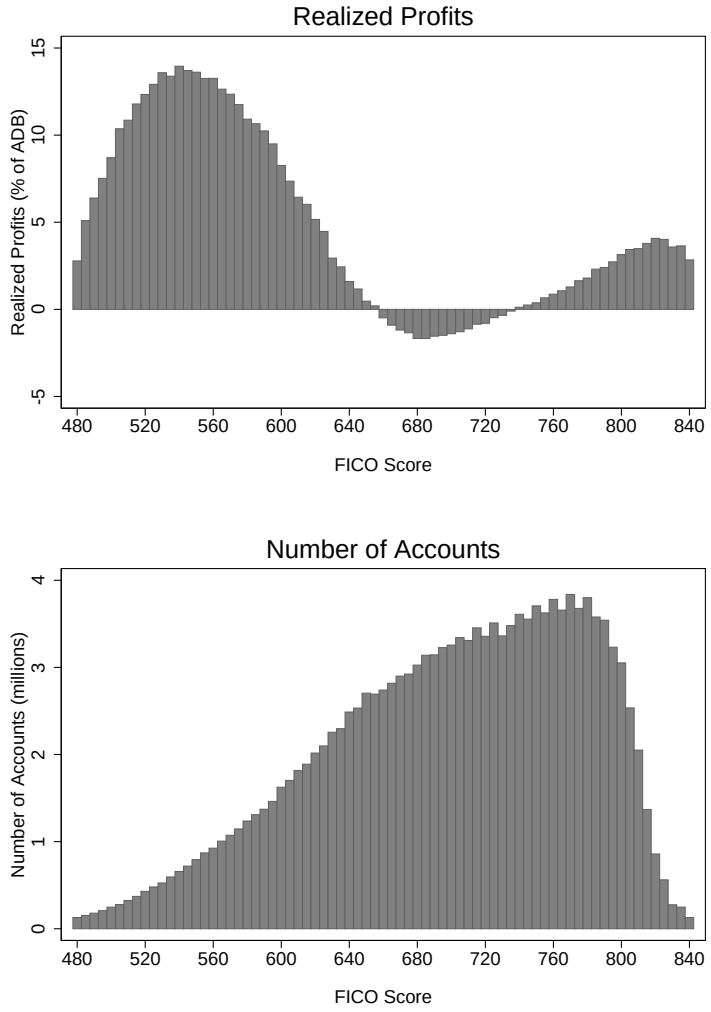
**Note:** Figure provides an example of the disclosure statement on monthly credit card reports required by the CARD Act. bigskip

**Figure 2:** Profit Components by FICO Score




**Note:** Figure shows key components of realized profits for consumer credit cards as an annualized percentage of ADB by FICO score at origination binned in groups of 5. The sample is restricted to the pre-CARD Act period, defined as April 2008 to January 2010.

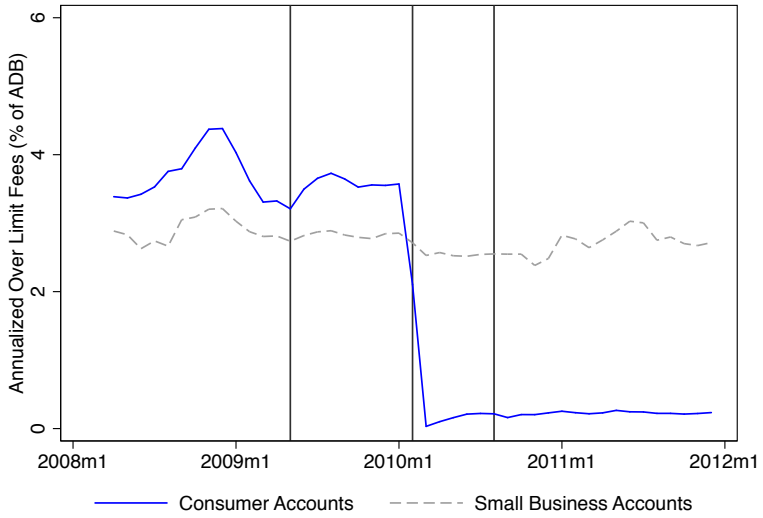
**Figure 3:** Realized Profits and Number of Accounts by FICO Score



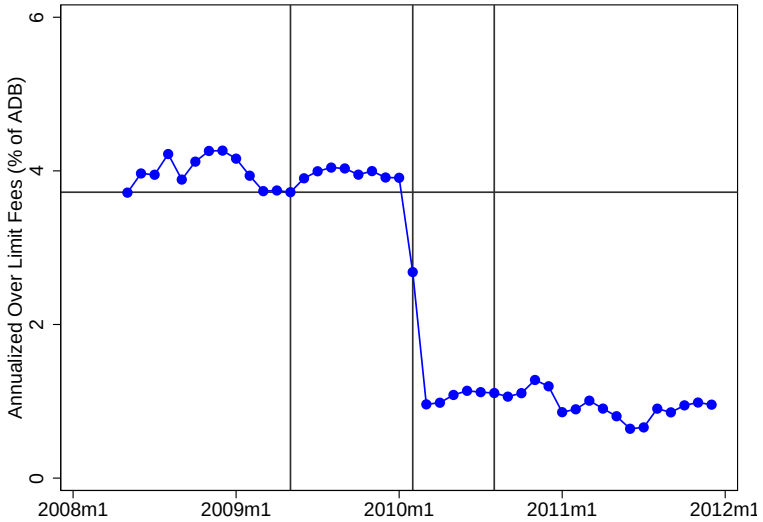

**Note:** Figure shows realized profits for consumer credit cards as an annualized percentage of ADB (top panel) and number of accounts (bottom panel) by FICO score at origination binned in groups of 5. The sample is restricted to the pre-CARD Act period, defined as April 2008 to January 2010. Realized profits are the difference between revenues (interest charges, fees and interchange income) and costs (charge-offs, cost of funds, operational expense, and fraud and rewards expense). Number of accounts are per reporting month.

**Figure 4:** Over Limit Fees: FICO < 660

(a) Means



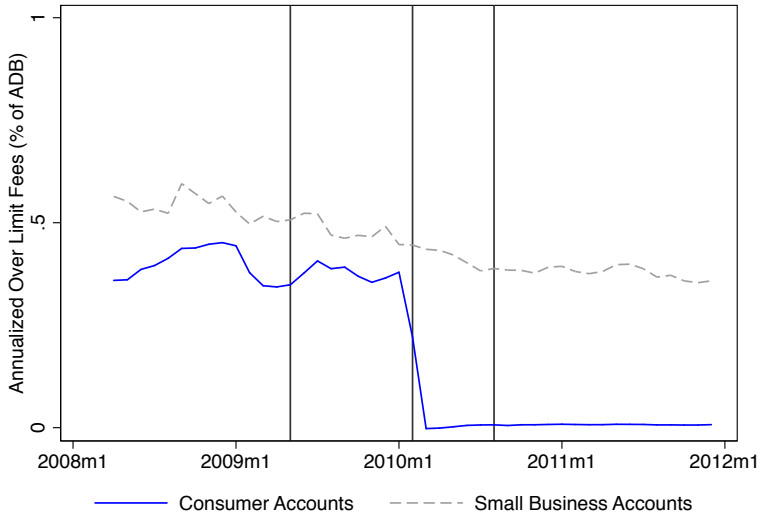

(b) Regression Coefficients



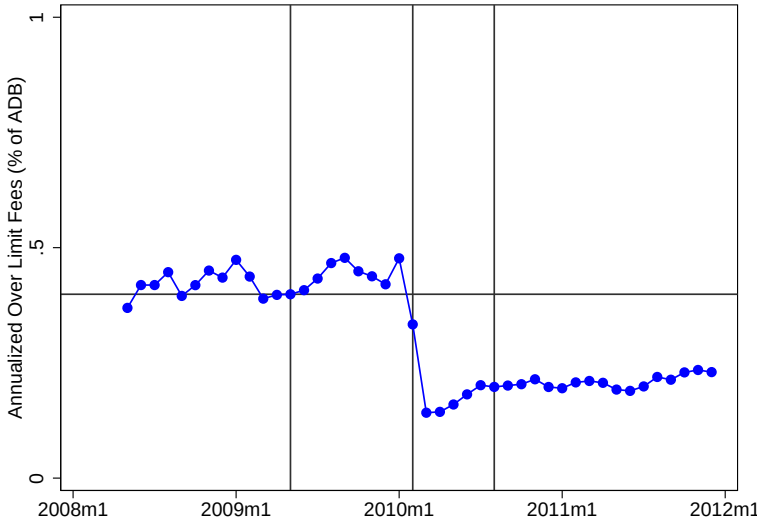

**Note:** Figures show over limit fees as an annualized percent of ADB for account holders with a FICO score less than 660 at origination. Panel A shows month averages for consumer and small business credit cards. Panel B show the coefficient on consumer accounts × month interactions from a difference-in-differences regressions with over limit fees as an annualized percent of ADB as the dependent variable. In Panel B, we normalize the coefficient on the month when the bill was passed to the pre-CARD Act consumer account mean for reference. We show coefficients from a baseline specification where we include a consumer account and month fixed effects, and fully interacted fixed effects for product type, bank, and FICO score groups. Vertical lines are plotted in May 2009, February 2010 and August 2010, the date when the bill was passed and the two key implementation dates of the CARD Act.

**Figure 5:** Over Limit Fees: FICO $\geq$ 660

(a) Means



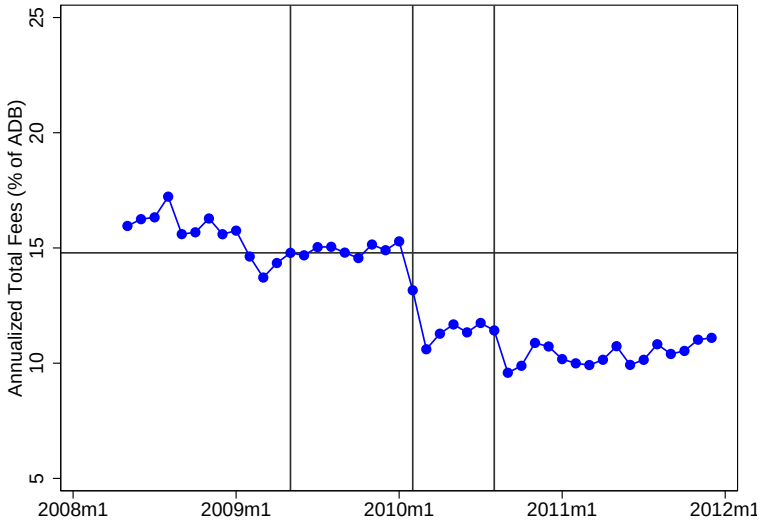

(b) Regression Coefficients



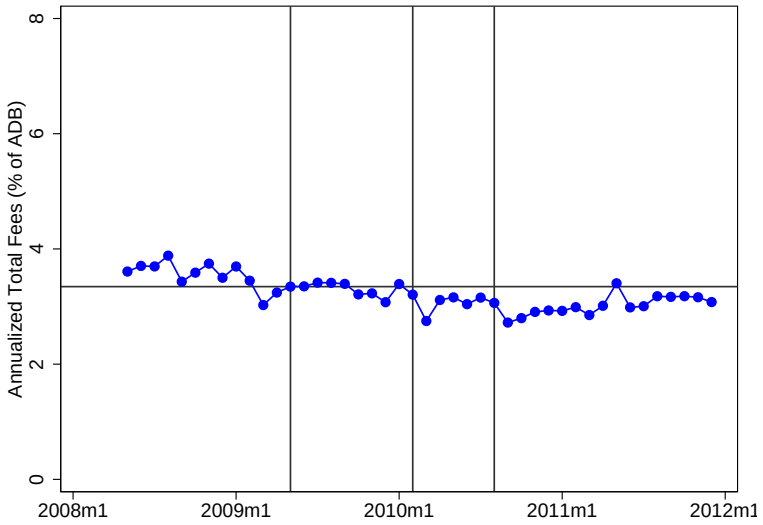

**Note:** Figures show over limit fees as an annualized percent of ADB for account holders with a FICO score of at least 660 at origination. Panel A shows monthly averages for consumer and small business credit cards. Panel B show the coefficient on consumer accounts $\times$ month interactions from a difference-in-differences regressions with over limit fees as an annualized percent of ADB as the dependent variable. In Panel B, we normalize the coefficient on the month when the bill was passed to the pre-CARD Act consumer account mean for reference. We show coefficients from a baseline specification where we include a consumer account and month fixed effects, and fully interacted fixed effects for product type, bank, and FICO score groups. Vertical lines are plotted in May 2009, February 2010 and August 2010, the date when the bill was passed and the two key implementation dates of the CARD Act.

**Figure 6:** Total Fees: Regression Coefficients

(a) FICO <660

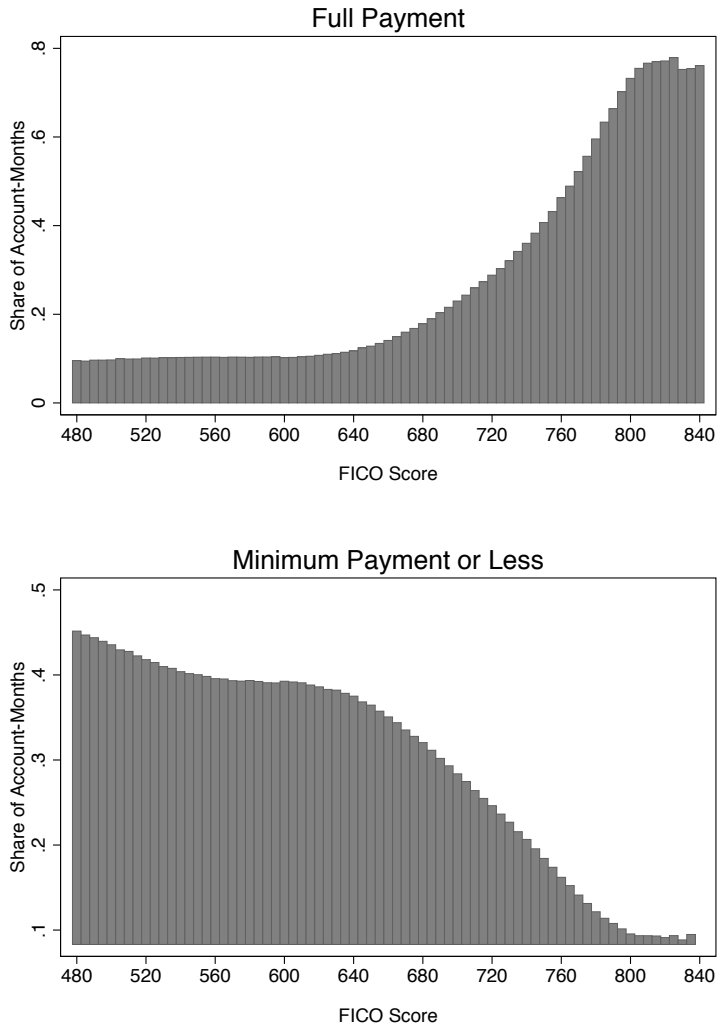



(b) FICO $\geq$ 660




**Note:** Figure show coefficient on consumer accounts $\times$ month interactions from a difference-in-differences regressions with total fees as an annualized percent of ADB as the dependent variable. Panel A show restricts the sample to account holders with a FICO score below 660 at origination. Panel B show the coefficient on consumer accounts $\times$ month interactions from a difference-in-differences regressions with over limit fees as an annualized percent of ADB as the dependent variable. We normalize the coefficient on the month when the bill was passed to the pre-CARD Act consumer account mean for reference. We show coefficients from a baseline specification where we include a consumer account and month fixed effects, and fully interacted fixed effects for product type, bank, and FICO score groups. Vertical lines are plotted in May 2009, February 2010 and August 2010, the date when the bill was passed and the two key implementation dates of the CARD Act.

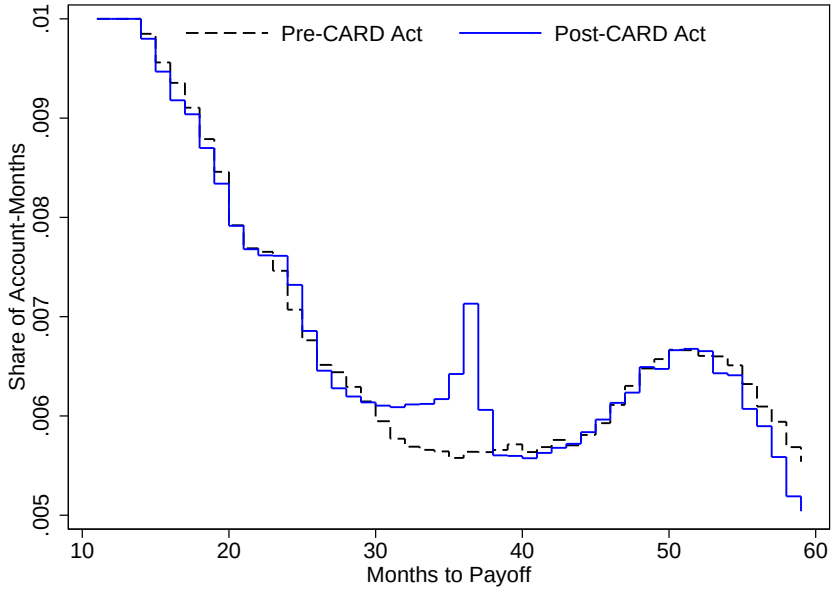
**Figure 7:** Payoff Distribution by FICO Score



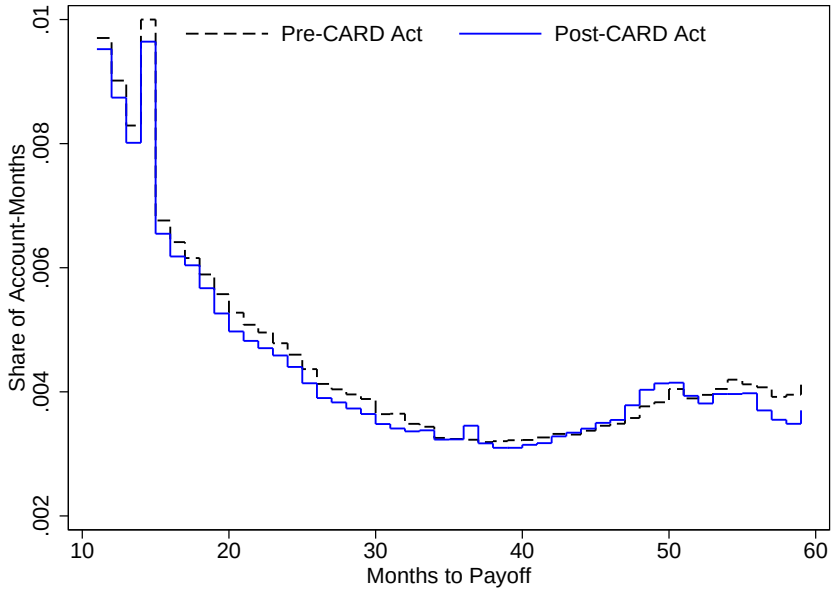

**Note:** Figure shows payoff behavior by FICO score at origination in the year preceding the CARD Act, defined as February 2009 to January 2010. The top panel shows the share of account-months making the full payment. The bottom panel shows the share of account-months making the minimum payment or less.

**Figure 8:** Distribution of Months-to-Payoff ($T$)

(a) Consumer Credit Cards



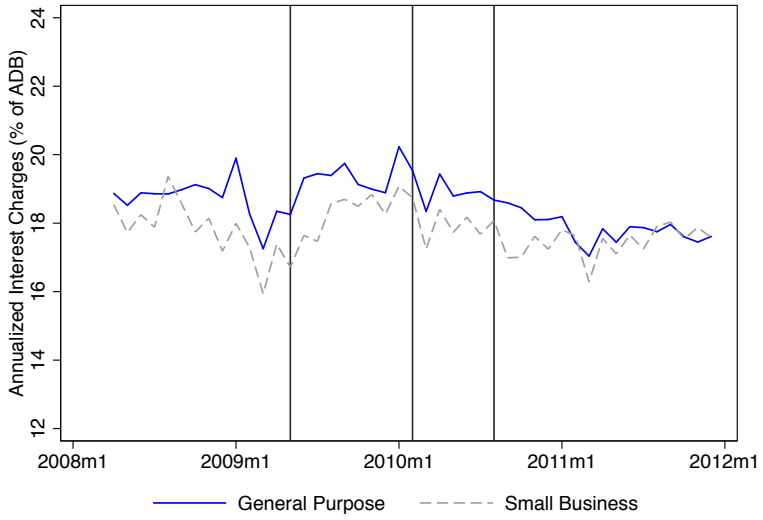

(b) Small Business Credit Cards



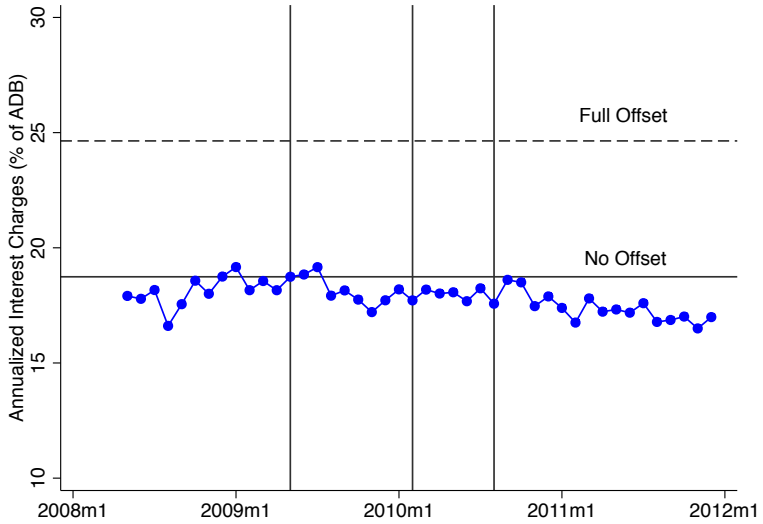

**Note:** Figure plots distributions of months-to-payoff ($T$) in the year before (dashed black line) and after (solid blue line) the February 2009 CARD Act implementation date. Months-to-payoff ($T$) is the number of months it would take to pay off the cycle-ending balance if the account holder makes constant payments and makes no new purchases, and is calculated using Equation 4. We present the distribution for $T$ between 10 and 60. The "share of account-months" is top-coded at 1% in order to focus on the distribution around the CARD Act target payoff amount ($T = 36$). The top panel shows the distribution for consumer credit cards, the bottom panel for small business credit cards.

**Figure 9:** Interest Charges: FICO <660

(a) Means



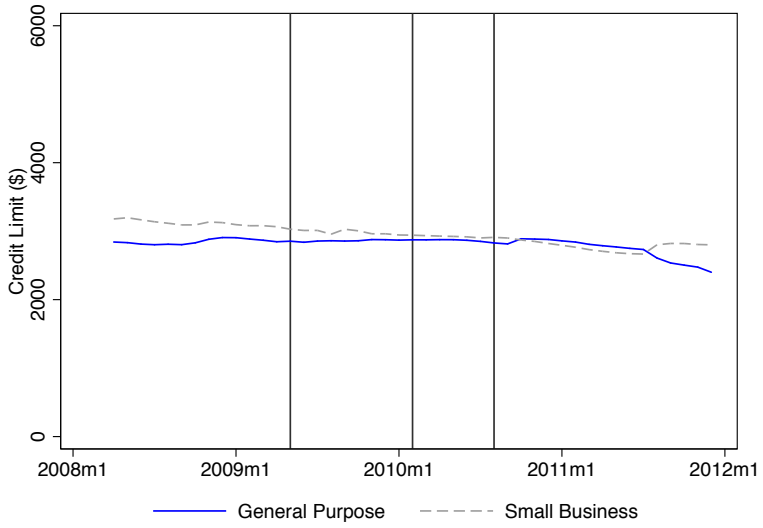

(b) Regression Coefficients



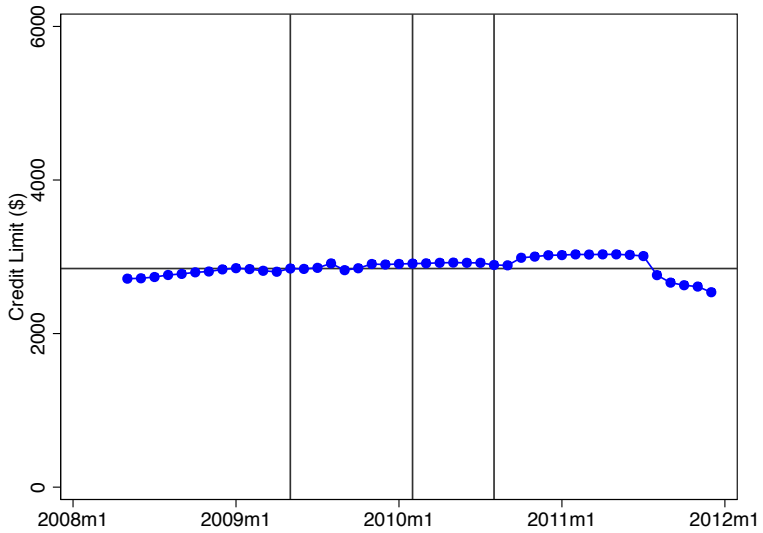

**Note:** Figures show interest charges as an annualized percent of ADB for account holders with a FICO score below 660 at origination. Panel A shows monthly averages for consumer and small business credit cards. Panel B show the coefficient on consumer accounts × month interactions from a difference-in-differences regressions with interest charges as an annualized percent of ADB as the dependent variable. In Panel B, we normalize the coefficient on the month when the bill was passed to the pre-CARD Act consumer account mean for reference. We show coefficients from a baseline specification where we include a consumer account and month fixed effects, and fully interacted fixed effects for FICO score group, product type, and bank. Vertical lines are plotted in May 2009, February 2010 and August 2010, the date when the bill was passed and the two key implementation dates of the CARD Act, respectively. The dashed horizontal line shows the increase in interest charges that would be required to offset the 5.5 percentage point reduction in fee revenue.

**Figure 10:** Credit Limits: FICO <660

(a) Means



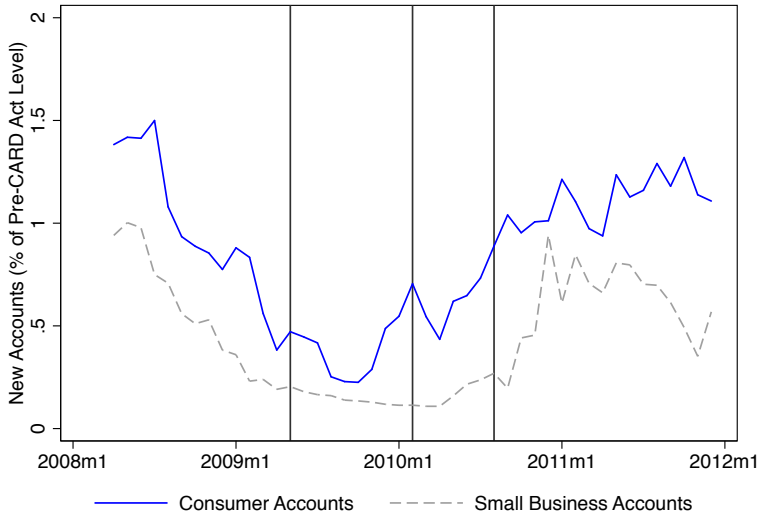

(b) Regression Coefficieints



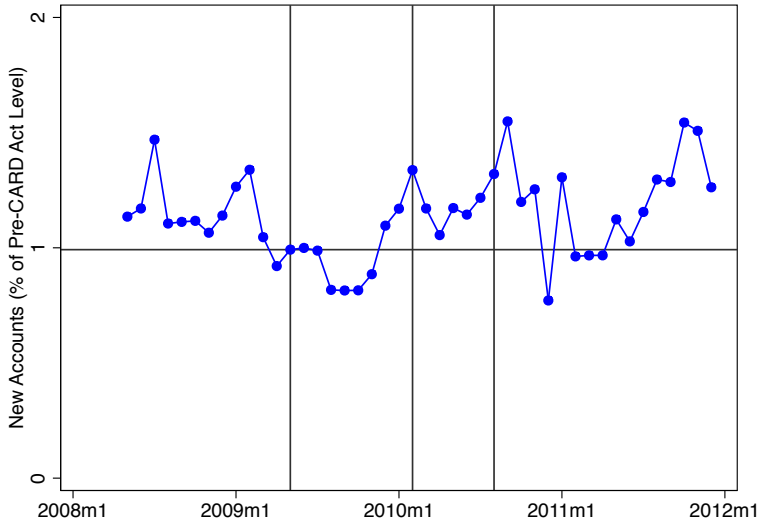

**Note:** Figures show credit limits for account holders with a FICO score below 660 at origination. Panel A shows monthly averages for consumer and small business credit cards. Panel B show the coefficient on consumer accounts $\times$ month interactions from a difference-in-differences regressions with credit limits as the dependent variable. In Panel B, we normalize the coefficient on the month when the bill was passed to the pre-CARD Act consumer account mean for reference. We show coefficients from a baseline specification where we include a consumer account and month fixed effects, and fully interacted fixed effects for FICO score group, product type, and bank. Vertical lines are plotted in May 2009, February 2010 and August 2010, the date when the bill was passed and the two key implementation dates of the CARD Act, respectively.

## **Figure 11:** New Accounts: FICO <660

(a) Means



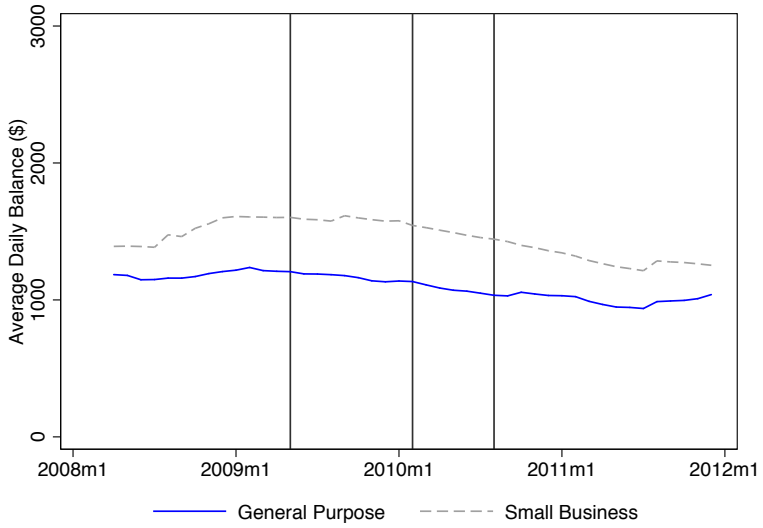

(b) Regression Coefficients



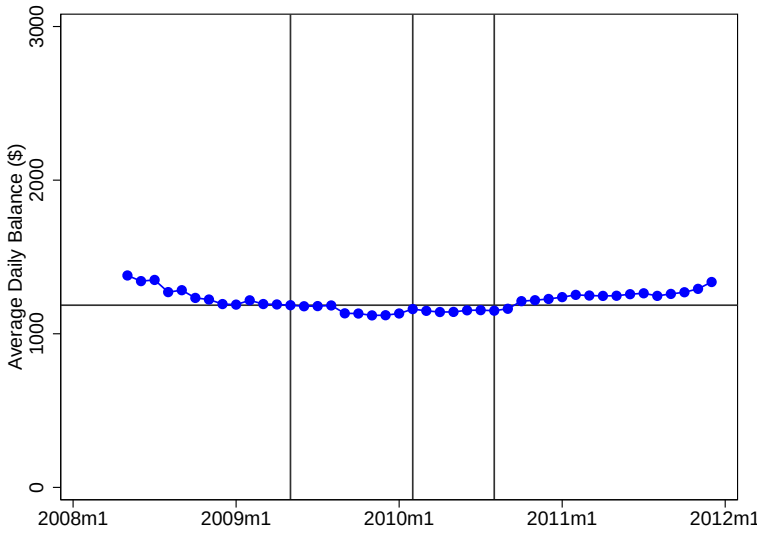

**Note:** Figures show new accounts for accounts holders with FICO scores below 660 at origination, which we measure as the percent of new account relative to the average pre-CARD Act number of accounts in the data. Panel A shows monthly averages for consumer and small business credit cards. Panel B show the coefficient on consumer accounts $\times$ month interactions from a difference-in-differences regressions with new accounts as a percentage of the pre-CARD Act average number of accounts as the dependent variable. In Panel B, we normalize the coefficient on the month when the bill was passed to the pre-CARD Act consumer account mean for reference. We show coefficients from a baseline specification where we include a consumer account and month fixed effects, and fully interacted fixed effects for FICO score group, product type, and bank. Vertical lines are plotted in May 2009, February 2010 and August 2010, the date when the bill was passed and the two key implementation dates of the CARD Act, respectively.

**Figure 12:** Average Daily Balances: FICO <660

(a) Means




(b) Regression Coefficients




**Note:** Figures show average daily balances for account holder with a FICO score below 660 at origination. Panel A shows monthly averages for consumer and small business credit cards. Panel B show the coefficient on consumer accounts $\times$ month interactions from a difference-in-differences regressions with average daily balances as the dependent variable. In Panel B, we normalize the coefficient on the month when the bill was passed to the pre-CARD Act consumer account mean for reference. We show coefficients from a baseline specification where we include a consumer account and month fixed effects, and fully interacted fixed effects for FICO score group, product type, and bank. Vertical lines are plotted in May 2009, February 2010 and August 2010, the date when the bill was passed and the two key implementation dates of the CARD Act, respectively.

**Table 1:** Sample Description

| | | Reporting Accounts | |
|---|---|---|---|
| **Quarter** | **Banks** | **Consumer** | **Small Business** |
| 2008 | | | |
| Q2 | 8 | 177,713,728 | 7,422,349 |
| Q3 | 8 | 180,284,192 | 7,520,575 |
| Q4 | 8 | 180,366,912 | 7,509,119 |
| 2009 | | | |
| Q1 | 8 | 185,079,440 | 7,441,654 |
| Q2 | 8 | 181,871,392 | 7,399,013 |
| Q3 | 8 | 178,302,784 | 7,248,618 |
| Q4 | 8 | 168,607,120 | 7,037,495 |
| 2010 | | | |
| Q1 | 8 | 164,606,800 | 6,945,173 |
| Q2 | 8 | 162,466,176 | 6,874,952 |
| Q3 | 8 | 159,884,496 | 6,586,731 |
| Q4 | 8 | 156,683,184 | 6,432,224 |
| 2011 | | | |
| Q1 | 8 | 156,066,400 | 6,382,361 |
| Q2 | 8 | 156,183,376 | 6,366,461 |
| Q3 | 8 | 157,558,864 | 6,499,567 |
| Q4 | 8 | 147,511,504 | 6,573,132 |

**Note:** Table shows the number of consumer and small business accounts by quarter for the sample period, defined as Q2 2008 to Q4 2011.

## **Table 2:** Summary Statistics

**Panel A**: Account-level, Annualized

| | Combined Sample | | Consumer Credit Cards | | Small Business Credit Cards | |
|---|---|---|---|---|---|---|
| | **Mean** | **Std Dev** | **Mean** | **Std Dev** | **Mean** | **Std Dev** |
| **Average Daily Balance** | 1,277.85 | 2,854.48 | 1,251.10 | 2,809.28 | 1,922.78 | 3,726.52 |
| **Purchase Volume** | 1,985.97 | 10,264.61 | 1,810.45 | 9,061.63 | 6,217.85 | 25,441.00 |
| **Interest Charges** | 161.82 | 448.52 | 159.14 | 439.30 | 226.51 | 627.76 |
| **Total Fees** | 51.28 | 223.37 | 51.19 | 221.89 | 53.43 | 256.54 |
| Annual Fee | 5.80 | 60.86 | 5.87 | 61.07 | 4.19 | 55.61 |
| Balance Transfer | 3.56 | 118.60 | 3.56 | 119.02 | 3.59 | 107.96 |
| Cash Advance | 3.82 | 81.57 | 3.92 | 82.36 | 1.43 | 59.33 |
| Debt Suspension | 7.70 | 60.97 | 7.93 | 61.73 | 2.14 | 37.98 |
| Late Fee | 23.22 | 102.29 | 22.99 | 99.65 | 28.83 | 152.52 |
| Not Sufficient Funds | 0.50 | 17.55 | 0.49 | 16.70 | 0.70 | 31.75 |
| Other Fees | 1.38 | 49.62 | 1.36 | 47.67 | 1.84 | 83.93 |
| Over-Limit | 7.70 | 59.40 | 7.48 | 57.73 | 13.12 | 90.67 |
| **Total Chargeoffs** | 157.16 | 4,485.40 | 153.75 | 4,402.81 | 239.41 | 6,149.02 |
| Principal | 136.68 | 4,101.92 | 130.99 | 3,963.38 | 273.85 | 6,614.07 |
| Interest and Fees | 29.18 | 696.85 | 28.14 | 658.79 | 54.05 | 1,314.87 |
| **Recovery** | 6.06 | 454.56 | 5.91 | 438.98 | 9.71 | 736.42 |
| **Repayment*** | | | | | | |
| Minimum or less | TBD | | 26.2% | | TBD | |
| Full or more | 30.2% | | 29.4% | | 43.9% | |

**Panel B**: Using Portfolio-level Information

| | **Mean** | **Note on Construction** |
|---|---|---|
| Interchange Income | 39.72 | 2% of Purchase Volume |
| Rewards + Fraud Expense | 27.80 | 1.4% of Purchase Volume |
| Cost of Funds | 21.62 | Share of ADB (Time Varying) |
| Operational Costs | 47.12 | Share of ADB (Time Varying) |

**Note:** Panel A shows summary statistics for key variables for the combined sample of consumer and small business accounts, and separately for consumer and small business accounts. Panel B reports additional variables that are constructed by combining account-level measures of ADB and purchase volume with information from the portfolio-level data. Values are calculated using all account-months in the sample period. Operational expenses include expenses for marketing and acquisition, collections, servicing, card-holder billing, processing payments, card issuing and administration. See note on construction and Appendix A for more details. Except for ADB and repayment statistics, values are annualized. All variables are inflation-adjusted to 2012 using the CPI-U.

*These statistics are calculated on the sample of account-months with nonzero cycle-ending balances.

**Table 3:** Pre-CARD Utilization and Realized Profits by FICO Score

| | FICO Score Range | | | | | | |
|---|---|---|---|---|---|---|---|
| | Total | <620 | 620-659 | 660-719 | 720-759 | 760-799 | 800+ |
| Percent of Accounts | 100.0% | 17.3% | 12.6% | 24.6% | 18.6% | 19.2% | 7.6% |
| **Panel A:** Capacity and Utilization | | | | | | | |
| Credit Limit | 8,042 | 2,025 | 3,546 | 7,781 | 11,156 | 12,400 | 11,390 |
| Average Daily Balance | 1,410 | 804 | 1,469 | 2,029 | 1,797 | 1,110 | 486 |
| Purchase Volume | 1,820 | 730 | 1,019 | 1,651 | 2,306 | 2,892 | 2,282 |
| **Panel B:** Realized Profits (% of ADB) | | | | | | | |
| **Total Income** | 25.0% | 45.7% | 31.5% | 21.0% | 16.9% | 17.1% | 19.9% |
| Interest Charges | 14.3% | 20.6% | 19.2% | 15.2% | 11.8% | 9.3% | 7.6% |
| Total Fees | 7.6% | 23.3% | 10.9% | 4.1% | 2.5% | 2.4% | 2.9% |
| Interchange Income | 3.2% | 1.8% | 1.5% | 1.7% | 2.6% | 5.4% | 9.5% |
| **Total Costs** | 23.4% | 37.8% | 30.2% | 22.5% | 17.2% | 15.6% | 16.8% |
| Net Charge-offs | 15.6% | 30.8% | 23.4% | 15.8% | 9.7% | 6.3% | 4.7% |
| Cost of funds | 2.3% | 2.4% | 2.3% | 2.2% | 2.2% | 2.2% | 2.2% |
| Rewards and Fraud | 2.2% | 1.3% | 1.0% | 1.2% | 1.8% | 3.7% | 6.5% |
| Operational Costs | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% | 3.4% |
| **Realized Profit** | 1.6% | 7.9% | 1.3% | -1.6% | -0.2% | 1.5% | 3.1% |

**Note:** Table shows income and cost components the consumer accounts during the pre-CARD Act period, defined as April 2008 to January 2010. The first column shows averages over all accounts; the other columns show averages by FICO scores at account origination. Net charge-offs are the sum of principle and interest/fees charges-offs minus recoveries. Panel B show values as annualized percent of average daily balances. All dollar variables are inflation-adjusted to 2012 using the CPI-U.

**Table 4:** Fees Restrictions: Difference-in-Differences Regressions

| | Dependent Variable: % of ADB | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Over Limit Fees | | Late Fees | | Other Fees | | Total Fees | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| **Panel A**: FICO <660 | | | | | | | | |
| Consumer X Phase 2 | -3.30 | -3.27 | -0.61 | -0.63 | -0.70 | -0.66 | -4.61 | -4.56 |
| | (1.50) | (1.53) | (0.42) | (0.39) | (0.46) | (0.42) | (2.25) | (2.24) |
| | [0.03] | [0.04] | [0.15] | [0.11] | [0.13] | [0.12] | [0.04] | [0.05] |
| Consumer X Phase 3 | -3.38 | -3.35 | -1.46 | -1.57 | -0.58 | -0.60 | -5.42 | -5.52 |
| | (1.52) | (1.54) | (0.78) | (0.73) | (0.46) | (0.38) | (2.70) | (2.60) |
| | [0.03] | [0.03] | [0.07] | [0.04] | [0.20] | [0.12] | [0.05] | [0.04] |
| Pre-CARD Act, Consumer Mean | 3.77 | 3.77 | 5.85 | 5.85 | 5.05 | 5.05 | 14.68 | 14.68 |
| R-Squared | 0.31 | 0.75 | 0.10 | 0.94 | 0.04 | 0.96 | 0.11 | 0.91 |
| **Panel B:** FICO 660+ | | | | | | | | |
| Consumer X Phase 2 | -0.30 | -0.30 | -0.07 | -0.10 | -0.08 | -0.07 | -0.45 | -0.48 |
| | (0.11) | (0.11) | (0.07) | (0.07) | (0.10) | (0.10) | (0.14) | (0.14) |
| | [0.01] | [0.01] | [0.32] | [0.16] | [0.43] | [0.49] | [0.00] | [0.00] |
| Consumer X Phase 3 | -0.25 | -0.26 | -0.26 | -0.30 | 0.06 | 0.06 | -0.45 | -0.51 |
| | (0.12) | (0.12) | (0.08) | (0.09) | (0.08) | (0.07) | (0.20) | (0.19) |
| | [0.04] | [0.03] | [0.00] | [0.00] | [0.46] | [0.39] | [0.03] | [0.01] |
| Pre-CARD Act, Consumer Mean | 0.40 | 0.40 | 1.27 | 1.27 | 1.50 | 1.50 | 3.17 | 3.17 |
| R-Squared | 0.23 | 0.73 | 0.11 | 0.91 | 0.19 | 0.76 | 0.16 | 0.88 |
| **Controls:** All Panels | | | | | | | | |
| Main Effects | | | | | | | | |
| Consumer Card FE | X | X | X | X | X | X | X | X |
| Month FE | X | X | X | X | X | X | X | X |
| Additional Covariates (Fully Interacted) | | | | | | | | |
| Bank FE | | X | | X | | X | | X |
| Product type FE | | X | | X | | X | | X |
| FICO Score FE | | X | | X | | X | | X |

**Note:** Table shows coefficients from difference-in-differences regressions that compare fees for consumer credit cards (treatment group) and small business cards (control group) during the different phases of the CARD Act implementation. The dependent variables are shown as an annualized percent of ADB and are calculated in the same manner as the values in Panel B of Table 3. We define Phase 2 as March 2010 to August 2010 and Phase 3 as the months after August 2010. The period prior to February 2010 is the omitted group so the coefficients can be interpreted as the differential effect relative to the pre-implementation period. Standard errors clustered by bank $\times$ card type are shown in parentheses and the associated p-values are shown in brackets.

**Table 5:** Payoff Nudge: Difference-in-Differences Regressions

| | Dependent Variable: Percent of Payments | | | |
|---|---|---|---|---|
| | Target Range (31 ≤ T ≤ 37) | | Less than Target (T > 37) | |
| | (1) | (2) | (3) | (4) |
| Consumer X Phase 2 | 0.41 | 0.49 | 0.59 | 0.92 |
| | (0.06) | (0.07) | (0.62) | (1.41) |
| | [<0.01] | [<0.01] | [0.36] | [0.52] |
| Controls | | | | |
| Main Effects | | | | |
| Consumer Card FE | X | X | X | X |
| Month FE | X | X | X | X |
| Time Trends | | X | | X |
| Consumer Card X Time | | X | | X |
| Pre-CARD Act, Consumer Mean | 4.03 | 4.03 | 34.51 | 34.51 |
| R-Squared | 0.92 | 0.97 | 0.82 | 0.82 |

**Note:** Table show estimates from difference-in-differences regressions of payoff behavior or a consumer accounts indicator fully interested with an indicator for months after the February 2010 implementation date. In Columns 1 and 2, the dependent variable is the percent of account holders that make a payment corresponding to the target CARD Act payment ($31 \leq T \leq 37$). In Columns 3 and 4, the dependent variable is the percent of account holders that make payments smaller than the CARD Act target amount ($T > 37$). The regressions are estimated on data aggregated to the level of variation in the full interaction of the independent variables. We report standard errors clustered by bank $\times$ credit card type in parenthesis and show p-value in brackets using a t-distribution with 15 degrees of freedom.

**Table 6:** Interest Charge Offset: Difference-in-Differences Regressions

| | Dependent Variable: % of ADB | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Interest Charges | | Offset | | Total Income | | Costs Excluding Chargesoffs | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Consumer X Anticipation | 0.25 | 0.26 | 0.05 | 0.05 | -0.37 | -0.13 | -0.06 | -0.04 |
| | (1.40) | (1.38) | (0.26) | (0.25) | (1.51) | (1.43) | (0.17) | (0.16) |
| | [0.86] | [0.86] | [0.86] | [0.86] | [0.81] | [0.93] | [0.71] | [0.80] |
| Consumer X Phase 2 | 0.22 | 0.15 | 0.04 | 0.03 | -4.68 | -4.59 | -0.48 | -0.51 |
| | (2.31) | (2.24) | (0.43) | (0.41) | (2.27) | (2.16) | (0.25) | (0.24) |
| | [0.93] | [0.95] | [0.93] | [0.95] | [0.06] | [0.05] | [0.07] | [0.05] |
| Consumer X Phase 3 | -0.35 | -0.46 | -0.06 | -0.08 | -6.66 | -6.70 | -0.61 | -0.66 |
| | (2.00) | (1.83) | (0.37) | (0.33) | (2.76) | (2.35) | (0.29) | (0.26) |
| | [0.86] | [0.81] | [0.87] | [0.81] | [0.03] | [0.01] | [0.06] | [0.02] |
| Controls | | | | | | | | |
| Main Effects | | | | | | | | |
| Consumer Card FE | X | X | X | X | X | X | X | X |
| Month FE | X | X | X | X | X | X | X | X |
| Additional Covariates (Fully Interacted) | | | | | | | | |
| Bank FE | | X | | X | | X | | X |
| Product type FE | | X | | X | | X | | X |
| FICO Score FE | | X | | | | X | | X |
| Pre-CARD Act, Consumer Mean | 19.14 | 19.14 | N/A | N/A | 35.40 | 35.40 | 3.65 | 3.65 |
| R-Squared | 0.06 | 0.83 | N/A | N/A | 0.05 | 0.53 | 0.20 | 0.32 |

**Note:** Table shows coefficients from difference-in-differences regressions that compare interest charges as an annualized percent of ADB for consumer credit cards (treatment group) and small business cards (control group) during the different phases of the CARD Act implementation. We define the Anticipation period as the months between the passage of the bill in May 2009 and the implementation of Phase 2 in February 2010. We define Phase 2 as March 2010 to August 2010 and Phase 3 as the months after August 2010. The period prior to April 2009 is the omitted group so the coefficients can be interpreted as the differential effect relative to pre-CARD Act period. The sample is restricted to accounts with FICO scores below 660 at origination. Standard errors clustered by bank $\times$ card type are shown in parentheses and the associated p-values are shown in brackets.

**Table 7:** Credit Volume: Difference-in-Differences Regressions

| | Dependent Variable: | | | | | |
|---|---|---|---|---|---|---|
| | Credit Limits ($) | | New Accounts (% of Pre-CARD Act Level) | | Average Daily Balances ($) | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Consumer X Anticipation | 124.31 | 52.15 | 0.13 | 0.17 | -105.66 | -107.57 |
| | (153.63) | (174.83) | (0.11) | (0.11) | (59.32) | (62.40) |
| | [0.43] | [0.77] | [0.26] | [0.14] | [0.10] | [0.11] |
| Consumer X Phase 2 | 229.37 | 125.25 | 0.19 | 0.26 | -98.13 | -96.96 |
| | (285.75) | (316.02) | (0.11) | (0.14) | (142.37) | (145.93) |
| | [0.43] | [0.70] | [0.10] | [0.08] | [0.50] | [0.52] |
| Consumer X Phase 3 | 294.20 | 150.54 | -0.09 | 0.02 | 16.00 | -13.89 |
| | (328.38) | (342.42) | (0.23) | (0.28) | (192.66) | (188.39) |
| | [0.38] | [0.67] | [0.70] | [0.94] | [0.93] | [0.94] |
| Controls | | | | | | |
| Main Effects | | | | | | |
| Consumer Card FE | X | X | X | X | X | X |
| Month FE | X | X | X | X | X | X |
| Additional Covariates (Fully Interacted) | | | | | | |
| Bank FE | | X | | X | | X |
| Product type FE | | X | | X | | X |
| FICO Score FE | | | | | | |
| Pre-CARD Act, Consumer Mean | 2,807.88 | 2,807.88 | 0.25 | 0.25 | 1,159.29 | 1,159.29 |
| R-Squared | 0.00 | 0.99 | 0.04 | 0.67 | 0.03 | 0.89 |

**Note:** Table shows coefficients from difference-in-differences regressions that compare measures of credit volume for consumer credit cards (treatment group) and small business cards (control group) during the different phases of the CARD Act implementation. Columns 1 and 2 show regressions with credit limits as the dependent variable. Columns 3 and 4 show regressions with new accounts as a percentage of the pre-CARD Act average number of accounts as the dependent variable. Columns 5 and 6 shows regressions with average daily balances as the dependent variable. We define the Anticipation period as the months between the passage of the bill in May 2009 and the implementation of Phase 2 in February 2010. We define Phase 2 as March 2010 to August 2010 and Phase 3 as the months after August 2010. The period prior to April 2009 is the omitted group so the coefficients can be interpreted as the differential effect relative to pre-CARD Act period. The sample is restricted to accounts with FICO scores below 660 at origination. Standard errors clustered by bank $\times$ card type are shown in parentheses and the associated p-values are shown in brackets.

# APPENDIX

## A Data Appendix

### A.1 Constructing Revenue and Cost Measures

A number of the important cost and revenue measures for credit cards are not observed at the account level, but only at the credit card portfolio level. These include the cost of funds, operational expenses, interchange income, rewards expenses, and fraud expenses. Since most of these measures broadly scale with either average daily balances (cost of funds, operational expenses) or purchase volume (interchange income, rewards, and fraud), we can use the information in the portfolio-level data to construct account-level measures of these variables. At the portfolio level, banks also report "daily average managed receivables," but not total monthly transaction volume.

#### A.1.1 Cost of Funds

The cost of funds is the interest rate paid by financial institutions for the funds that they deploy in their business, and is a significant component of the cost of extending credit. The cost of funds also varies across banks, depending, amongst other things, on their ability to raise funds in the interbank market. Banks report "total interest expense accrued for the month to fund credit card receivables" in the portfolio-level data. This allows us, for every bank and month, to calculate the cost of funds—that is, the annualized cost of funding credit card lending. The top panel of Figure A1 shows the average cost across banks of this cost-of-fund measure. The cost of funds declined markedly over our sample period, with particularly steep drops in 2008, as the Fed Funds Rate declined to zero. The graph also shows the 11th District Cost of Funds Index (COFI), a monthly weighted average of the interest rates paid on checking and savings accounts offered by financial institutions operating in the states of Arizona, California and Nevada. This index is widely seen as a measure of the refinancing costs of US financial institutions. Reassuringly, it moves closely with the cost-of-funds derived from the credit card portfolio data. For every account, we calculate the cost of funding that account's receivables by multiplying the average daily balances with the cost of funds for the corresponding bank and month.

#### A.1.2 Operational Expenses

At the portfolio level, we also observe banks reporting three other components of cost. These are *collection expenses*, which include the costs incurred to collect problem credit; *marketing/acquisition and card processing costs*, which include the costs to acquire, advertise, and promote and process credit cards; and *other expenses*, which include servicing, cardholder billing, processing interchange, processing payments, card issuing, authorizations, card administration and outside services/outsourcing expenses. We combine these three expense categories into the category "Operational Costs." For each month, we calculate the ratio of these operational costs to the average daily managed receivables. This ratio is shown in the middle panel of Figure A1. We use the smoothed version of this series to

assign a corresponding "operational cost" to every account by multiplying the average daily balances with the operational expense ratio for the corresponding month.

### A.1.3 Interchange Income, Rewards and Fraud Expenses

Three other components of overall credit card profitability are also reported in the portfolio-level data. At the account level, these measures are likely to scale with total purchase volume rather than with average daily balances. Unfortunately, we do not observe a measure of total purchase volume at the portfolio level. In order to assign these costs to individual accounts, we proceed in a number of steps. We determine that while there is some heterogeneity in interchange fees, average interchange income for the issuing bank is roughly 2% of the overall volume (Government Accountability Office, 2009). Hence, we assess interchange income at the account level to be 2% of purchase volume. The portfolio-level data shows that expenditures for rewards and fraud make up about 70% of interchange income (see the bottom panel of Figure A1). Therefore, we assess reward and fraud expenses at the account level to be approximately $0.7 \times 2\% = 1.4\%$ of purchase volume.

To validate the approach of choosing interchange income as a constant fraction of purchase volume, we conduct the following analysis: First, we use the account-level data to calculate, for every month, the ratio of purchase volume to average daily balances. This is plotted in the top panel of Figure A2. Next, we combine this ratio with the portfolio-level data to impute a total purchase volume for the entire credit card portfolio. Finally, we construct the ratio of interchange income to this imputed purchase volume at the portfolio level. This is plotted in the bottom panel if Figure A2. The ratio is constant at 2% over the entire sample period.

## B Econometric Model

We estimate the parameters of the econometric model on data collapsed to groups that represent the full interaction of the categorical variables in the data. Let $g$ denote these groups. Using this subscript, we can write difference-in-differences specification (Equation 2) as:

$$y_{it} = \sum_{t \neq 0} \beta_t C_g + X'_{gt}\delta_X + \delta_t + \epsilon_{igt} \tag{9}$$

where the $g$ subscripts on $C_g$ and $X_{gt}$ indicate that these variables vary, respectively, at the group and group $\times$ month level. This specification is identical to the hierarchical regression model:

$$\begin{aligned} y_{igt} &= \gamma_{gt} + \nu_{igt} \\ \gamma_{gt} &= \sum_{t \neq 0} \beta_t C_g + X'_{gt}\delta_X + \delta_t + \mu_{gt} \end{aligned}$$

where the first equation is a regression of the account level outcomes on group $\times$ month fixed effects and the second equation is a difference-in-differences specification with these fixed effects as the dependent variable. The account level level error is defined as the sum of errors from the hierarchical

model: $\epsilon_{igt} = \mu_{gt} + \nu_{igt}$.

We can estimate the group $\times$ month fixed effects $\hat{\gamma}_{gt}$ by collapsing the data to the group level. Given these estimates, we can recover the coefficient of interest with a difference-in-differences regression with these groups fixed effects as the dependent variable:

$$\hat{\gamma}_{gt} = \sum \beta_t C_g + X'_{gt}\delta_X + \delta_t + \mu_{igt} + \bar{v}_{gt} \tag{10}$$

# C Fee Offset with Selection

The composition of the borrower pool may not be invariant to the prices charged, and changing the price might attract either higher or lower marginal cost consumers.[41] To allow for such adverse or advantageous selection, we allow aggregate marginal costs $c'(q)$ to depend on aggregate demand $q$. Adverse selection at the industry level is indicated by decreasing aggregate marginal costs $c''(q) < 0$; advantageous selection is indicated by increasing aggregate marginal costs $c''(q) > 0$.

When a single firm lowers its price, it attracts consumers that are new to the market and consumers who are already purchasing the product from competing firms. The share of consumers that firm $i$ captures from its competitors is given by the aggregate diversion ratio: $A = -\dfrac{\sum_{j\neq i} \partial q_j/\partial p_i}{\partial q_i/\partial p_j}$, the sum consumers lost by firms $j \neq i$ divided by the consumers gained by firm $i$.[42]

We assume that the consumers acquired from competitors are not selected and have costs equal to industry average cost: $\frac{c(q)}{q}$. Marginal costs for a single firm $c'_i(q_i)$ are the weighted sum of marginal costs for consumers that are new to the market and marginal costs for consumers that are attracted from other firms:

$$c'_i(q_i) = (1 - A)c'(q) + A\frac{c(q)}{q}. \tag{11}$$

It is convenient to characterize the demand curve faced by a single firm in terms of aggregate demand and the aggregate diversion ratio:

$$1 - A = 1 - \frac{\sum_{j\neq i} \partial q_j/\partial p_i}{\partial q_i/\partial p_j} = \frac{\partial q_i/\partial p_j - \sum_{j\neq i} \partial q_j/\partial p_i}{\partial q_i/\partial p_j} = \frac{q'}{q'_i} \quad \iff \quad q'_i = \frac{q'}{1 - A} \tag{12}$$

where $q'$ is the derivative of aggregate demand with respect to the price $p_1$ of a single firm $i$.

The first order condition for $p_1$ is given by

$$p_1 + p_2 - c'_i(q_i) = \theta\, \mu(p_1 + \psi p_2) \tag{13}$$

with the conduct parameter $\theta \in [0, 1]$ and markup term $\mu(p_1 + \psi p_2)$ as previously defined. The second order condition for $p_1$ is $\theta\, \mu' + c''\, q' < 1$. We assume that at the optimal price this condition

[41] Similarly, changing the price might have a direct impact on costs. For example, if high prices increase debt levels and thereby increases the probability of default.

[42] We thank Glen Weyl for suggesting this approach to modeling selection.

is satisfied.

For small changes in $p_2$ we can calculate pass-through by totally differentiating the first order condition:

$$\frac{dp_1}{dp_2} + 1 - c_i''(q_i)\, q_i' \left[\frac{dp_1}{dp_2} + \psi\right] = \theta\, \mu'(p_1 + \psi p_2) \left[\frac{dp_1}{dp_2} + \psi\right]. \tag{14}$$

Substituting $c_i'' = (1 - A)c''$ and $q_i' = \frac{q'}{1-A}$ and re-arranging gives us the pass-through formula:

$$\omega = \frac{1 - \psi\,[\,\theta\,\mu' + \,c''\,q']}{1 - [\theta\,\mu' + c''\,q']} \tag{15}$$

where we have suppressed the arguments of $c$, $q$ and $\mu$.

The offset $\omega$ is increasing in the term $c''\,q'$. With downward sloping demand $q' < 0$, this means that the offset is relatively larger when there is adverse selection ($c'' < 0$) and relatively smaller when there is advantageous selection ($c'' > 0$). The reason the offset is larger with adverse selection is that a higher $p_1$ brings in higher marginal cost consumers, requiring a further increase in price.

Under what conditions is the offset less than full? The second order condition $\theta\,\mu' + \,c''\,q' < 1$ restricts the numerator and denominator to be positive. For $\psi \in (0, 1)$, it follows that

$$\omega < 1 \iff \theta\,\mu' + \,c''\,q' < 0. \tag{16}$$

Under what conditions is the offset increasing in competition? Differentiating the pass-through formula yields

$$\frac{d\omega}{d\theta} = \frac{[1 - \theta\,\mu' - c''\,q']\,[-\psi\,\mu'] - [1 - \psi\,\theta\,\mu' - \psi\,c''\,q']\,[-\mu']}{[1 - \theta\,\mu' - c''\,q']^2} \tag{17}$$

which simplifies to

$$\frac{d\omega}{d\theta} = \frac{\mu'\,[1 - \psi]}{[1 - \theta\,\mu' - c''\,q']^2} \tag{18}$$

Since the denominator is always positive, for $\psi \in (0, 1)$ we have

$$\frac{d\omega}{d\theta} < 0 \iff \mu' < 0 \tag{19}$$

where recall that increasing competition is indicated by a lower value of $\theta$.

Under what conditions is the offset increasing in salience? Differentiating the pass-through formula gives us:

$$\frac{d\omega}{d\psi} = -\frac{[\theta\,\mu' + c''\,q']}{1 - [\theta\,\mu' + c''\,q']}. \tag{20}$$

Since $\theta\,\mu' + c''\,q' < 0$ is implied by the second order condition, it follows that

$$\frac{d\omega}{d\psi} > 0 \iff \theta\,\mu' + c''\,q' < 0 \tag{21}$$

We can also relate pass-through to the offset of a cost shock in settings with selection. Differentiating the first order conditions with respect to $c$ yields the pass-through equation

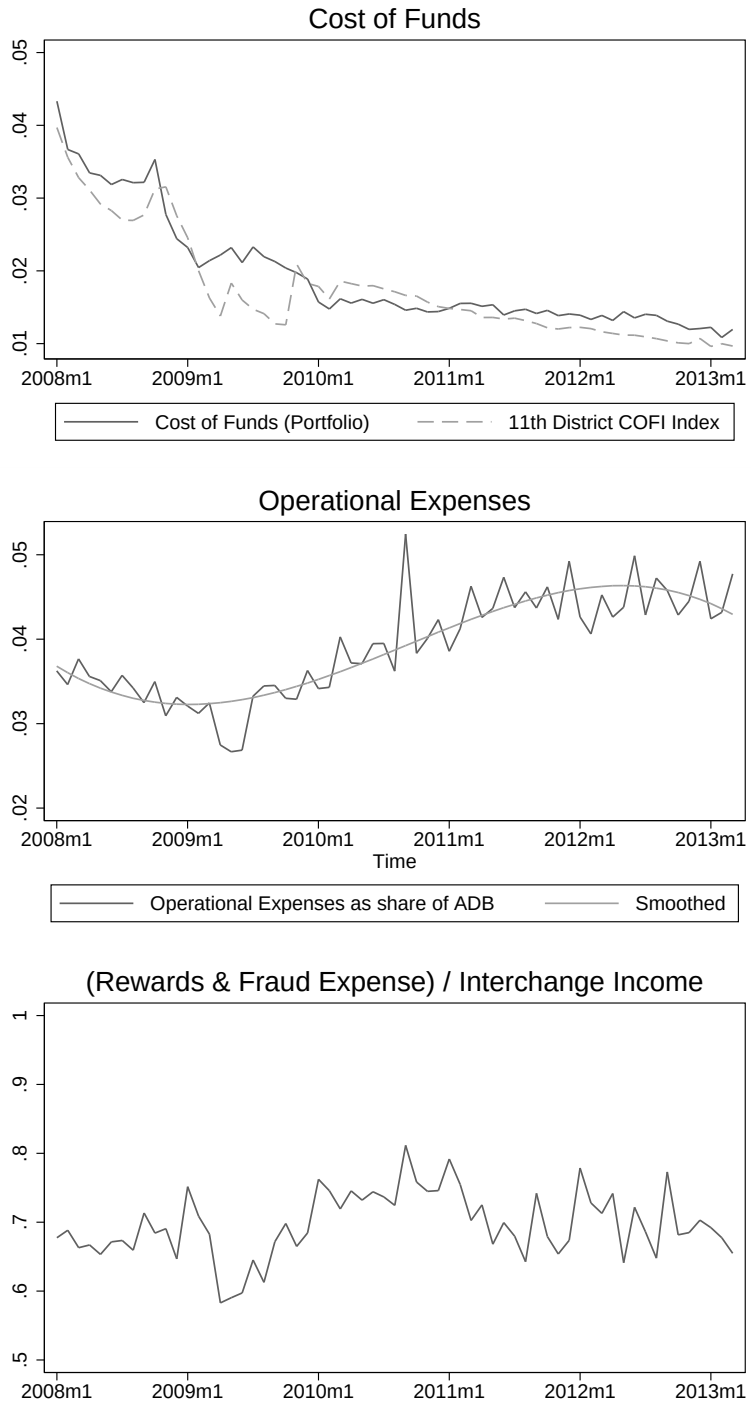
$$\rho = \frac{1}{1 - [\theta\,\mu' + c''\,q']}. \tag{22}$$

Simple algebra allows us to write the offset as a function of the pass-through rate

$$\omega = \rho + \psi\,[1 - \rho] \tag{23}$$

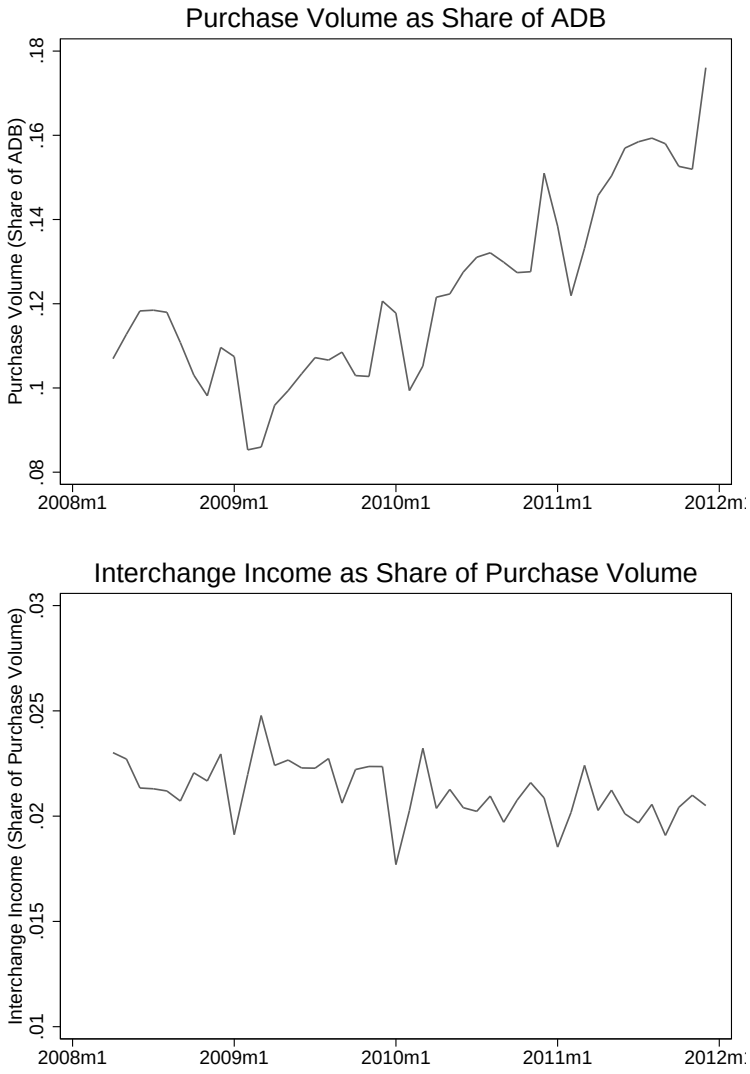
If $\psi = 0$, the offset is equal to the pass-through because a decrease in the non-salient price $p_2$ enters the firm's problem in the exact same manner as an increase in marginal costs $c$. If $\psi = 1$, then the offset is full. If $\psi \in (0, 1)$, then we have $\rho < \omega < 1$ if $\theta\,\mu' + c''\,q' < 0$ and $\rho > \omega > 1$ if $\theta\,\mu' + c''\,q' > 0$. Hence the result that the offset ($\omega$) of a decrease in the non-salient price is weaker closer to full than the pass-through ($\rho$) of an increase in marginal costs.

**Figure A1:** Portfolio Data




**Note:** Figure shows plots of cost components by month. The top panel shows the cost of funds, calculated as the annualized interest expense ("total interest expense accrued for the month to fund credit card receivables") as a share of average daily managed receivables for that month. It also shows the 11th District Cost of Funds Index (COFI). The middle panel shows the share of annualized operational expenses (including marketing and acquisition, collections, servicing, cardholder billing, processing payments, card issuing and administration) as a share of average daily managed receivables. The bottom panel shows the share of rewards and fraud expenses as a ratio of the interchange income. These figures are constructed using the monthly general purpose credit card portfolio-level data. Numbers are averages across banks.

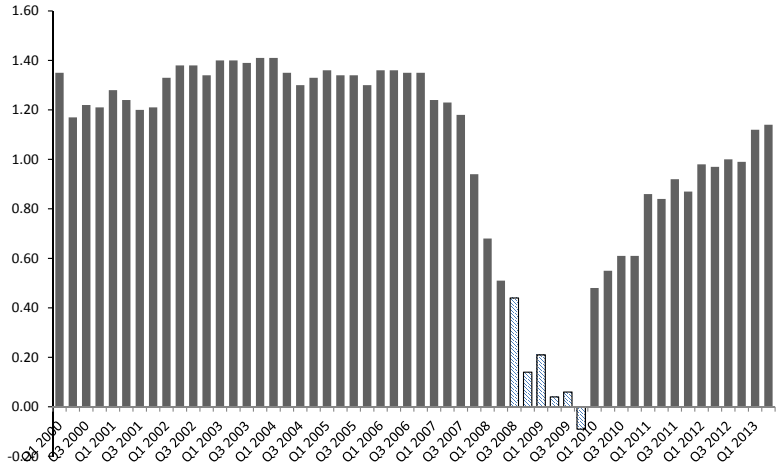
**Figure A2:** Interchange Income



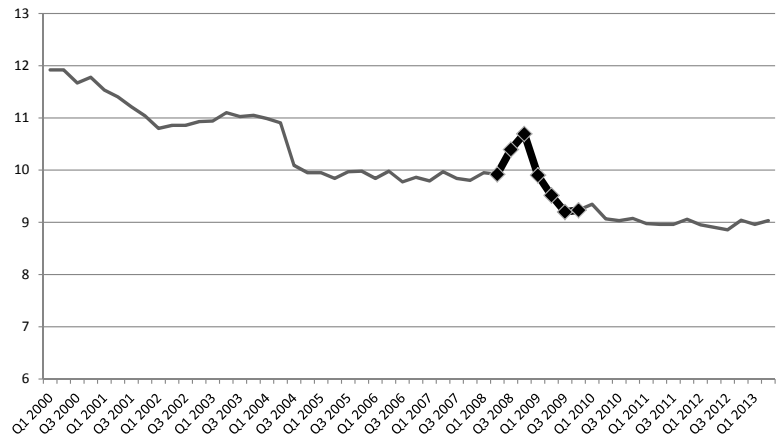

**Note:** Figure shows ratio of purchase volume to ADB (top panel) and share of interchange income to purchase volume (bottom panel). The top panel is constructed from account-level data. The bottom panel is constructed by taking the information from the top panel to scale the portfolio-level information on ADB to get a portfolio-level of measure of purchase volume. Total interchange income is also reported at the portfolio level.

**Figure A3:** U.S. Commercial Banking Sector - ROA and Leverage

(a) Return on Assets (ROA)



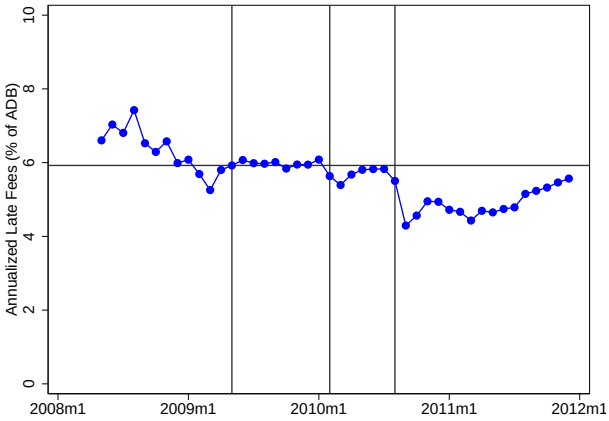

(b) Leverage



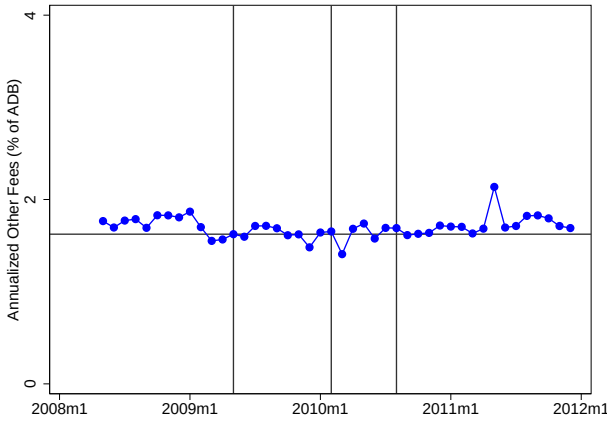

**Note:** Top panel shows the average Return on Assets (ROA) in percent for all insured U.S. Commercial Banks (FRED Series USROA) as reported by the Federal Financial Institutions Examination Council. The bottom panel reports the leverage (Total Assets / Total Equity) for all insured U.S. Commercial Banks (the inverse of FRED Series EQTA). The shaded bars in the top panel and bolded line in the bottom panel depict the pre-CARD Act period covered in Table 3.

## **Figure A4:** Fees: Regression Coefficients

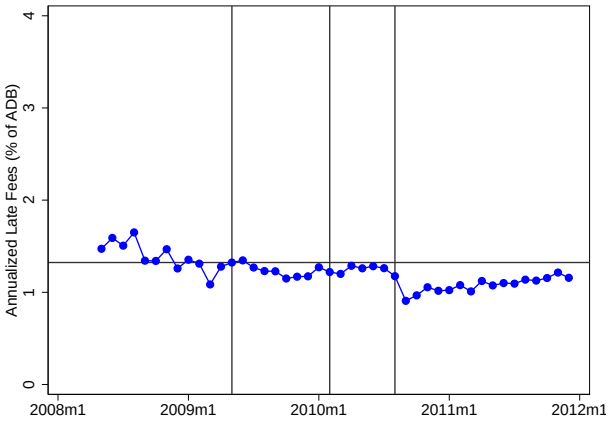
(a) Late Fees: FICO <660



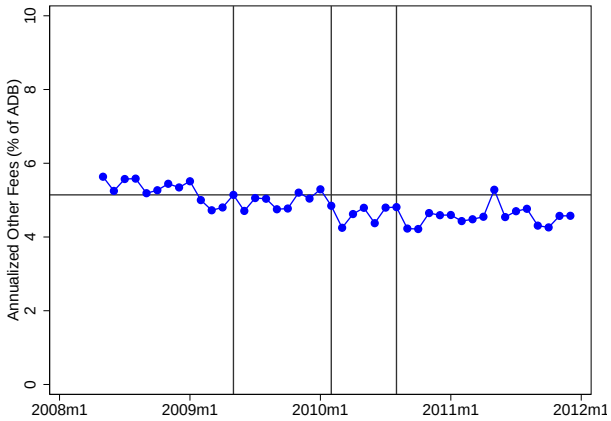

(b) Other Fees: FICO <660




(c) Late Fees: FICO $\geq$ 660



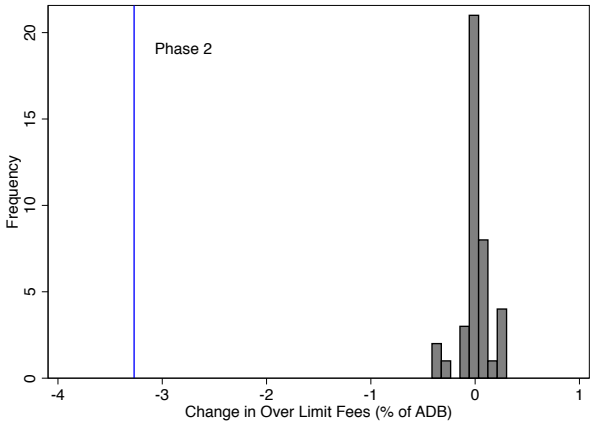

(d) Other Fees: FICO $\geq$ 660



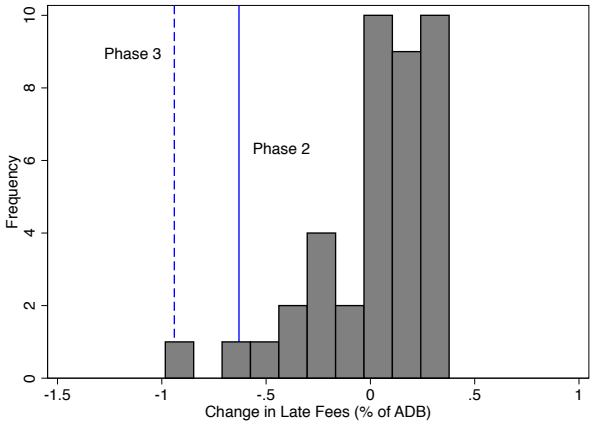

**Note:** Figure shows the coefficient on consumer accounts $\times$ month interactions from difference-in-differences regressions with late fees and other fees as an annualized percent of ADB as the dependent variable. Other fees are the sum of all fees except over limit and late fees. Panels A and B show values for account holders with a FICO score below 660 at origination. Panels C and D show values for account holders with a FICO score of at least this value. In all panels, we normalize the coefficient on the month when the bill was passed to zero and reinsert the pre-CARD Act consumer account mean for reference. We show coefficients from a baseline specification where we include a consumer account and month fixed effects, and fully interacted fixed effects for product type, bank, and FICO score groups. Vertical lines are plotted in May 2009, February 2010 and August 2010, the date when the bill was passed and the two key implementation dates of the CARD Act.

## **Figure A5:** Fees: Permutation Tests

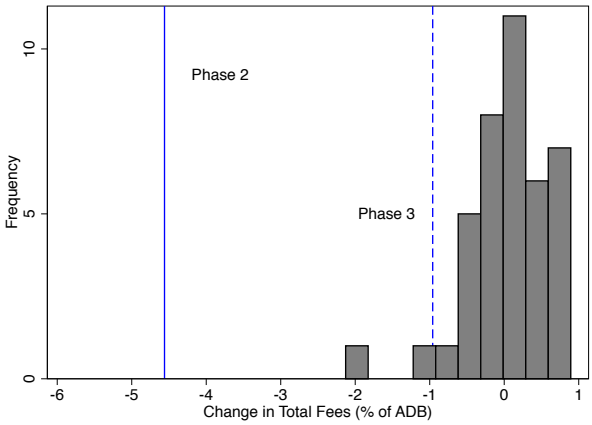
(a) Over Limit Fees




(b) Late Fees



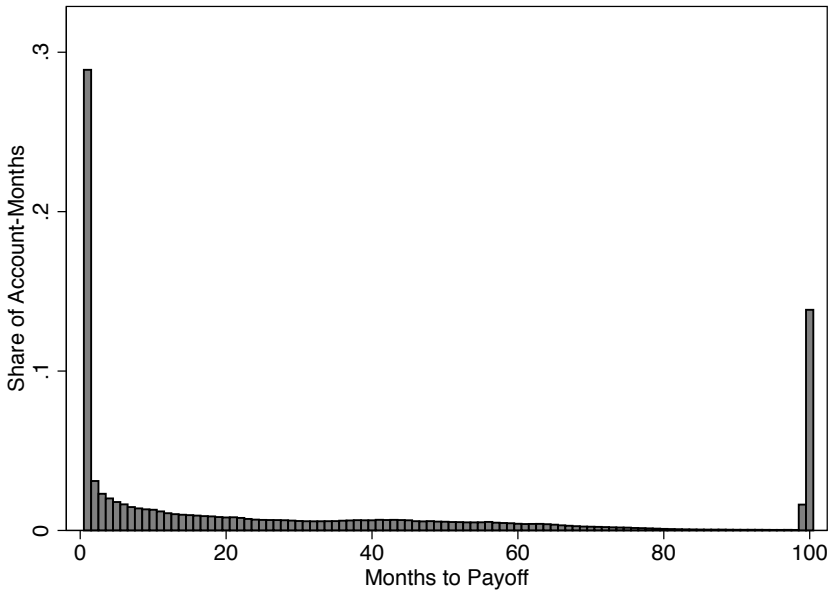

(c) Total Fees



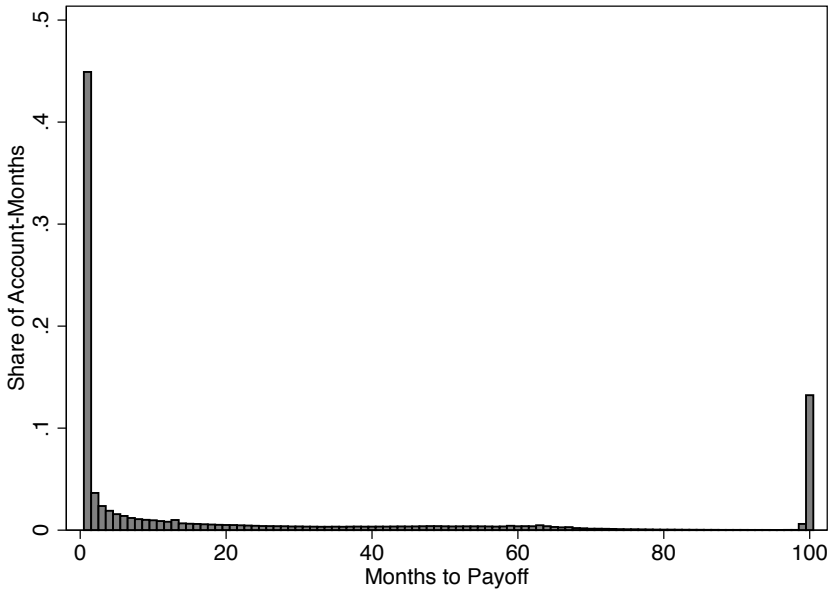

**Note:** Figure shows results perturbation tests where we show the estimates that uses the Phase 2 (solid line) and Phase 3 (dashed line) implementation dates to a histogram of estimates that use placebo implementation dates of each other month in the data. See Section 4 for additional details.

**Figure A6:** Distribution of Months-to-Payoff ($T$) in Pre-CARD Act Period

(a) Consumer Credit Cards



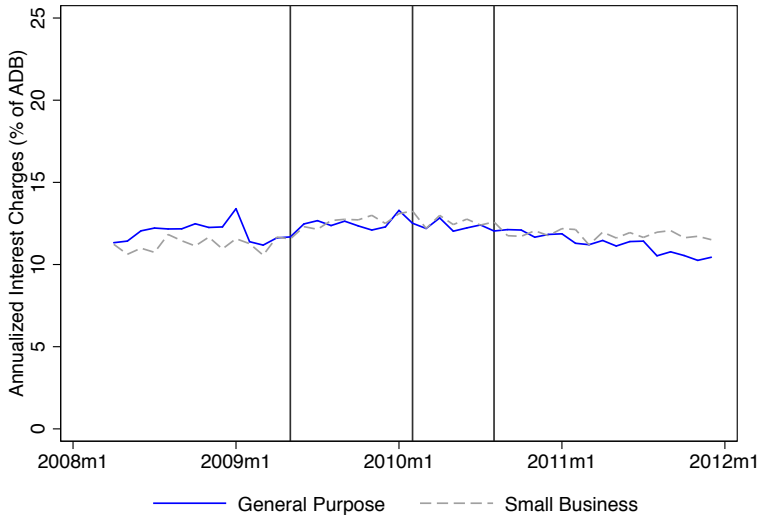

(b) Small Business Credit Cards



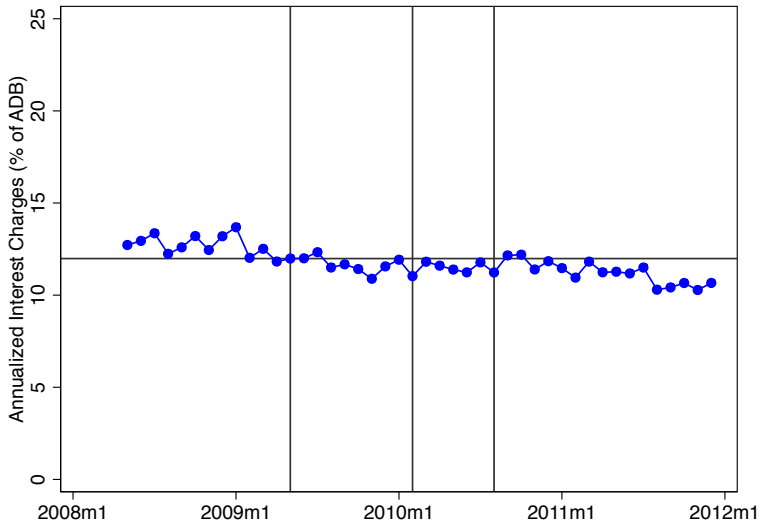

**Note:** Figure shows histogram of months-to-payoff $(T)$ in the year preceding the CARD Act, defined as February 2009 to January 2010. Months-to-payoff $(T)$ is the number of months it would take to pay off the cycle-ending balance if the account holder makes constant payments and makes no new purchases, and is calculated using Equation 4. The variable $T$ is top-coded at 99 months with $T = 100$ denoting account holders that make no payment. The top panel shows the distribution for consumer credit cards, the bottom panel for small business credit cards.

**Figure A7:** Interest Charges: FICO $\geq$ 660

(a) Means




(b) Regression Coefficients




**Note:** Figures show interest charges as an annualized percent of ADB for account holders with a FICO score of at least 660 at origination. Panel A shows monthly averages for consumer and small business credit cards. Panel B show the coefficient on consumer accounts $\times$ month interactions from a difference-in-differences regressions with interest charges as an annualized percent of ADB as the dependent variable. In Panel B, we normalize the coefficient on the month when the bill was passed to the pre-CARD Act consumer account mean for reference. We show coefficients from a baseline specification where we include a consumer account and month fixed effects, and fully interacted fixed effects for FICO score group, product type, and bank. Vertical lines are plotted in May 2009, February 2010 and August 2010, the date when the bill was passed and the two key implementation dates of the CARD Act, respectively.

**Table A1:** Interest Charges for New and High FICO Score Accounts: Difference-in-Differences Regressions

| | Dependent Variable: Interest Charges (% of ADB) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | FICO < 660 | | | | FICO 660+ | | | |
| | All Accounts | | New Accounts | | All Accounts | | New Accounts | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Consumer X Anticipation | 0.25 | 0.26 | -2.83 | -2.25 | -0.86 | -1.06 | -0.47 | -0.82 |
| | (1.40) | (1.38) | (2.03) | (1.81) | (1.21) | (1.13) | (0.80) | (0.67) |
| | [0.86] | [0.86] | [0.18] | [0.23] | [0.49] | [0.36] | [0.57] | [0.24] |
| Consumer X Phase 2 | 0.22 | 0.15 | -4.50 | -3.86 | -0.97 | -1.40 | -1.79 | -1.77 |
| | (2.31) | (2.24) | (2.22) | (1.57) | (2.02) | (1.77) | (1.14) | (0.94) |
| | [0.92] | [0.95] | [0.06] | [0.03] | [0.64] | [0.44] | [0.14] | [0.08] |
| Consumer X Phase 3 | -0.35 | -0.46 | 1.25 | 0.05 | -1.31 | -1.77 | -1.70 | -1.75 |
| | (2.00) | (1.83) | (3.10) | (1.73) | (1.99) | (1.69) | (0.81) | (0.79) |
| | [0.86] | [0.81] | [0.69] | [0.98] | [0.52] | [0.31] | [0.05] | [0.04] |
| Controls | | | | | | | | |
| Main Effects | | | | | | | | |
| Consumer Card FE | X | X | X | X | X | X | X | X |
| Month FE | X | X | X | X | X | X | X | X |
| Additional Covariates (Fully Interacted) | | | | | | | | |
| Bank FE | | X | | X | | X | | X |
| Product type FE | | X | | X | | X | | X |
| FICO Score FE | | X | | X | | X | | X |
| Pre-CARD Act, Consumer Mean | 19.14 | 19.14 | 7.69 | 7.69 | 12.29 | 12.29 | 2.08 | 2.08 |
| R-Squared | 0.06 | 0.83 | 0.05 | 0.71 | 0.04 | 0.87 | 0.03 | 0.52 |

**Note:** Table shows coefficients from difference-in-differences regressions that compare interest charges as an annualized percent of ADB for consumer credit cards (treatment group) and small business cards (control group) during the different phases of the CARD Act implementation. Wed define new accounts as account in their first full month after origination. We define the Anticipation period as the months between the passage of the bill in May 2009 and the implementation of Phase 2 in February 2010. We define Phase 2 as March 2010 to August 2010 and Phase 3 as the months after August 2010. The period prior to April 2009 is the omitted group so the coefficients can be interpreted as the differential effect relative to pre-CARD Act period. Standard errors clustered by bank $\times$ card type are shown in parentheses and the associated p-values are shown in brackets.