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Credit Card Industry:
Evidence from US Survey
Data**

*By José Liñares-Zegarra and
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Risk Based Pricing in the Credit Card Industry: Evidence from US Survey Data

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Abstract

This paper explores the risk-based pricing strategies of banks issuing credit cards in the United States. We employ a unique database which combines both the risk of cardholders (demand side) and terms and conditions of credit cards (supply side) offered in the US. Our results suggest that the annual percentage rates paid per unit of long-term risk decrease, implying that high-risk cardholders pay lower interest rates than their low-risk counterparts. This effect is pronounced for sub-prime cardholders. However, under stressed conditions, it seems that issuer banks have increased their interest rates to account for the high prevailing level of short-term risk observed in the market. Overall, our findings suggest that the risk-based pricing strategies employed by banks do not sort effectively cardholders in terms of risk. The non-price characteristics of credit cards (such as network affiliation, issuer brand and reward program) play an important role in complementing the risk-based strategies.

Keywords: Risk-based pricing, credit card plans, demand, supply.

JEL Codes: G21, L8.

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1. Introduction

Credit cards are an integral part of the financial and payment systems of modern societies being used as a convenient payment medium (in place of traditional paper-based instruments such as cash and checks) and a method for obtaining short-term revolving credit to make purchases.¹ Evidence suggests that reliance on credit cards has led to an increase in consumer indebtedness and a rise in personal bankruptcy (Mann, 2007; Zywicki, 2005).

In recent years, banks and other financial institutions offering credit cards have implemented risk-based pricing strategies, where high-risk cardholders are granted credit cards at higher Annual Percentage Rates of interest (APRs) relative to their low-risk counterparts. In a world of full information and rational decision makers, pricing differences should only be related to differences in credit risk (Getter, 2006). Despite the obvious importance for banks issuing credit cards, and government agencies tasked with supervising and monitoring developments in the credit card industry, there has been very little empirical research to assess whether in fact these risk-based pricing strategies are effective.² This in part is due to a lack of publicly available data.

Against this background, this paper investigates risk-based pricing in the US credit card market. We use survey data on both supply (terms and conditions of credit card plans from a representative sample of issuer banks) and demand (risk characteristics of cardholders located where banks market their card plans) sides of the

¹ Revolving consumer debt in the US (comprising almost entirely of credit card debt) stands at \$950 billion, and approximately 13.9 per cent of consumer disposable income is used to service this debt (Joint Economic Committee, 2009). Over 6,000 US depository institutions issue credit cards, and independently set the terms and conditions. In addition, approximately 10,000 other institutions act as agents for card-issuing institutions (Federal Reserve Board, 2011; GAO 2011). Recent data suggests that 176.8 million US consumers hold 609.8 million credit cards, which represents an average of 3.5 cards per cardholder (Foster et al., 2010, 2011). Gerdes (2008) and Prager et al. (2009) provide detailed overviews of the functioning and regulation of the US credit card market.

² A major issue in payment research concerns the interchange fees charged to merchants by issuer banks. The interchange fee is designed to compensate for the risk (that the cardholder might not pay) and for the costs of processing a transaction. An analysis of interchange fees goes beyond the scope of this paper.

credit card market in the US. We use an innovative matching procedure to study how card attributes and the level of risk of cardholders affect APRs charged by issuer banks. Cardholder risk measures comprise: FICO credit score; presence of unpaid credit card debt in the previous twelve months; and outstanding credit card debt.³ These measures allow us to identify patterns of risk from a temporal perspective. The FICO credit score can be interpreted as a long-term indicator of risk which is likely to be less affected by the recent financial crisis.⁴ Unpaid credit card debt in the previous twelve months can be considered a short-term indicator of risk which to some extent is driven by the recent financial crisis. These risk measures complement each other and represent an improvement to previous empirical studies that only differentiate between high- and low-risk cardholders (using a measure of outstanding card debt). To test the effect of card issuer characteristics (supply of credit card plans) and the risk of cardholders (demand side) on credit card interest rates, we utilize both a two-stage least squares (2SLS) along with a two-step efficient Generalized Method of Moments (IV-GMM) approach to control for potential endogeneity biases in the empirical specification.⁵

The results show a negative and statistically significant relationship between different long-term measures of cardholder risk and APRs. Specifically, we find a negative relationship between being a sub-prime consumer (measured as a combination of low levels of FICO credit scores and high levels of outstanding credit card debt) and the APR charged on credit cards. This result has two important implications for

³ The Fair Issac Corporation (FICO) credit score provides a snapshot of credit risk, and is computed using information from an individual consumer's previous credit and payment history, and provides a summary measure of the risk of default. As such, the FICO score. Consumers with high (low) FICO scores have a lower (higher) risk of default.

⁴ The FICO score is a collection of several years of credit history based on a model developed by Fair Isaac Corporation. Our measure of risk "unpaid credit card debt in the previous twelve months" is likely to have been affected to some extent by the recent financial crisis. The FICO score captures longer term financial information of cardholders (before and during the financial crisis).

⁵ Endogeneity can arise when causality is reversed, i.e., when some credit card fees and penalties (over the limit fees and minimum finance charges, in our particular case) depend on the prices (annual percentage rates) charged to consumers.

industry, regulatory and consumer stakeholders. First, it provides empirical support to theories based on search behaviour by risky consumers in the US credit card market. Second it suggests that issuer banks do not sort consumers in terms of risk by charging them prices which are not related to their level of risk. In other words, it would be expected that low-risk consumers, on average, pay more APRs than high-risk consumers.⁶ Low APRs charged to high-risk cardholders could lead to an unexpected increase in their credit card debt and a worsening of their financial situation. However, these findings could be also consistent with the observation that banks target high-risk cardholders in order to increase long-term revenue, and that prime consumers are cross-subsidizing sub-prime consumers. In fact, it seems that the credit card industry has relied on riskier borrowers as a prime source of revenue (Martin, 2009). This is also consistent with the idea that issuers want consumers accumulate debt so that higher rates and more fees can be charged relative to counterparts who pay off their bill each month (Frank, 2012; Mann, 2007).⁷ We also find, by contrast, that during the recent financial crisis an increase in the level of short-term risk (i.e. unpaid credit card debt in the previous twelve months) led issuer banks to increase APRs, as predicted by standard economic theory.

Our results suggest that non-price characteristics play a complementary role to risk based pricing strategies. We find that the APRs charged on national credit cards are lower compared to their local counterparts. This is perhaps due to advantages in screening and monitoring cardholder risk across the entire country. We also find some evidence which suggests that banks offering cards with reward programs charge lower APRs compared to cards with no reward programs.

⁶ Frank (2009) finds many banks issuing credit cards do not appear to pursue risk-based pricing.

⁷ Recent theoretical research suggests that firms structure pricing in order to exploit consumer cognitive biases or limitations (DellaVigna and Malmendier, 2004; Gabaix and Laibson, 2006).

Cardholders pay high APRs for credit cards that include minimum finance charges. This result can be explained by assuming that banks advertise credit card plans with minimum finance charges to attract customers, but then exploit them with high fees later. Furthermore, some cardholders are willing to pay a premium for access to a large card network. For example, cardholders holding a Discover card (a major network in the US) pay higher interest rates relative to counterparts holding cards affiliated to smaller networks such as American Express or Diners Club. We also observe that prime cardholders of premium and gold cards pay lower APRs than their sub-prime counterparts. Finally, our results suggest that APRs adjust to changes in the market interest rates (1 year CD rate that represents a cost of funding to the card providers) even after controlling for non-price characteristics of credit cards. These results are robust to different econometric models and specifications.

The rest of this paper is structured as follows. Section 2 reviews relevant literature. Section 3 describes the data set. The methods utilized to test the hypotheses are discussed in Section 4, while the empirical findings are presented in Section 5. Section 6 provides final remarks.

2. Literature

Risk-based pricing (RBP hereafter) refers to the practice of setting prices or other credit terms based on the risk of nonpayment. In order to compensate for the higher risk of default, banks offer consumers with poor credit histories less favorable credit terms than their counterparts with strong credit histories. This practice has been used for many years by lenders in mortgage loan markets, and more recently in the credit card industry. In recent years, there has been considerable interest in how RBP has been used for extending credit to high-risk consumers. In the case of credit cards,

several laws and amendments have been passed to ensure consumers are informed of the terms and conditions of their credit cards and are protected from unfair business practices.⁸ The extent to which RBP in the credit card industry has been implemented in order to distinguish between high- and low-risk consumers remains unclear.

A small body of research evidence has explored the relationship between consumer risk and the price charged by credit card providers. Here we can distinguish between two strands of research. The first (which has been the most common in the literature) explores the effects of price changes on cardholder default. The second examines the determinants of observed credit card prices (Annual Percentage Rates of Interest or APRs). The market power of incumbent card providers, credit card characteristics and the credit risk of consumers are commonly cited factors in determining prices. The remainder of this section provides a brief review of this literature.

2.1 The effect of price changes on cardholder default

In a seminal contribution, Ausubel (1991) uses US bank-level survey data to find that three-quarters of cardholders pay finance charges on their outstanding credit card balance. This implies that there are a high proportion of high-risk cardholders in the market. Given these results, he contends that credit card providers would be discouraged from competing on price, given that a price cut would disproportionately attract cardholders who intend to borrow, and hold an outstanding balance on their respective cards. This group represents, in fact, those high-risk cardholders who are most likely to default. As a consequence, high and sticky prices (APRs) prevail despite the large numbers of competing card providers.

⁸ The Credit Card Accountability, Responsibility and Disclosure (CARD) Act of 2009 served to give cardholders many guarantees with respect to the terms and conditions associated with their credit cards (Bar-Gill and Bubb, 2012).

Drawing on Ausubel's insights, Stavins (1996) finds that if an average US issuer bank raised its APR by a percentage point, average delinquent credit card loans portfolio (at least 30 days overdue) would decrease by \$2.7 million, during the period 1990 to 1995. In contrast, Park (1997) finds that delinquency rates are positively related to changes in APRs for a sample of major credit card providers in US between 1991 and 1994. The positive relationship suggests that credit card providers offering lower rates control default risk more effectively. Stavins (2000) appears to support this conclusion using US bank-level data for the period 1990 to 1999. She finds that banks that charged higher APRs had higher delinquency rates. Calem and Mester (1995) use data from the 1989 Survey of Consumer Finances (SCF hereafter) to find that households with large outstanding credit card balances (as an indicator of risk) are more likely to be denied or be granted a lower-than-desired credit limit when applying for new cards with rival providers. These households are likely to face higher switching costs, and consequently search less intensely for new deals than counterparts with low levels of credit card outstanding debt.⁹ Therefore, if a bank unilaterally lowers APR, it will attract consumers that have low card balances and search most intensively. However, Agarwal et al. (2010) find that consumers who responded to inferior solicitations (e.g., credit card offers with a high APR) exhibit poorer credit quality characteristics and are significantly more likely to default ex post than those responding to superior offer types. However, the authors argue that these results are based on a sample of low-risk 'prime' borrowers, and so the results can be considered as only a minimal test of the importance of adverse selection in the credit card market.

Gross and Souleles (2002) use account level data from a sample of credit card providers in the US for 1995 to find that for every percentage point increase in APR,

⁹ Switching costs result in cardholders becoming locked into a particular bank (Stango, 2000).

outstanding credit card debt declines by an average of \$110 per card. The authors contend that since cardholders are in fact sensitive to prices, a higher APR leads to less borrowing.

2.2 Determinants of Credit Card Prices

Outstanding credit card debt, consumer credit ratings, market power of incumbents, and non-price characteristics of credit cards have shown to be important determinants of prices in the credit card literature (Scholnick et al., 2008).¹⁰ Calem et al. (2006) use data from the 1998 and 2001 SCF to examine the extent to which APRs are affected by cardholder credit risk (proxied by outstanding credit card debt along with a pseudo FICO score computed for each respondent to the Survey).¹¹ They find that a large credit card balance along with a low credit score represents an impediment to consumers successfully obtaining a low interest rate through search. Related research uses accounting data from representative samples of US banks. Stango (2002) maintains that credit card prices are positively related to the aggregate outstanding balances for the issuer banks and its competitors, annual fees and market share of providers.¹² Recent evidence reveals that market power has a positive and statistically significant effect on APRs in the Turkish credit card market (Akin et al., 2011). However, this finding does not appear to hold for the US credit card market where the effect is positive but not statistically significant (Massoud et al., 2011).

¹⁰ While much of the focus on the credit card pricing has been on the determinants of APRs, other work analyses the determinants of credit card penalty fees such as late fees and over limit fees. For example, Massoud et al., (2011) argue that banks that face greater default risks from borrowers (bank level risk of credit card default as measured by the charge off ratio from each bank's balance sheet) will charge higher penalty fees to compensate for this risk.

¹¹ Agarwal et al. (2003) show that consumer credit scores are highly predictive in determining credit card default rates.

¹² Outstanding balances for issuer banks and their competitors represent a measure of the issuer's own customers' captivity, and the captivity of its competitors' customers, respectively.

A small number of studies consider simultaneously the extent to which cardholder risk and credit card attributes determine APRs. Based on a US household telephone survey during the period 1998 to 1999, Kim et al. (2005) investigate the extent to which the risk of cardholders is reflected in credit card prices. The results suggest that consumers with higher credit card balances are charged lower prices. This is attributed to these consumers engaging in more intensive search for lower priced offerings. Amess et al. (2010) explore the relationship between credit card APRs and differentiation characteristics for a sample of UK credit card providers. The authors assume that credit card providers use reward programs, network brands and other card characteristics to cater for varied customer preferences. Therefore, consumers holding platinum cards (which are assumed to be low-risk cardholders) are found to pay lower rates than high-risk counterparts holding starter cards. Unfortunately, the authors are unable to capture explicitly the risk characteristics of potential consumers (demand-side factors). As a consequence, they can only show that characteristics of issuer banks and credit card attributes (supply side factors) determine prices.

The remainder of this paper builds on these aforementioned studies in three respects. First, we employ IV estimation techniques (two-stage least squares and two-step GMM) to deal with potential bias due to reverse causality (endogeneity) between prices and their determinants. Second, we exploit a more comprehensive range of cardholder risk measures than used in previous studies. Since previous research has tended to focus on a single measure of risk (i.e. outstanding credit card debt), our approach provides a unique opportunity to assess the effects of different types of long and short-term risks on APRs charged by banks. Third, we include both the supply and demand sides of the credit card market in order to analyse the pricing decisions of issuer banks.

3. Data

We match data from two national representative surveys where the characteristics of credit cards and the risk of potential cardholders are both close to the US national averages. Our first data source is the Terms of Credit Card Plans (TCCP) Survey which provides comprehensive information on both APRs and other characteristics of credit card plans offered in the US states where each bank operates.¹³ Banks offer credit cards at national (entire country), regional (several states) or local level (a single state). Information on product attributes allows us to classify cards into four categories, comprising credit cards: with reward programs offered by a commercial bank; without reward programs offered by a commercial bank; with reward programs offered by a non-commercial bank; and without reward programs offered by a non-commercial bank.¹⁴

Our second source of data is the 2008 and 2009 Federal Reserve Survey of Consumer Payment Choice (SCPC). It provides information regarding the risk of cardholders. The information provided comprises: credit card outstanding debt; FICO score; and unpaid debt in the previous twelve months.¹⁵ These variables allow us to deal with the likely influence of the recent financial crisis on our proxies of risk. In particular, FICO credit score can be interpreted as a longer term indicator of risk which

¹³ Appendix A provides a full list of banks included in our sample, while Appendix B explains the TCCP Survey. It should be noted that we focus on nominal APRs instead of effective APRs (i.e. fees plus interest rate). We do this for three reasons. First, most of the analysis carried out in empirical literature is based on nominal APRs. Second, there is not a strict legal definition for “effective APR” since it can vary greatly depending on the type of fees included, (such as participation fees, loan origination fees, monthly service charges, or late fees). Also, credit card companies are required to clearly state the APRs applied to their credit card plans. Third, we follow a hedonic model of credit card pricing where fees affect the APRs charged to cardholders. In this way, our approach differs from Massoud et al. (2011) which focus on the determinants of US credit card penalty fees.

¹⁴ We follow the FDIC Bank classification in order to classify issuers as commercial and non-commercial banks. Appendix A provides further detail. Reward programs typically offer rebates on purchases, extension of manufactures warranty, discounts on the purchases of goods or services, purchase protection/security plan, travel accident insurance, automobile rental insurance, credit card registration services, and reduced introductory interest rates.

¹⁵ Further details related to the 2008/2009 SCPC are provided in Appendix B.

smoothes the level of risk over the time. In contrast, our variable “unpaid credit card debt in the previous twelve months” is a short-term indicator of risk that captures the effect of the recent financial crisis. Collectively, these indicators allow us to explore the reactions of credit card prices to changes in the short and longer term measures of risk. In a similar way to the TCCP Survey, the SCPC Survey also provides additional information to classify cardholders into four categories, comprising credit cardholders who: are commercial bank clients with a reward card; are commercial bank clients without a reward card; are non-commercial bank clients with a reward card; and are non-commercial bank clients without a reward card.¹⁶ Appendix C presents national representative averages of the level of risk of cardholders at US state-level for each of the four groups.¹⁷ By combining the data from Appendix C, we are able to identify five types of cardholders in terms of risk (using indicator variables) for each of the four categories at state-level. Type I cardholders (sub-prime cardholders), which have a high outstanding credit card debt (card debt is higher than 50th percentile of the sample distribution of the outstanding credit card debt in each year) and a low FICO credit score (FICO score is lower than the 50th percentile of the sample distribution of the FICO score in each year). Type II cardholders have a low FICO credit score (as defined previously) and a high probability of having any unpaid credit card debt in the previous twelve months (unpaid credit card debt is higher than the 50th percentile of the sample distribution of the unpaid debt in the previous twelve months in each year). Type III cardholders have a high outstanding credit card debt (as defined previously), Type IV

¹⁶ Following the 2008 and 2009 SCPC Survey (questions PA006 and PA007), we assume that a cardholder is a client of a commercial bank if her primary checking account/saving account is at (i) a large national or international commercial bank or (ii) a small local or regional commercial bank. If the account is kept at a credit union, savings bank, internet bank or other financial institution, we assume that the cardholder is a client of a non-commercial bank.

¹⁷ Tables C1 – C3 show sample corrected weighted average values (2008-2009) of different levels of risk considered in our study. Missing values are reported when data is missing in the 2008 and 2009 SCPC. All data was weighted to match national population estimates from the Current Population Survey (CPS), sponsored jointly by the U.S. Census Bureau and the U.S. Bureau of Labor Statistics (BLS).

cardholders have a low FICO credit score (as defined previously), while Type V cardholders have a high probability of having any unpaid credit card debt in the previous twelve months (as defined previously).

The initial classification of cardholders into four categories (as defined above) allows us to match each credit card plan (which includes the full set of terms and conditions) offered by a given bank with the average risk measures of cardholders living in the US states where the credit cards are marketed. In other words, national credit cards are matched with national representative average values of cardholder risk. Regional credit cards are matched with weighted average values of cardholder risk in the states where the bank offers its credit cards.¹⁸ State specific credit cards are matched with representative average values of cardholder risk in the state the card is offered.¹⁹ Our final data set contains price and non-price information on bank-level credit card plans along with a set of indicators that capture quantitatively the risk of the potential cardholders living in US states where the cards are marketed.

To control for local market power, we use issuer bank deposit market share collected at the branch-level.²⁰ In order to do so, we employ the FDIC Summary of Deposits (SOD) which contains deposit data for branches and offices of all FDIC-insured institutions. Each bank in the SOD is matched with the TCCP data by using a bank unique identifier (RSSD ID) assigned by the Federal Deposit Insurance Corporation (FDIC) which is made available in both data sources.

We apply two filtering rules to eliminate non-representative data. First, we exclude banks that have missing values in any of our covariates in a given year. Second,

¹⁸ Our weighted factor is the population of the states where each credit card is offered.

¹⁹ Matching at state-level is possible since the characteristics of both samples are very close, and the surveys are nationally representative. Appendix B provides details of these surveys and the matching procedure.

²⁰ Unfortunately, the TCCP does not offer information about the total number of credit cards issued by a specific bank.

the weighted average of the outstanding credit debt has been winsorized at the top and bottom one per cent of the distribution in order to avoid potential outliers. The final dataset comprises 575 observations and 182 credit card plans associated to a unique issuer bank. Tables 1 and 2 provide definitions and descriptive statistics of the main variables.

Panel A presents descriptive statistics for the supply side variables. The average APR is 12.53 per cent (ranging from 4.25 per cent to 24.7 per cent). National and regional credit cards account for approximately 43 per cent and 30 per cent of the sample. The average grace period is approximately 24 days. Around 65 per cent of credit card plans include a reward program. Approximately half of the credit card plans include minimum finance charges while each card plan includes, on average, 2.4 additional credit card fees.²¹ Visa and MasterCard represent 70 per cent and 19 per cent of the card plans in our sample, respectively. Gold and platinum cards represent 8 per cent and 18 per cent of the sample, respectively. Average market share is close to one per cent ranging from zero per cent to 15.51 per cent of the market. As a benchmark of the market's interest rates, we include the average interest rates of CDs which are on average 2.33 per cent, in our sample.²²

Panel B presents demand side variables related to the level of risk of cardholders. The average outstanding credit card debt is \$3380 dollars, and the average FICO score is 4.04 points.²³ We observe that 59 per cent of the cardholders included in our sample show an episode of unpaid credit card debt in the previous twelve months. In terms of cardholder type, 18 per cent of our sample is characterized as Type I (low FICO credit score and high outstanding debt), 30 per cent are Type III (low FICO credit

²¹ These additional charges include: annual fees, transaction fees for purchases, transaction fees for cash advances, and late payment fees.

²² This variable captures the effects of underlying macroeconomic conditions and how rapidly changes in the market's interest rates pass-through into the APRs (Calem and Mester, 1995).

²³ The FICO score is computed on a scale of 1 to 6. Details are provided in Appendix C, Table 2C.

score and high probability of having any unpaid credit card debt in the previous twelve months), 41 per cent are Type III (high outstanding card debt), 47 per cent are Type IV (low FICO credit score), and 39 per cent are Type V (high probability of having any unpaid credit card debt in the previous twelve months).²⁴

Descriptive statistics presented in Table 3 show that APRs vary widely both by credit card type and respective attributes of cards. Non-banks offering credit cards with reward programs charge an average APR of 9.89 per cent, while credit cards tied to Visa and MasterCard networks charge an average of 15.61 per cent. The grace period (days) and fees linked to a specific plan are also related to the type of credit card. Fees are particularly relevant since high risk consumers are likely to be attracted to lower over the credit limit fees and minimum finance charges. A priori it would be expected a positive and statistically significant effect between fees and APRs, since a high risk premium should be associated with high risk cardholders. Over the credit limit fees range from \$24.99 (cards offered by banks without reward programs) to \$31.63 (offered by other networks such as American Express or Diners Club). Minimum finance charges and the number of other fees charged by providers also vary substantially across credit card types.

The final column of Table 3 provides the percentage of credit cards which include reward programs. Rewards programs can be used to create consumer lock-in (Klemperer, 1995), differentiate products and restrict price competition. We observe that reward programs are used extensively by banks. In particular, approximately 50 per cent of credit card plans offered under the Visa and MasterCard brands include reward programs, while 80 per cent of platinum cards include such enhancements.

²⁴ Since each group could overlap with another group (they are not mutually exclusive), the aggregate proportion of cardholders Type I, II and III is not necessarily 100 per cent.

Table 4 presents a correlation matrix of the full set of variables employed in the empirical analysis. We observe high and significant levels of correlations between our measures of risk. In order to avoid multicollinearity, we use a single measure of risk in each of our models. The correlation between the other covariates used in our empirical models is low.

4. Methods

We adopt a hedonic regression approach to capture the importance of demand and supply characteristics of the credit card market in determining the price of a specific credit card plan. The specification of the empirical model is as follows:

$$APR_{it} = \alpha + \gamma x_{it}^{demand} + \beta x_{it}^{attributes} + \phi x_{it}^{market} + f_i + T_t + \varepsilon_{it} \text{ (Equation 1)}$$

APR is a vector of the most common interest rate charged by a specific credit card i in year t . x_{it}^{demand} is a vector of covariates that control for cardholder risk (comprising FICO credit score, outstanding credit card debt, unpaid debt in the previous twelve months and a combination of these indicators) living in the regions where the credit card i is offered. $x_{it}^{attributes}$ is a vector of credit card characteristics (such as regional coverage, type of credit card provider, grace period, reward programs, fees, network brand, platinum, gold, student, classic card, etc.). x_{it}^{market} includes two control variables, comprising the one year CD interest rate and the deposit market share of the bank offering credit card i . The model also includes issuer fixed effects (f_i) to capture unobserved issuer characteristics that are constant over time, a time dummy for

technological change (T_t), and a constant term α (which captures an interest rate mark-up). ε_{it} is a stochastic error term.

Equation 1 is estimated using both a two-stage least squares (2SLS) and a two-stage efficient GMM estimator as robustness check. The choice of this instrumental variable (IV) approach relies on the assumption that both over the credit limit fees and minimum finances charges could be potentially endogenous due to simultaneity bias.²⁵ To test this hypothesis, we have conducted a set of endogeneity tests under the null hypothesis that the specified endogenous regressors can actually be treated as exogenous, where the test statistic is distributed as χ^2 with degrees of freedom equal to the number of regressors tested (Baum et al., 2007). The derived test statistic rejects the null hypothesis of exogeneity in all of the specifications, providing support for our IV approach. The instrument set contains the full set of exogenous variables (both at bank and consumer level) along with a set of excluded instruments at bank level as follows: percentage of bank branches, average wages per employee, advertising expenditures and the amount of gross charge-offs on loans and leases and operating costs.²⁶ For each of these instruments to be valid, they must be: correlated with the endogenous variable; and uncorrelated with the error terms (in this case, the unobserved differences in the most common APRs charged by a particular bank). A Hansen/Sargan test of instrument validity is conducted, and the rejection of the null hypothesis indicates the validity of the instrument set employed (Baum et al., 2007; Cameron and Trivedi, 2005).

²⁵ Endogeneity bias due to reverse causality is unlikely to be an issue given that a change in the APRs are unlikely to modify substantially the attributes of the credit card plans, the deposit market share of the banks and the level of risk of their potential cardholders.

²⁶ These instruments are collected from Call Reports available at: <https://cdr.ffiec.gov/public/>. Each bank is matched using a unique bank identifier (RSSD ID) assigned by the FDIC which is used as a bank identifier in both data sources. The codes of the instruments are as follows: average wages per employee (RIAD4135/RIAD4150), expenditures in advertisement (RIAD0497) and the amount of gross charge-offs on loans and leases (RIAD4635). The instrument “operating costs” is only included in the 2-step GMM models. Unfortunately, no additional instruments were available from the demand side of the market.

5. Results

We test for the importance of card characteristics and the level of risk of potential cardholders where banks offer their respective cards in determining APRs. Tables 5 and 6 reports the regression results for Equation 1. Table 5 presents the results from estimating three different models (Models (1), (2) and (3)) based on our standard measures of risk (FICO score, unpaid credit card debt in the previous twelve months and outstanding credit card debt). Table 6 reports five additional models (Models (4), (5), (6), (7) and (8)) which expand the analysis by using different combinations of these measures of risk.²⁷ Model (4) includes an indicator variable where “subprime” cardholders have a low FICO score and a high outstanding card debt (Type I). Model (5) includes an indicator variable where cardholders have a low FICO score and a high probability of having any unpaid credit card debt in the previous twelve months (Type II). A separate indicator variable is included in Model (6) where cardholders have a high outstanding card debt (Type III). Model (7) includes an indicator variable for cardholders with a low FICO score (Type IV). Model (8) includes an indicator variable for cardholders with a high probability of having any unpaid credit card debt in the previous twelve months (Type V). We include both bank and time fixed effects in all models to control for time-invariant factors specific to an individual bank as well as global shocks that influence all banks in a similar fashion (unobserved heterogeneity).²⁸ Tables 5 and 6 report estimations carried out using both a 2SLS and 2-step efficient GMM procedure.

Results reported in Table 5 and 6 suggest that using GMM estimation does not appear to affect the sign of the coefficient estimates of our key risk variables, but does affect the statistical level of significance. We also observe differences in both size of

²⁷ This solves an important limitation of previous literature (for example, Amess et al. 2010).

²⁸ In all our empirical models, approximately 109 observations were automatically dropped by our statistical software (STATA 11) in order to deal with eventual multicollinearity problems in the data.

estimated coefficients and statistical level of significance of the other explanatory variables. Focusing on our risk indicators, our results suggest that cardholders with a high FICO score (long-term indicator of risk) pay a typical APR that is between 0.38 per cent and 0.39 per cent (38 - 39 basis points) higher than cardholders with an average FICO score, depending on the estimation procedure used (Model 1). This result could be explained by the fact that high-risk consumers search more intensively for the best interest rates (shopping around) available in the market. The results based on FICO credit score are likely to be less affected by the influence of the recent financial crisis. We also consider a second type of cardholders which have a high probability of having any unpaid credit card debt in the previous twelve months (Model 2). We argue that this particular variable captures a short-term component of risk that could be influenced by the recent financial crisis. In this sense, these results should be interpreted with caution. We find that this group pays an average APR that is between 1.79 per cent and 1.91 per cent (179- 191 basis points) higher than those cardholders without any unpaid balance in the previous year, depending on the estimation procedure used. In this particular case, a risk premium seems to be adequately attached to cardholder risk. Previous unpaid card debt could also generate substantial switching costs to cardholders allowing banks to use the whole payment history of cardholders as an effective tool to adjust prices to the level of risk.

In Model 3, we observe that outstanding credit card debt (which is often considered an accurate indicator of cardholder risk) has no significant effect on APRs both in the 2SLS and GMM estimations.²⁹ This suggests that this measure of risk fails to capture the full extent of cardholder risk. Rather a measure which considers

²⁹ This finding contrast with the Calem and Mester (1995) result, which relies on SCF data to show that cardholders with larger outstanding balances are more likely to shop around for better prices.

simultaneously both outstanding credit card debt and other risk indicators (such as credit score) should be taken into account when measuring cardholder risk.

In Table 6, we proceed by considering five additional measures of risk of cardholders (introduced in Section 3). APRs charged to Type I cardholders (sub-prime) are between 0.82 per cent and 0.85 per cent (82 - 85 basis points) lower than those charged to prime counterparts, depending on the estimation procedure used (Model 4). This result is consistent with the idea that risky consumers shop around in order to find better credit cards terms and, consequently, banks fail to achieve the benefits of a RBP strategy.³⁰ In this sense, it can be also argued that issuer banks do not sort effectively cardholders in terms of risk. These results provide support for findings reported in Model 1 and are also less sensitive to the effect of the financial crisis.

APRs charged to Type II cardholders are 0.41 per cent (41 basis points) higher than those charged to cardholders with both a high FICO score and a low probability of having any unpaid credit card debt in the previous twelve months (Model 5). This variable is marginally statistically significant in the 2SLS regression, but is not statistically significant in the two stage GMM estimation. This suggests that APRs are positively affected by an increase in our short-term indicator of risk. However, it must be interpreted with caution because of the likely influence of the recent financial crisis.

Similar to the previous results presented for Model 3, we do not find any statistically significant effect for Type III cardholders (Model 6). However, we find that Type IV cardholders (with a FICO score lower than the median value) pay a typical APR that is between 0.66 per cent and 0.70 (66 - 70 basis points) lower than cardholders with a FICO score that is higher than the median value, depending on the estimation procedure used to estimate the coefficients (Model 7). Finally, we find that

³⁰ This result contrasts with previous research which fails to find evidence supporting the search cost hypothesis (Berlin and Mester, 2004).

Type V cardholders (with a higher probability of having any unpaid debt in the previous twelve months than the median value of the distribution) pay a typical APR that is between 0.55 per cent and 0.60 per cent (55 - 60 basis points) higher than cardholders with a low probability of having any unpaid debt in the previous twelve months, depending on the estimation procedure used (Model 8). This is in line with the results reported in Models 2 and 5, suggesting that during stressed periods, banks adjust APRs according to the short-term risks observed in the market.

Of the other covariates included both in Tables 5 and 6, we observe that national credit cards have a rate that is between seven and eight per cent (700 – 800 basis points) lower than their local counterparts. Banks which offer credit cards nationally are likely to benefit from scale economies in payment production which enables them to offer better rates to consumers. The higher prices charged by banks offering credit cards locally could reflect localised market power advantages, which enable these providers to charge consumers higher APRs. Regional credit card plans show a negative, but marginally statistically significant effect on APRs in only two of the 2SLS regressions (Models 3 and 7). Estimates for the commercial bank indicator are not statistically significant at conventional levels. We also observe that the length of the grace period affects positively the APRs charged to consumers. However, these results do not seem to be robust to estimation procedure and empirical specifications.

Credit cards that include reward programs charge a rate that is between 0.60 per cent and 0.99 per cent lower than counterparts without reward programs.³¹ However, coefficients in the GMM models are not always statistically significant at conventional levels. Overall, this result appears to conform to recent developments in the US card industry, where the intense competition for clients has led banks to offer credit cards

³¹ This contrasts with Amess et al. (2010) who find that reward programs are associated with higher APRs in UK.

with low APRs and reward programs, simultaneously. Estimates for over the credit limit fee are not statistically significant at conventional levels. We find, by contrast, a positive and statistically significant effect of minimum finance charges which are passed on as higher APRs charged to cardholders. This relationship suggests that bank providers employ minimum finance charges as a tool to induce consumers to switch bank and then to exploit them with high APRs.³² The number of other fees charged by credit cards is found to be not statistically significant at conventional levels. Similar results are observed in credit card plans marketed by issuer banks working in exclusivity with either Visa or MasterCard.

Cardholders are willing to pay a premium for adopting credit card plans issued by banks members of large established network such as MasterCard/Visa (at the same time) and Discover compared to smaller networks such as American Express and Diners Club.³³ This is consistent with the idea that smaller networks charge lower interest rates to compensate cardholders for the fact that fewer merchants accept these cards.

Premium and gold cards charge APRs that are 3.83 per cent and 4 per cent lower than classic credit card plans, depending on the empirical procedure used. This implies that a risk premium is attached to classic cards, which are more likely to be used by higher risk consumers. A similar effect is observed across Platinum cards; however estimated coefficients are not always statistically significant at conventional levels. Market share is marginally significant in only Model 1 showing a positive effect on the prices charged to cardholders. This implies that an increase in the market share of banks is passed on to cardholders as higher credit card rates. Finally, as it would be expected,

³² Minimum finance charges are mainly targeted at high-risk cardholders (Amess et al., 2010).

³³ Our results are similar to those reported by Amess et al. (2010). However, these must be interpreted with caution since the coefficients for the Discover card were marginally statistically significant the 10 per cent level.

changes in market interest rates (one year CD interest rates) pass-through to APRs charged to cardholders.

6. Final Remarks

Previous literature on credit card pricing has not explored how both demand and supply sides of the payment card market explain risk-based pricing strategies. In this paper, we devise a methodology that considers both sides of the industry simultaneously, in order to explore the extent to which issuer banks charge prices so as to account for the risk of customers. We use two recently made available national representative surveys conducted in the US, and an innovative matching procedure to study how card attributes and the level of risk of cardholders affect APRs charged by issuer banks. The results of our econometric analysis suggest that contrary to theoretical predictions, high-risk consumers are charged lower rates on their credit cards when longer term indicators of risk are considered. This suggests that either high risk consumers search more intensively in order to access good deals, or that issuer banks do not sort cardholders in terms of risk, or indeed both. We also find that changes in short-term indicators of risk of cardholders had led to higher levels of APRs during stressed periods. This result could be of interest to regulators since the CARD Act 2009 prevented issuers from changing the terms of a credit card contract for the length of the card agreement (with only limited exceptions). As such the results of our analysis are also of interest to government agencies focused on consumer protection in the credit card industry. Our results also suggest that a variety of non-price characteristics are important in determining prices charged to consumers.

In the light of these findings, we believe that the results of our analysis suggest that an adequate implementation of risk-based pricing strategies could be useful to improve

transparency and the allocation of resources in the credit card industry given that the Dodd-Frank Act of 2010 required creditors to disclose in risk-based pricing notices detailing information used in making a credit decision. All in all, the results point out the relevance of more in-depth research in this area, and the need for high quality data sets on both the demand- and supply side of the industry.

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Table 1. Variable definitions

Variable	Data Source	Definition
Credit Card debt (\$)	Own elaboration based on the 2008 & 2009 Survey of Consumer Payment Choice (SCPC)	Q. Last month, about how much was the unpaid balance on all your credit cards that you carried over from the previous month? (thousands). Figures in Table C1 include regional weighted averages of these values.
FICO Score		Q. Please estimate your most recent credit rating, as measured by a FICO score: 1 (< 600), 2 (600-649), 3 (650-699), 4 (700-749), 5 (750-800) and 6 (> 800). Figures in Table C2 include regional weighted averages of these values.
Unpaid credit card debt		Q. During the past 12 months, did you carry an unpaid balance on any credit card from one month to the next (that is, you did not pay the balance in full at the end of the month)? (1=yes and 0=no). Figures in Table C3 include regional weighted averages of these values.
Cardholder Type I		1 if consumer has both a credit card debt higher than the median value of the credit card debt distribution AND a FICO score lower than the median value of the FICO score distribution, and 0 otherwise. This variable varies per year.
Cardholder Type II		1 if consumer has both an unpaid balance on any credit card from one month to the next during the past 12 months higher than the median value of the credit card unpaid debt distribution AND a FICO score lower than the median value of the FICO score distribution, and 0 otherwise. This variable varies per year.
Cardholder Type III	1 if consumer has a credit card debt higher than the median value of the credit card debt distribution and 0 otherwise. This variable varies per year.	
Cardholder Type IV	1 if consumer has a FICO credit score lower than the median value of the FICO score distribution, and 0 otherwise. This variable varies per year.	
Cardholder Type V	1 if consumer has an unpaid balance on any credit card from one month to the next during the past 12 months higher than the median value of the credit card unpaid debt distribution, and 0 otherwise. This variable varies per year.	
APR		Annual interest rate in credit card loans (percent).
National/Regional/local		1 if the credit card plan is marketed in all states/ some states / single state.
Commercial bank		1 if the issuer bank is listed as a commercial bank by FDIC and 0 otherwise.
Grace period		Grace period of credit card loans (days).
Reward programs	Terms of Credit Card Plans (TCCP)	1 if the indicate credit card plan includes “free of charge” any of the following reward programs: rebates on purchases, extension of manufacturer’s warranty, purchase protection/security plan, travel accident insurance, travel discounts, automobile rental insurance, non-travel discounts,, credit card registration services, reduced introductory interest rate available and other plan enhancements, and 0 otherwise.
Over the limit fee		Over the credit limit fees charges (the fee imposed for exceeding a credit limit).
Minimum Finance Charge		Minimum finance charge (the minimum or fixed finance charge that could be imposed during a billing cycle).
Other fees		Number of fees included in the credit card plan (Annual fees, transaction fees for purchases, transaction fees for cash advances, late payment fees).
Visa® / MasterCard®/Discover®		Visa®/MasterCard®/Discover® credit card plan dummy variable.
Platinum/Premium-Gold card		Platinum/ Premium-Gold credit card plan dummy variable.
Certified of deposit 1 year	Federal Reserve Board	1 year CD interest rate (%).
Deposit Market share (market share)	Summary of Deposits (SOD) collected by the FDIC	Average market share in terms of deposits per branch adjusted to consider the states where bank offer their credit card plans (%).

Table 2. Summary of variables

Variables	Mean	Std. Dev.	Min	Max	Observations
Panel A: supply side variables (bank's terms of credit card plans)					
APR	12.53	3.60	4.25	24.7	575
National dummy	0.43	0.50	0	1	575
Regional dummy	0.30	0.46	0	1	575
Commercial bank	0.86	0.35	0	1	575
Grace period (days)	24.07	4.19	0	30	575
Reward program	0.65	0.48	0	1	575
Over the credit limit fee (\$)	26.33	10.39	0	39	525
Minimum Finance charges	0.51	0.50	0	1	575
Other fees	2.46	0.93	0	4	575
Visa®	0.70	0.46	0	1	574
MasterCard®	0.19	0.40	0	1	574
Visa®/MasterCard®	0.05	0.22	0	1	574
Discover®	0.01	0.12	0	1	574
Platinum card	0.18	0.38	0	1	574
Premium/Gold	0.08	0.27	0	1	574
Market share of the issuer bank (%)	0.73	1.57	0	15.51	575
Average Certificate of Deposits	2.33	1.53	0.44	4.61	575
Panel B: demand side variables (consumer's financial profiles)					
Credit Card debt (in thousands of dollars)	3.38	1.37	0.53	9.87	575
FICO Score	4.04	0.70	1	5.69	573
Unpaid credit card debt	0.59	0.16	0	1	575
Type I	0.18	0.39	0	1	575
Type II	0.30	0.46	0	1	575
Type III	0.41	0.49	0	1	575
Type IV	0.47	0.50	0	1	575
Type V	0.39	0.49	0	1	575

**Table 3. Typical terms and conditions of different credit card plans
(Mean values and standard deviation in parenthesis)**

Credit card type	APR (%)	Grace Period (days)	Fees			Reward programs (YES=1/NO=0)
			Over the limit fee (\$)	Minimum Finance charges (YES=1/NO=0)	Number of other fees	
Banks offering credit cards with rewards	12.36 (3.17)	24.07 (3.57)	26.94 (9.69)	0.55 (0.50)	2.54 (0.93)	
Banks offering credit cards w/o rewards	13.83 (4.05)	24.24 (4.38)	24.99 (11.64)	0.40 (0.49)	2.46 (0.90)	
Non-banks offering credit cards with rewards	9.89 (2.65)	25.08 (1.84)	27.51 (9.44)	0.55 (0.50)	2.19 (0.94)	
Non-banks offering credit cards w/o rewards	11.60 (3.58)	21.33 (8.80)	25.19 (11.56)	0.57 (0.50)	2.13 (0.97)	
Visa®	12.35 (3.59)	24.30 (3.49)	25.92 (10.20)	0.50 (0.50)	2.40 (0.91)	0.70 (0.46)
MasterCard®	12.41 (3.41)	23.93 (4.93)	26.87 (12.70)	0.55 (0.50)	2.42 (0.94)	0.50 (0.50)
Visa®/MasterCard®	15.61 (3.14)	25.00 (0.00)	24.62 (5.60)	0.17 (0.38)	3.17 (0.85)	0.59 (0.50)
Discover®	14.81 (1.14)	12.50 (13.36)	25.00 (10.69)	1.00 (0.00)	2.25 (0.71)	0.50 (0.53)
Others (i.e. Amex or Diners Club)	11.82 (3.85)	23.63 (2.47)	31.63 (4.27)	0.56 (0.51)	2.70 (0.99)	0.63 (0.49)
Platinum cards	10.52 (2.72)	23.89 (2.53)	28.26 (10.17)	0.64 (0.48)	2.31 (0.97)	0.80 (0.40)
Premium/Gold cards	11.20 (3.82)	24.77 (2.33)	25.51 (11.44)	0.32 (0.47)	2.43 (0.93)	0.57 (0.50)
Classic cards	13.16 (3.56)	24.04 (4.63)	25.95 (10.32)	0.49 (0.50)	2.50 (0.92)	0.62 (0.49)

Table 4. Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
FICO Score (1)	1											
Unpaid credit card debt (2)	-0.0846*	1										
Credit Card debt (\$) (3)	0.123***	0.310***	1									
Type I (4)	-0.176***	0.226***	0.414***	1								
Type Ia (5)	-0.379***	0.583***	0.214***	0.451***	1							
Type II (High card debt) (6)	0.149***	0.0947**	0.648***	0.537***	0.0245	1						
Type III (Low FICO score) (7)	-0.711***	0.173***	-0.0988**	0.480***	0.695***	-0.0929**	1					
Type IV (High unpaid debt) (8)	-0.183***	0.714***	0.161***	0.343***	0.820***	0.0255	0.484***	1				
National dummy (9)	-0.172***	-0.00903	0.127***	-0.219***	-0.116***	-0.0457	-0.0824*	-0.271***	1			
Regional dummy (10)	0.142***	0.0198	0.0283	0.123***	0.0402	0.128***	-0.00842	0.0891**	-0.1626***	1		
Commercial bank (11)	0.117***	-0.0598	-0.151***	-0.297***	-0.0716	-0.225***	-0.133***	-0.0574	-0.0556	0.00453	1	
Grace period (days) (12)	0.0777*	-0.0240	-0.0389	0.0338	-0.0176	0.00259	0.000279	0.0290	-0.274***	0.151***	0.0793*	1
Reward program (13)	0.186***	-0.0687	0.110**	-0.00807	-0.167***	0.132***	-0.229***	-0.182***	0.0795*	0.00405	-0.0533	-0.0235
Over the credit limit fee (14)	0.0595	0.0693	0.0111	-0.0277	0.00169	0.0173	-0.0623	0.00271	0.110**	0.152***	-0.00542	-0.199***
Minimum Finance charges (15)	0.0339	-0.0340	0.0368	0.0450	-0.0373	0.0932**	-0.0240	-0.0498	0.155***	0.0185	-0.0200	-0.170***
Other fees (16)	0.109**	-0.0117	-0.120***	-0.0699	-0.0189	-0.0746*	-0.0444	-0.0211	-0.0647	-0.0329	0.113***	-0.0472
Visa® (17)	0.120***	-0.0360	-0.0574	-0.0462	-0.0656	-0.0320	-0.0891**	0.0352	-0.224***	0.0952**	-0.00758	0.0854*
MasterCard® (18)	-0.0802*	0.0116	0.0197	0.0223	0.0213	0.00789	0.0617	-0.0578	0.159***	-0.115***	0.0517	-0.0245
Visa®/MasterCard® (19)	-0.0160	0.0192	0.00364	0.0276	0.0643	0.00378	0.0438	0.0163	-0.0645	0.118***	0.0923**	0.0609
Discover® (20)	-0.0618	0.0528	0.0568	0.0287	0.0567	0.0238	0.00959	0.0305	0.140***	-0.0863**	-0.140***	-0.330***
Platinum card (21)	0.0685	0.00299	0.0650	0.00236	-0.105**	0.0459	-0.0972**	-0.0972**	0.165***	-0.121***	-0.0858*	-0.0369
Premium/Gold (22)	-0.103**	0.103**	0.0367	0.0182	0.117***	-0.0308	0.104**	0.106**	0.0545	0.0163	-0.164***	0.0417
Market share of the issuer bank (%) (23)	0.203***	-0.0292	-0.136***	-0.0167	-0.0177	-0.0477	-0.101**	0.0420	-0.412***	0.455***	0.112**	0.0492
1 year CD interest rate (24)	-0.155***	-0.167***	-0.247***	0.0345	-0.131***	0.171***	0.0392	-0.163***	-0.00426	0.0168	-0.0108	-0.0144
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Reward program (13)	1											
Over the credit limit fee (14)	0.0706	1										
Minimum Finance charges (15)	0.0412	0.346***	1									
Other fees (16)	0.108**	0.0475	-0.0797*	1								
Visa® (17)	-0.0260	-0.0710	-0.0114	-0.0882**	1							
MasterCard® (18)	-0.147***	0.0471	0.0646	-0.0117	-0.718***	1						
Visa®/MasterCard® (19)	0.199***	-0.0423	-0.168***	0.172***	-0.360***	-0.117***	1					
Discover® (20)	0.134***	-0.0172	0.120***	-0.0361	-0.185***	-0.0604	-0.0303	1				
Platinum card (21)	0.0585	0.0818*	0.125***	-0.0360	0.00113	0.0250	-0.111**	0.0256	1			
Premium/Gold (22)	-0.109**	-0.0242	-0.0928**	-0.00112	-0.0555	0.0568	-0.0670	-0.0345	-0.126***	1		
Market share of the issuer bank (%) (23)	0.0465	0.135***	0.0430	0.0556	0.156***	-0.0878**	-0.0640	-0.0578	-0.0153	-0.0462	1	
1 year CD interest rate (24)	0.00790	0.0147	0.0788*	-0.0151	-0.0433	0.0555	-0.00510	0.00285	-0.0399	-0.00818	0.0179	1

* p<0.05, ** p<0.01, *** p<0.001

**Table 5. Determinants of credit card prices (APR) 2007-2008
Instrumental variables regression**

	Model 1		Model 2		Model 3	
	2SLS	2-step efficient GMM	2SLS	2-step efficient GMM	2SLS	2-step efficient GMM
FICO Score	0.390** (0.16)	0.381* (0.20)				
Unpaid credit card debt			1.907*** (0.48)	1.791** (0.73)		
Credit Card debt (\$)					0.010 (0.06)	0.000 (0.09)
National dummy^(a)	-7.745*** (0.67)	-8.511*** (2.46)	-7.217*** (0.66)	-7.208*** (2.37)	-7.934*** (0.71)	-7.866*** (2.42)
Regional dummy^(a)	-0.561 (0.57)	-0.806 (1.76)	-0.004 (0.58)	-0.068 (1.71)	-0.904* (0.53)	-0.886 (1.72)
Commercial bank	1.268 (1.63)	1.115 (2.24)	1.083 (1.63)	1.679 (2.15)	1.517 (1.55)	1.925 (2.15)
Grace period (days)	0.169 (0.12)	0.201** (0.09)	0.171 (0.12)	0.180** (0.09)	0.166 (0.12)	0.172* (0.09)
Reward program	-0.815** (0.34)	-0.884* (0.45)	-0.420 (0.34)	-0.517 (0.43)	-0.602* (0.34)	-0.648 (0.43)
Over the credit limit fee	0.181 (0.26)	0.179 (0.25)	0.183 (0.25)	0.085 (0.23)	0.146 (0.24)	0.076 (0.23)
Minimum Finance charges	2.615*** (0.65)	2.697* (1.45)	2.299*** (0.64)	2.731** (1.36)	2.572*** (0.61)	2.864** (1.34)
Other fees	0.117 (0.12)	0.107 (0.16)	0.145 (0.12)	0.156 (0.16)	0.113 (0.12)	0.122 (0.16)
Visa®^(b)	-0.925 (1.57)	-1.133 (1.88)	-0.867 (1.57)	-1.434 (1.76)	-1.197 (1.48)	-1.603 (1.78)
MasterCard®^(b)	0.057 (1.78)	-0.292 (1.95)	0.025 (1.78)	0.660 (1.86)	0.152 (1.67)	0.595 (1.86)
Visa®/MasterCard®^(b)	6.553** (3.18)	6.414* (3.29)	7.003** (3.19)	6.167* (3.17)	6.341** (3.06)	5.734* (3.23)
Discover®^(b)	12.072* (6.86)	12.302* (6.97)	12.413* (6.78)	9.746 (6.57)	10.915* (6.50)	9.043 (6.55)
Platinum card^(c)	-1.817 (1.20)	-1.749* (0.95)	-1.847 (1.21)	-1.801** (0.90)	-1.835 (1.22)	-1.801* (0.92)
Premium/Gold^(c)	-3.919*** (1.50)	-3.970*** (1.00)	-3.832** (1.49)	-3.930*** (0.96)	-3.889** (1.56)	-3.955*** (0.97)
Market share (%)	0.701* (0.39)	0.708 (0.92)	0.149 (0.37)	0.218 (0.88)	0.428 (0.35)	0.486 (0.91)
1 year CD interest rate	0.247*** (0.07)	0.272*** (0.07)	0.270*** (0.07)	0.246*** (0.07)	0.219*** (0.07)	0.202*** (0.07)
Constant	-1.683 (8.93)	-2.040 (8.94)	-2.052 (8.66)	1.006 (8.45)	1.558 (8.15)	3.649 (8.28)
Observations	464	464	466	466	466	466
Year and firm dummies	YES	YES	YES	YES	YES	YES
Endogeneity tests	8.606	5.169	7.179	4.876	7.719	5.292
Ho: variables are exogenous	(p = 0.014)	(p = 0.076)	(p = 0.028)	(p = 0.087)	(p = 0.021)	(0.071)
Hansen/Sargan tests of overidentifying restrictions (p-value)	3.835 (p = 0.147)	4.863 (p = 0.182)	4.710 (p = 0.095)	4.740 (p = 0.191)	4.338 (p = 0.114)	4.467 (0.215)
Adjusted R-squared	0.901	0.841	0.904	0.855	0.903	0.850

Notes: (1) *, **, *** indicate estimates statistically different from zero at the 0.10, 0.05, and 0.01 probability levels. (2) Empty cells occur when a particular variable is not included in a regression. (3) Standard errors reported in parenthesis, they are robust to general forms of heteroscedasticity. (4) The omitted categories include (a) local banks, (b) other credit card networks (American Express or Diners Club) and (c) Classic/started cards.

Table 6. Determinants of credit card prices (APR) 2007-2008
Instrumental variables regression

	Model 4		Model 5		Model 6		Model 7		Model 8	
	2SLS	2-step efficient GMM	2SLS	2-step efficient GMM	2SLS	2-step efficient GMM	2SLS	2-step efficient GMM	2SLS	2-step efficient GMM
Type I (Low FICO score & High card debt)	-0.819*** (0.29)	-0.853** (0.37)								
Type II (Low FICO score & High unpaid debt)			0.405* (0.22)	0.369 (0.27)						
Type III (High card debt)					-0.109 (0.20)	-0.140 (0.26)				
Type IV (Low FICO score)							-0.659** (0.28)	-0.697* (0.41)		
Type V (High unpaid debt)									0.597*** (0.20)	0.554** (0.25)
National dummy ^(a)	-8.675*** (0.75)	-8.668*** (2.38)	-7.876*** (0.68)	-7.832*** (2.38)	-7.847*** (0.74)	-7.821*** (2.43)	-8.592*** (0.76)	-8.595*** (2.41)	-7.442*** (0.67)	-7.417*** (2.36)
Regional dummy ^(a)	-0.805 (0.53)	-0.810 (1.69)	-0.801 (0.53)	-0.818 (1.69)	-0.803 (0.52)	-0.784 (1.74)	-0.899* (0.53)	-0.908 (1.70)	-0.320 (0.55)	-0.371 (1.69)
Commercial bank	1.427 (1.58)	-1.035 (6.53)	1.073 (1.57)	1.630 (2.18)	1.977 (1.45)	2.232 (2.22)	1.393 (1.61)	1.803 (2.15)	0.784 (1.59)	1.471 (2.17)
Grace period (days)	0.159 (0.12)	0.166* (0.09)	0.179 (0.12)	0.187** (0.09)	0.170 (0.12)	0.173* (0.09)	0.153 (0.12)	0.159* (0.09)	0.180 (0.12)	0.189** (0.09)
Reward program	-0.394 (0.34)	-0.454 (0.42)	-0.509 (0.34)	-0.595 (0.43)	-0.598* (0.32)	-0.620 (0.42)	-0.912*** (0.34)	-0.996** (0.50)	-0.441 (0.33)	-0.549 (0.43)
Over the credit limit fee	0.158 (0.25)	0.084 (0.23)	0.153 (0.24)	0.065 (0.23)	0.067 (0.22)	0.024 (0.24)	0.164 (0.25)	0.095 (0.23)	0.170 (0.24)	0.061 (0.22)
Minimum Finance charges	2.529*** (0.57)	2.848** (1.35)	2.367*** (0.56)	2.764** (1.35)	2.889*** (0.74)	3.067** (1.38)	2.598*** (0.62)	2.906** (1.38)	2.113*** (0.59)	2.617* (1.37)
Other fees	0.094 (0.12)	0.103 (0.16)	0.116 (0.12)	0.128 (0.16)	0.127 (0.12)	0.134 (0.16)	0.103 (0.12)	0.113 (0.16)	0.139 (0.11)	0.152 (0.16)
Visa ^{®(b)}	-1.506 (1.49)	-1.943 (1.77)	-0.860 (1.49)	-1.388 (1.78)	-1.696 (1.36)	-1.953 (1.86)	-1.445 (1.51)	-1.858 (1.78)	-0.623 (1.54)	-1.273 (1.77)
MasterCard ^{®(b)}	-0.258 (1.72)	0.212 (1.86)	0.428 (1.74)	0.974 (1.85)	0.615 (1.52)	0.886 (1.92)	-0.300 (1.77)	0.134 (1.87)	0.443 (1.75)	1.121 (1.83)
Visa [®] /MasterCard ^{®(b)}	5.184* (3.08)	4.519 (3.17)	6.947** (3.00)	6.168* (3.19)	5.493* (2.86)	5.086 (3.42)	5.594* (3.10)	4.973 (3.16)	7.393** (3.07)	6.438** (3.17)
Discover ^{®(b)}	10.874* (6.61)	8.874 (6.50)	11.978* (6.49)	9.538 (6.56)	8.797 (6.02)	7.640 (6.83)	10.988 (6.71)	9.108 (6.53)	12.784* (6.55)	9.780 (6.53)
Platinum card ^(c)	-1.770 (1.22)	-1.733* (0.91)	-1.986 (1.22)	-1.931** (0.92)	-1.786 (1.23)	-1.763* (0.93)	-1.697 (1.22)	-1.656* (0.93)	-1.975 (1.21)	-1.914** (0.91)
Premium/Gold ^(c)	-3.867** (1.57)	-3.939*** (0.96)	-3.871** (1.53)	-3.959*** (0.96)	-3.960** (1.59)	-4.000*** (0.98)	-3.858** (1.56)	-3.927*** (0.96)	-3.901*** (1.50)	-4.007*** (0.95)
Market share (%)	0.580 (0.36)	0.624 (0.88)	0.452 (0.37)	0.499 (0.87)	0.588 (0.36)	0.638 (0.94)	0.428 (0.36)	0.465 (0.87)	0.190 (0.37)	0.267 (0.88)
1 year CD interest rate	0.218*** (0.06)	0.201*** (0.07)	0.244*** (0.06)	0.222*** (0.07)	0.207*** (0.06)	0.199*** (0.06)	0.217*** (0.06)	0.202*** (0.07)	0.267*** (0.07)	0.240*** (0.07)
Constant	2.328 (8.25)	7.462* (4.24)	0.613 (8.03)	3.281 (8.19)	3.973 (7.48)	5.266 (8.59)	2.615 (8.34)	4.748 (8.23)	-0.539 (8.12)	2.765 (8.16)
Observations	466	466	466	466	466	466	466	466	466	466
Year and firm dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Endogeneity test	7.037	4.668	7.239	5.171	8.426	5.894	7.614	4.872	6.036	4.353
Ho: variables are exogenous	(p = 0.030)	(p = 0.097)	(p = 0.027)	(p = 0.075)	(p = 0.015)	(p = 0.053)	(p = 0.022)	(p = 0.088)	(p = 0.049)	(p = 0.113)
Hansen/Sargan tests of overidentifying restrictions (p-value)	4.315	4.816	4.054	3.797	4.289	4.098	4.197	4.752	4.341	3.974
	(p = 0.116)	(p = 0.186)	(p = 0.132)	(p = 0.284)	(p = 0.117)	(p = 0.251)	(p = 0.123)	(p = 0.191)	(p = 0.114)	(p = 0.264)
Adjusted R-squared	0.904	0.854	0.903	0.852	0.902	0.846	0.903	0.852	0.906	0.855

Notes: (1) *, **, *** indicate estimates statistically different from zero at the 0.10, 0.05, and 0.01 probability levels. (2) Empty cells occur when a particular variable is not included in a regression. (3) Standard errors reported in parenthesis, they are robust to general forms of heteroscedasticity. (4) Type I comprises cardholders with both a high outstanding balance and a low FICO Score, Type II comprises cardholders with both a high propensity to have an unpaid debt during the previous year and a low FICO Score, Type III comprises cardholders with a high outstanding balance, Type IV comprises cardholders with a low FICO Score and Type V comprises cardholders with a high probability of having any unpaid debt in the previous twelve months. (5) The omitted categories include (a) local banks, (b) other credit card networks (American Express or Diners Club) and (c) Classic/started cards.

Appendix A. Sample of banks

Type of credit card plan	Bank Class (FDIC)	Name of the bank	Headquarters' area
NATIONAL	NM	1st Summit Bank	Pennsylvania
NATIONAL	NM	5Star Bank	Colorado
NATIONAL	NM	Amalgamated Bank of Chicago	Illinois
LOCAL	N	Amegy Bank National Association	Texas
NATIONAL	SA	American Express Bank, FSB.	Utah
NATIONAL	NM	American Express Centurion Bank	Utah
LOCAL	NM	American State Bank	Texas
NATIONAL	SA	Ameriprise Bank, FSB	Minnesota
NATIONAL	N	ANB Financial National Association	Arkansas
NATIONAL	NM	Appalachian Community Bank	Georgia
REGIONAL	SM	Arvest Bank	Arkansas
NATIONAL	NM	Banamex USA	California
REGIONAL	NM	Banamex USA	California
REGIONAL	SM	Banco Popular North America	New York
REGIONAL	NM	BancorpSouth Bank	Mississippi
REGIONAL	N	Bank Midwest, National Association	Missouri
NATIONAL	NM	Bank of Louisiana	Louisiana
LOCAL	N	Banker's Bank of Kansas, National Association	Kansas
REGIONAL	N	Banker's Bank of Kansas, National Association	Kansas
REGIONAL	NM	Banner Bank	Washington
LOCAL	NM	Bar Harbor Bank & Trust	Maine
NATIONAL	NM	Barclays Bank Delaware	Delaware
REGIONAL	SA	BB&T Financial, FSB	Georgia
NATIONAL	NM	BMW Bank of North America	Utah
REGIONAL	NM	Branch Banking and Trust Company	North Carolina
NATIONAL	N	Capital One Bank (USA), National Association	Virginia
LOCAL	NM	Central Bank & Trust Co.	Kentucky
REGIONAL	SM	Centura Card Bank	Georgia
NATIONAL	N	Citibank (South Dakota), N.A.	South Dakota
LOCAL	NM	Citizens First Bank	Florida
REGIONAL	N	City National Bank	California
NATIONAL	NM	CNB Bank	Pennsylvania
REGIONAL	NM	Columbia River Bank	Oregon
REGIONAL	N	Commerce Bank, National Association	Pennsylvania
REGIONAL	N	Commerce Bank, National Association	Nebraska
LOCAL	SM	Community Bank & Trust Company	Pennsylvania
LOCAL	NM	Community First Bank	Arkansas
REGIONAL	SM	Compass Bank	Alabama
REGIONAL	NM	Coppermark Bank	Oklahoma
LOCAL	NM	CoreFirst Bank & Trust	Kansas
REGIONAL	NM	CoreFirst Bank & Trust	Kansas
NATIONAL	N	Credit One Bank, National Association	Nevada
NATIONAL	N	Chase Bank USA, National Association	Delaware
LOCAL	SM	Chemung Canal Trust Company	New York
NATIONAL	NM	D. L. Evans Bank	Idaho
REGIONAL	N	Delaware National Bank	Delaware
NATIONAL	NM	Discover Bank	Delaware
REGIONAL	SA	Dollar Bank, Federal Savings Bank	Pennsylvania
LOCAL	SA	Fairfield Federal Savings and Loan Association of Lancaster	Ohio
LOCAL	NM	Farmers State Bank	Iowa
NATIONAL	N	FIA Card Services, National Association	Delaware
REGIONAL	SM	Fifth Third Bank	Ohio
LOCAL	NM	First Bank & Trust East Texas	Texas

REGIONAL	NM	First Citizens Bank and Trust Company, Inc.	South Carolina
NATIONAL	SA	First Command Bank	Texas
LOCAL	NM	First Commercial Bank	Alabama
NATIONAL	SM	First Community Bank	New Mexico
LOCAL	SB	First County Bank	Connecticut
NATIONAL	SA	First Federal Savings and Loan Association of Charleston	South Carolina
REGIONAL	N	First Financial Bank, National Association	Ohio
REGIONAL	N	First Financial Bank, National Association	Indiana
REGIONAL	SM	First Interstate Bank	Montana
NATIONAL	N	First National Bank	South Dakota
LOCAL	N	First National Bank	Texas
LOCAL	N	First National Bank Alaska	Alaska
NATIONAL	N	First National Bank of Omaha	Nebraska
REGIONAL	N	First National Bank of St. Louis	Missouri
NATIONAL	N	First National Bank of the Mid-Cities	Texas
LOCAL	NM	First Security Bank	Arkansas
LOCAL	NM	First State Bank	New Mexico
REGIONAL	N	First Tennessee Bank, National Association	Tennessee
REGIONAL	SM	FirstBank	Colorado
REGIONAL	NM	First-Citizens Bank & Trust Company	North Carolina
LOCAL	N	First-Knox National Bank	Ohio
REGIONAL	N	Firstmerit Bank, National Association	Ohio
LOCAL	N	FNB Bank, National Association	Pennsylvania
LOCAL	NM	FNBT.COM BANK	Florida
NATIONAL	SA	Franklin Templeton Bank and Trust, F.S.B.	Utah
NATIONAL	SA	GE Money Bank	Utah
LOCAL	N	Greenville National Bank	Ohio
LOCAL	NM	Hawthorn Bank	Missouri
LOCAL	SM	Heartland Bank	Ohio
LOCAL	NM	Hills Bank and Trust Company	Iowa
LOCAL	SA	Home Federal Bank of Tennessee	Tennessee
NATIONAL	SM	HSBC Bank USA	New York
LOCAL	NM	Huntington State Bank	Texas
NATIONAL	NM	Idaho Independent Bank	Idaho
NATIONAL	N	InfiBank, National Association	Nebraska
NATIONAL	N	Intrust Bank, National Association	Kansas
REGIONAL	SA	IronStone Bank	Florida
NATIONAL	SM	Johnson Bank	Wisconsin
LOCAL	NM	Kentucky Bank	Kentucky
LOCAL	SM	Lafayette Ambassador Bank	Pennsylvania
NATIONAL	NM	Liberty Bank and Trust Company	Louisiana
NATIONAL	N	Los Alamos National Bank	New Mexico
REGIONAL	SA	M & I Bank FSB	Nevada
LOCAL	N	Mercantil Commercebank, National Association	Florida
LOCAL	SA	Mercer Savings Bank	Ohio
NATIONAL	NM	Merrick Bank	Utah
REGIONAL	SA	MFB Financial (The "Savings Bank")	Indiana
NATIONAL	SM	Morton Community Bank	Illinois
REGIONAL	N	National City Bank	Ohio
NATIONAL	SA	Nationwide Bank	Ohio
NATIONAL	NM	New Millennium Bank	New Jersey
LOCAL	NM	NewBridge Bank	North Carolina
LOCAL	N	Newfield National Bank	New Jersey
NATIONAL	SA	Nordstrom fsb	Arizona
REGIONAL	SB	Northwest Savings Bank	Pennsylvania
NATIONAL	NM	Oak Hill Banks	Ohio
LOCAL	NM	Palos Bank and Trust Company	Illinois

NATIONAL	NM	Penn Security Bank and Trust Company	Pennsylvania
LOCAL	SA	Peoples First Community Bank	Florida
REGIONAL	NM	Pinnacle Bank	Nebraska
REGIONAL	NM	Plains Commerce Bank	South Dakota
NATIONAL	SA	Pocahontas Federal Savings and Loan Association	Arkansas
REGIONAL	SM	Quad City Bank and Trust Company	Illinois
NATIONAL	SB	Rainier Pacific Bank	Washington
REGIONAL	SM	RBC Bank (USA)	North Carolina
NATIONAL	N	RBS Citizens, National Association	Rhode Island
LOCAL	NM	Republic Bank & Trust Company	Kentucky
LOCAL	NM	S&T Bank	Pennsylvania
NATIONAL	N	Silverton Bank, National Association	Georgia
NATIONAL	N	Simmons First National Bank	Arkansas
LOCAL	SM	Solvay Bank	New York
LOCAL	NM	State Bank of Cross Plains	Wisconsin
NATIONAL	SA	State Farm Bank, F.S.B.	Illinois
NATIONAL	N	Sunflower Bank, National Association	Kansas
REGIONAL	SM	SunTrust Bank	Georgia
NATIONAL	NM	Synovus Bank	Georgia
NATIONAL	N	TCM Bank, National Association	Florida
NATIONAL	N	TD Bank, National Association	Delaware
LOCAL	NM	Texas Bank and Trust Company	Texas
LOCAL	SM	The Adirondack Trust Company	New York
LOCAL	NM	The Bank	New Jersey
LOCAL	SB	The Bank of Canton	Massachusetts
REGIONAL	NM	The Bank of Kentucky, Inc.	Kentucky
LOCAL	SA	The Bank of Maine	Maine
REGIONAL	N	The Boone County National Bank of Columbia	Missouri
REGIONAL	NM	The Central Trust Bank	Missouri
LOCAL	N	The City National Bank of Taylor	Texas
LOCAL	NM	The Delaware County Bank and Trust Company	Ohio
NATIONAL	NM	The Farmers & Merchants State Bank	Ohio
REGIONAL	NM	The Fidelity Bank	North Carolina
LOCAL	N	The First National Bank of Fairfield	Montana
NATIONAL	N	The First National Bank of Ipswich	Massachusetts
LOCAL	N	The First National Bank of Litchfield	Connecticut
NATIONAL	N	The National Bank of Blacksburg	Virginia
LOCAL	N	The National Grand Bank of Marblehead	Massachusetts
REGIONAL	SM	The North Side Bank and Trust Company	Ohio
REGIONAL	NM	The Ohio Valley Bank Company	Ohio
LOCAL	NM	The Park Bank	Wisconsin
LOCAL	N	The Park National Bank	Ohio
NATIONAL	N	The Randolph National Bank	Vermont
LOCAL	NM	The Richland Trust Company	Ohio
REGIONAL	N	The Rockport National Bank	Massachusetts
LOCAL	N	The Security National Bank and Trust Co.	Ohio
LOCAL	N	The Vinton County National Bank of McArthur	Ohio
NATIONAL	SM	TIB The Independent Bankersbank	Texas
NATIONAL	N	Town North Bank Nevada, National Association	Nevada
NATIONAL	NM	Toyota Financial Savings Bank	Nevada
REGIONAL	N	Trustmark National Bank	Mississippi
REGIONAL	N	U.S. Bank National Association ND	North Dakota
NATIONAL	N	UMB Bank, National Association	Missouri
REGIONAL	NM	Union Bank and Trust Company	Nebraska
REGIONAL	SM	United Bank	West Virginia
LOCAL	N	Univest National Bank and Trust Co.	Pennsylvania
NATIONAL	NM	USAA Savings Bank	Nevada
NATIONAL	N	Wachovia Bank, National Association	North Carolina

LOCAL	NM	Wallis State Bank	Texas
NATIONAL	SA	Washington Mutual Bank	California
NATIONAL	SM	Wayne Bank and Trust Co.	Indiana
NATIONAL	N	Wells Fargo Bank, National Association	South Dakota
REGIONAL	NM	Wells Fargo Financial Bank	South Dakota
NATIONAL	N	Wells Fargo Financial National Bank	Nevada
LOCAL	NM	West Suburban Bank	Illinois
REGIONAL	N	Whitney National Bank	Louisiana
NATIONAL	SM	Wilmington Trust Company	Delaware
NATIONAL	N	World Financial Network National Bank	Delaware
NATIONAL	NM	World's Foremost Bank	Nebraska
NATIONAL	NM	York State Bank	Nebraska
REGIONAL	N	Zions First National Bank	Utah

Note: Commercial Banks include: **SM** = commercial bank, state charter and Fed member, supervised by the Federal Reserve (FRB), **NM** = commercial bank, state charter and Fed non-member, supervised by the FDIC and **N** = commercial bank, national (federal) charter and Fed member, supervised by the Office of the Comptroller of the Currency (OCC). Non-commercial banks include the following codes: **SA** = savings associations, state or federal charter, supervised by the Office of Thrift Supervision (OTS) and **SB** = savings banks, state charter, supervised by the FDIC.

Appendix B: Methodology used to build the demand and supply variables

In this Appendix, we discuss the various data sources used to build both demand (cardholder's sources of risk) and supply (credit card terms and conditions) variables needed to carry out our empirical estimations. We also explain the methodology used to match each bank's credit card plan (supply side) with the risk profile of the cardholders located in the markets where the credit cards are offered (demand side).

Supply side variables

For data related to supply of credit cards, we use the twice yearly Terms of Credit Card Plans (TCCP) Survey undertaken by the U.S. Federal Reserve Bank. Since demand data is only available for 2008 and 2009, we limit our sample to these years. Each bank surveyed reports specific details of its most popular credit card plans.³⁴ Appendix A provides a list of the banks surveyed. Credit cards vary across providers (banks and non-banks), reward enhancements (reward and non-reward cards) and location (US States). For each bank in the TCCP, we know specifically which of the various U.S. states where the credit card plan is advertised and issued for each bank. Credit card plans in our database can be issued on a nationwide (all 50 states and the District of Columbia), regional (more than one state), or state-specific basis. Each category is mutually exclusive; so each bank matches with only one category. In order to guarantee that each bank is associated with a unique card plan, we follow the next criteria: if the card plan is offered nationally, but with different terms in a few states, we only consider the 'most common terms' reported by the bank; if identical terms are offered regionally, we take average values across all states in which the plan is

³⁴ This refers to the plans that have the largest number of cards outstanding and that was available to new cardholders as of the report date.

marketed while if the card is regional but with different terms in a few states, we consider the ‘most common terms’ reported by the bank. Finally, if the plan is offered only in one state, we consider the terms applied by the bank in the specific state.

Demand side variables

We use both the 2008 and 2009 Survey of Consumer Payment Choice (SCPC) as a primary data source of our demand side variables. The SCPC is a nationally representative survey data on consumer payment choices in the U.S. (Foster et al., 2011). It is conducted online to a random sample of more than 2,000 consumers by the RAND Corporation as a module of the American Life Panel (ALP). The survey contains detailed information about the state of residence of credit cardholders and risk measures such as outstanding card debt, unpaid debt information, FICO score along with the primary financial institution of the cardholders (bank or non-bank institutions) and information on reward programs linked to the cardholder’s credit card. We employ this data to compute state-level average level of risk of credit cardholders according to the next criteria: if a cardholder has or does not have a reward programs associated to their credit cards along with if the cardholder has or does not have a commercial bank as her primary financial institution.³⁵

Tables C1 to C3 show the weighted average values (2008-2009) across U.S. states of the main financial characteristics considered in our study.³⁶ All data are weighted to match national population estimates from the Census Bureau’s Current Population Survey. Table C1 shows a considerable state-level variation in the unpaid debt of credit cardholders. The credit card debt of bank cardholders is much lower than

³⁵ It should be noted that we restrict our analysis to consumers whom have adopted one or more credit cards and have a positive outstanding balance in their card (revolving cardholders). Because the interest rate is only relevant to those who borrow on their credit card, respondents were filtered to include only credit card users who carry a balance.

³⁶ Missing values in Tables 1 to 4 are due to there is no state-level available data for cardholders who meet these criteria in both the 2008 and 2009 SCPC.

non-bank cardholders. Unpaid debt is higher for reward receivers than non-reward receivers. Table C2 completes this picture and provides self-reported FICO scores, ranging from 1 (<600 points) to 5 (>800 points), of the cardholders surveyed. There is substantial variation in FICO scores across states and between consumers holding cards with associated reward programs. Table C3 shows that, on average, the U.S. cardholders have carried an unpaid balance on any credit card from one month to the next during the previous 12 months. More precisely, the last row of Table C3 (national weighted average) shows that more than 50 per cent of the cardholders in our sample have carried an unpaid balance on any credit card from one month to the next during the previous 12 months.

Matching demand, supply and market variables

As shown in Section 3, our database contains both demand and supply side information of the credit card market for the period 2008 to 2009. From the demand side, we can observe if the cardholder is or is not a client of a commercial bank and has or does not have reward programs associated with their credit cards. From the supply side, we can observe whether each credit card plan is or is not marketed by a commercial bank, and if the plan offers or does not offer reward programs. By using this information, we are able to match each bank's credit card plan with the level of risk of their most likely credit cardholder living in the regions where each bank offers its card plans. Nationally marketed credit cards plans have been matched with national average values of the cardholder's level of risk extracted from the 2008/2009 SCPC (see Tables C1-C3). Regional card plans are matched with the weighted average value of the cardholder's level of risk in the regions where the bank operates while if the card plan is

offered in only a single US state, we impute the cardholder's level of risk in this particular US state to the card plan marketed in the same US state.³⁷

³⁷ Our weighted factor is the population of the states where each credit card is offered.

**APPENDIX C: Measuring the level of risk of cardholders using data from the
2008/2009 SCPC**

Table C1. Last month, about how much was the unpaid balance on all your credit cards that you carried over from the previous month (in dollars)? (2008-2009)

	Bank customer with reward credit card	Non-Bank customer with reward credit card	Bank customer w/o reward credit card	Non-Bank customer w/o reward credit card
ALABAMA	1,026.3	1,354.8	4,500.0	
ALASKA	1,836.6	5,185.4		
ARIZONA	1,429.4	1,919.7		3,300.6
ARKANSAS	2,302.0	4,779.3		
CALIFORNIA	6,250.1	3,528.9	1,993.8	3,641.1
COLORADO	6,032.5	7,332.8	1,946.3	9,324.8
CONNECTICUT	9,780.3	6,656.7		
DELAWARE	6,399.5	3,702.0	6,000.0	5,000.0
WASHINGTON D.C.	2,308.6			
FLORIDA	5,140.4	2,407.3	1,915.0	6,467.5
GEORGIA	2,881.0		3,972.4	
IDAHO	1,656.4	4,800.6	9,831.9	7,248.9
ILLINOIS	3,317.9	5,823.5	1,802.0	7,161.2
INDIANA	5,199.7	1,827.7	1,500.3	5,796.6
IOWA	1,728.3	2,070.4	4,425.0	2,411.0
KANSAS	1,305.9	4,900.0	4,235.4	1,362.1
KENTUCKY	1,475.5	2,217.8	6,099.8	
LOUISIANA	6,310.9	1,940.3		
MAINE	7,449.2	3,247.7	3,500.0	
MARYLAND	3,020.0	4,228.9	1,047.3	1,894.3
MASSACHUSETTS	2,441.8		3,156.4	
MICHIGAN	2,422.1	1,638.9	950.7	2,748.1
MINNESOTA		7,498.0	3,529.5	7,402.3
MISSISSIPPI	7,500.0	6,131.2	5,595.3	
MISSOURI	4,961.3	5,498.9	1,653.2	5,231.8
MONTANA	2,029.4	2,108.8		8,214.1
NEBRASKA	2,704.9	4,894.5		
NEVADA		8,784.6		737.8
NEW HAMPSHIRE	5,364.9	2,738.5	9,000.0	
NEW JERSEY	2,898.2		5,495.7	1,000.0
NEW MEXICO		6,415.4		2,000.0
NEW YORK	2,901.7	4,554.2	2,017.4	985.6
NORTH CAROLINA	5,678.4	3,555.8	1,303.0	3,354.0
NORTH DAKOTA	3,000.0			
OHIO	3,154.2	2,803.3	891.4	3,874.4
OKLAHOMA	8,758.2		6,145.1	2,619.5
OREGON		2,037.7	7,408.1	
PENNSYLVANIA	3,367.0	4,205.0	5,549.9	5,625.0
RHODE ISLAND	658.7	2,727.7		
SOUTH CAROLINA	594.1	5,326.1	2,732.0	828.3
SOUTH DAKOTA		5,173.8		600.0
TENNESSEE	3,298.9	1,661.9	2,023.7	770.1
TEXAS	5,532.8	2,704.6	2,426.7	4,629.6
UTAH	750.3	706.0		3,650.5
VIRGINIA		3,259.0	3,012.4	
WASHINGTON	3,642.5	5,638.9	1,682.7	
WEST VIRGINIA		2,783.1	5,000.0	
WISCONSIN	2,750.7	1,076.0	4,489.3	6,794.2
NATIONAL	3,924.6	4,254.0	2,563.4	4,029.7

Note: Figures include regional weighted averages. Outstanding credit debt is winsorized at the top and bottom 1 per cent of the distribution.

Table C2. Please estimate your most recent credit rating, as measured by a FICO score: 1 (< 600), 2 (600-649), 3 (650-699), 4 (700-749), 5 (750-800) and 6 (> 800) (2008-2009)

	Bank customer with reward credit card	Non-Bank customer with reward credit card	Bank customer w/o reward credit card	Non-Bank customer w/o reward credit card
ALABAMA	5.00	5.59	3.00	4.00
ALASKA	5.00	2.00		
ARIZONA	5.01	5.19	4.61	2.43
ARKANSAS	5.27	3.54	6.00	
CALIFORNIA	3.77	4.35	3.52	2.18
COLORADO	5.22	4.55	1.26	3.00
CONNECTICUT	4.59	4.75		
DELAWARE	2.50	5.10	2.00	6.00
WASHINGTON D.C.	3.00			
FLORIDA	3.48	4.55	4.40	3.07
GEORGIA	4.44	4.55	3.48	6.00
IDAHO	4.67	5.01	1.96	4.62
ILLINOIS	4.59	4.26	3.12	3.00
INDIANA	3.49	3.65	3.55	3.21
IOWA	4.98	4.47		3.76
KANSAS	4.82	5.00	2.04	2.19
KENTUCKY	3.41	2.53	3.00	3.00
LOUISIANA	5.24	4.88		3.50
MAINE	5.34	2.59	4.00	4.93
MARYLAND	4.48	3.81	2.70	3.69
MASSACHUSETTS	3.94	4.28	2.22	1.00
MICHIGAN	4.41	3.82	3.28	2.82
MINNESOTA	4.57	4.94	1.74	3.24
MISSISSIPPI	2.50	3.69	2.23	3.00
MISSOURI	5.33	5.40	4.47	2.88
MONTANA	5.32	5.04		4.07
NEBRASKA	5.21	5.00		5.00
NEVADA	4.03	4.11		4.00
NEW HAMPSHIRE	3.00	5.25	5.00	
NEW JERSEY	3.83	5.02	3.59	5.00
NEW MEXICO	4.10	3.84	1.00	4.00
NEW YORK	4.79	4.33	4.63	4.35
NORTH CAROLINA	4.69	5.07	4.29	3.45
NORTH DAKOTA	4.00	4.00	4.00	
OHIO	4.41	4.38	3.28	4.18
OKLAHOMA	4.25	3.92	4.49	4.42
OREGON	4.87	5.05		2.12
PENNSYLVANIA	4.66	4.32	3.23	3.11
RHODE ISLAND	6.00	4.82		
SOUTH CAROLINA	5.38	3.89	3.16	3.52
SOUTH DAKOTA	3.50	5.00		6.00
TENNESSEE	4.29	2.82	5.00	4.83
TEXAS	3.97	4.37	3.25	4.38
UTAH	5.56	4.98	2.00	3.64
VIRGINIA	4.55	4.54	4.59	4.00
WASHINGTON	4.40	3.63	5.02	4.61
WEST VIRGINIA	6.00	3.64	6.00	
WISCONSIN	4.67	5.45	3.76	3.14
WYOMING	5.00	4.00		
NATIONAL	4.26	4.32	3.32	3.16

Note: Figures include regional weighted averages. FICO scores range from 200 to 900 with higher values representing better credit-quality or lower risk.

Table C3. During the past 12 months, did you carry an unpaid balance on any credit card from one month to the next (that is, you did not pay the balance in full at the end of the month)? (1=YES & 0=NO) (2008-2009)

	Bank customer with reward credit card	Non-Bank customer with reward credit card	Bank customer w/o reward credit card	Non-Bank customer w/o reward credit card
ALABAMA	0.48	0.23	1.00	1.00
ALASKA	0.52	1.00		
ARIZONA	0.43	0.62	0.36	0.83
ARKANSAS	0.46	0.81		
CALIFORNIA	0.62	0.56	0.65	0.36
COLORADO	0.15	0.55	1.00	1.00
CONNECTICUT	0.54	0.27		
DELAWARE	0.45	0.45	1.00	1.00
WASHINGTON D.C.	0.16			
FLORIDA	0.72	0.66	0.87	0.90
GEORGIA	0.54	0.65	0.73	
IDAHO	0.88	0.42	0.32	0.64
ILLINOIS	0.43	0.75	0.90	0.92
INDIANA	0.67	0.59	1.00	0.86
IOWA	0.35	0.26	1.00	0.72
KANSAS	0.87	0.50	0.53	1.00
KENTUCKY	0.59	0.73	0.64	1.00
LOUISIANA	0.69	0.71		1.00
MAINE	1.00	0.93	1.00	0.84
MARYLAND	0.66	0.48	0.92	0.60
MASSACHUSETTS	0.26	0.46	0.43	1.00
MICHIGAN	0.41	0.30	0.13	0.68
MINNESOTA	0.76	0.42	0.46	0.72
MISSISSIPPI	1.00	0.81	1.00	1.00
MISSOURI	0.57	0.40	1.00	1.00
MONTANA	0.34	0.50		0.78
NEBRASKA	0.59	0.33		1.00
NEVADA	1.00	0.69		0.11
NEW HAMPSHIRE	0.34	0.17	1.00	0.41
NEW JERSEY	0.49	0.57	0.92	0.50
NEW MEXICO	0.40	0.74		1.00
NEW YORK	0.49	0.50	0.68	0.59
NORTH CAROLINA	0.73	0.45	0.51	0.97
NORTH DAKOTA	1.00			
OHIO	0.57	0.45	0.30	0.91
OKLAHOMA	0.94	0.43	0.50	0.83
OREGON	0.14	0.17	1.00	0.25
PENNSYLVANIA	0.60	0.55	0.83	0.87
RHODE ISLAND	0.46	1.00		
SOUTH CAROLINA	0.63	0.90	1.00	0.62
SOUTH DAKOTA	1.00	0.92		1.00
TENNESSEE	0.38	0.49	0.87	0.72
TEXAS	0.67	0.39	0.54	0.43
UTAH	0.12	0.15	0.00	0.86
VIRGINIA	0.62	0.42	1.00	0.50
WASHINGTON	0.50	0.51	0.90	0.56
WEST VIRGINIA	0.62	0.36	0.50	1.00
WISCONSIN	0.55	0.30	0.97	1.00
NATIONAL	0.57	0.51	0.59	0.73

Note: Figures include regional weighted averages which range between 0 and 1.



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