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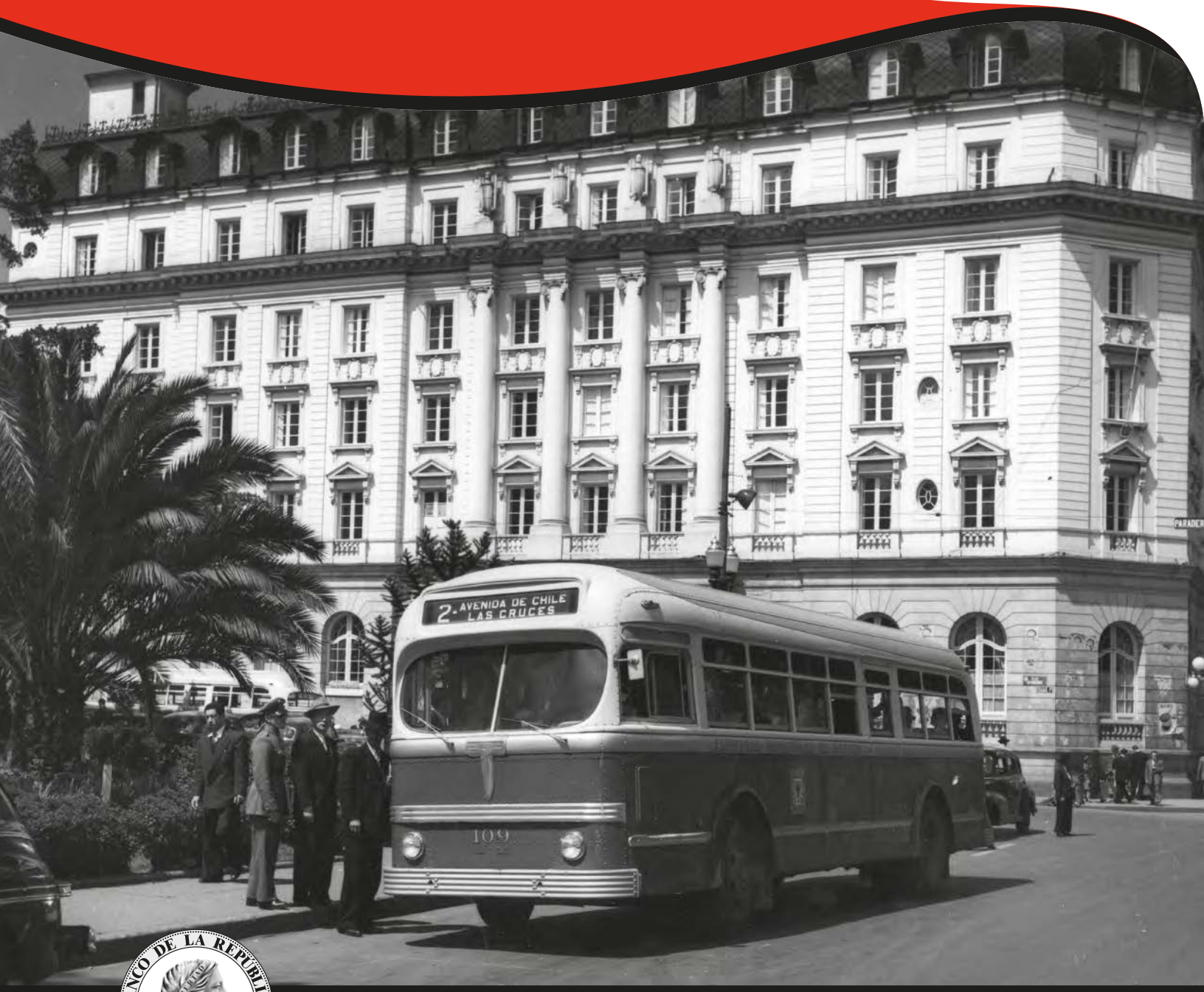
Núm. 912
2015



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Determinants of consumer credit within a constrained framework: evidence from Colombian microdata

By

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Abstract

In this paper, we study the determinants of consumer credit using microdata from a Credit Union in Colombia. To the best of our knowledge, this is the first study to use this type of data in Latin America. We present evidence of liquidity constraints and some of the ways these appear; nevertheless, we still find that variables related to the life cycle–permanent income hypothesis are important determinants of the demand for consumer debt. The elasticity of current income is between 0.3 and 0.7, while the semi-elasticity of the real interest rate is around –1.4. If individuals are homeowners and have some school attainments, they have an increased demand for debt. Similarly, their level of indebtedness drives them to acquire more debts instead of deterring them from borrowing. Once the supply side is considered, we provide evidence that the score assigned to individuals is a significant determinant in deciding which credit is approved by the Credit Union and which is not. At the same time, the indebtedness of individuals and their performance with regards to current debt are determinants of the trimming-down of the amounts requested by customers. Interestingly, when we include these latter variables in the specifications, the interest rate becomes a positive determinant of consumer credit supply.

Key words: consumer credit, credit constraints, score, indebtedness, life cycle-permanent income hypothesis.
JEL: D12, G21.

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* The opinions expressed here do not reflect those of *Banco de la República* or its Board of Directors. We are grateful to the manager, officials and representatives of the Credit Union for providing us with the data and explaining the contents of the information. Comments and suggestions provided by the Credit Union's staff are also appreciated. The authors also acknowledge the comments and suggestions of David Pérez and the assistants to the 2015 LASA Congress, the IDB seminar "Household Debt in Latin American", the seminars at *Universidad Javeriana* and *Banco de la República* in the Bogotá and Medellín branches and the 49th MMF-2017 held at King's College, London. Research assistance by Ingri Katherine Quevedo-Rocha is greatly acknowledged.
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1. Introduction

Most studies of consumer credit have been focused on developed countries[1] with little evidence presented for emerging economies. One of the contributions of this paper is to narrow this gap by examining the determinants of consumer credit demand and supply using data for Colombia.

Since the publication of the stochastic version of the life cycle–permanent income hypothesis[2] (Hall, 1978), borrowing constraints have been a crucial aspect in explaining consumer credit, given the enormous content related to the consumption behaviour of households (see, e.g., Zeldes, 1989; Runkle 1991; Ludvigson, 1999; Crook, 2006; Attanasio, Goldberg and Kyriazidou, 2008), the impact of the stabilization policy (Hubbard and Judd, 1986), economic growth (Jappelli and Pagano, 1994), and so on.

In this paper, we examine the determinants of consumer credit demand. In contrast to previous research based on surveys (e.g., Jappelli, 1990; Cox and Jappelli, 1993; Duca and Rosenthal, 1993; Magri, 2002, 2007),[3] we use a unique administrative dataset containing all the credit records of a Credit Union[4] located in Medellin, which is the second largest city in Colombia, and in ten further municipalities in the surrounding area. We verify the existence of liquidity constraints and the way in which they are present. Besides the initial treatment of data to control for liquidity constraints and other selections (see Cox and Jappelli, 1993; Duca and Rosenthal, 1993; Crook, 2006), we include a set of lender's variables that are used to grant credit and to determine the amount of credit. These variables include, for example, the credit score assigned to each individual, the indebtedness rate of individuals (i.e., the proportion of current income assigned to repay debts) and, finally, their current debt performance.

The dataset used in this study comes from a local credit union, which accounts for 0.5 per cent of the total consumer credit market in Colombia (the representativeness of these data is discussed in Section 4). The dataset contains information from 222,977 credits requested by 103,965 different individuals between July 2007 and March 2014, on a monthly basis. The information contained in the dataset includes the credit amounts requested by individuals and the amounts actually granted, the interest rate of each credit, the credit's maturity, the amount of monthly instalments relative to an

[1] See, for example, Bertola, Disney and Grant (2006), in which recent contributions to this area are surveyed and new studies are compiled.
[2] The first formulation of the life-cycle model corresponds to Modigliani and Brumberg (1954), while the first presentation of the permanent income model corresponds to Friedman (1957).
[3] Alessie, Hochguertel and Weber (2005) also use a database with financial operations instead of a survey.
[4] We identify this financial institution as the "Credit Union", keeping its business name private.

individual's income, and whether the credit is paid in person at the Credit Union or directly as a payroll deduction.[5] It also contains demographic characteristics such as age, education, current income, and marital status, among others.

Taking advantage of this unique dataset where the credit operations meet the legal definition of consumption credit in Colombia,[6] this paper contributes to the understanding of the determinants of the consumer credit demand in Colombia, where no previous investigation of this style has been carried out.[7] We find that variables related to the life cycle–permanent income hypothesis are important determinants of the demand for debt.[8] The elasticity of current income is between 0.3 and 0.7 while the semi-elasticity of the real interest rate is around –1.4.

Given that we have access to the credit score (external score) awarded to each individual, we can estimate the probability of the credit being granted or not. Moreover, the individuals' level of indebtedness as well as their current credit performance (internal score) appear as determinants of the lenders' decision to reject or reduce the amount requested.

Once we introduce restrictions, such as granting a credit or not, and whether or not to grant the amount requested, we end up with a specification for the credit supply. The estimates suggest that the higher the interest rate, the higher the supply of credit. Similarly, the credit supply increases with credit score, age, educational attainment, home ownership and credit payment through the monthly payroll. The positive sign and coefficient of the indebtedness rate are more revealing.

This paper is organized as follows. After this introduction, in Section 2, we present some facts about consumer credit in Colombia, as well as in the Credit Union, and we describe the data. In Section 3, we describe the theoretical and empirical approaches that guide the specifications used and the interpretation of the results. In Section 4, we show and discuss the results. In particular, we discuss the determinants of consumer credit demand, controlling for some sources of credit restrictions and selection bias, and then we introduce factors such as the applicant's scores, the current credit performance and the indebtedness rate. The purpose of this is to understand the variables that affect the

[5] This type of credit repayment, which comes directly from an individual's wage, is called *libranza* and it requires the Credit Union to have an agreement with the employer.

[6] The criteria used by the Credit Union to classify an active operation as a "consumer credit" are consistent with the definition used by the Office of the Financial Superintendent (i.e., the Financial Supervisory Authority in Colombia) as the credit granted to natural persons, with no commercial purposes, intended for the acquisition of consumption goods or the payment of services. See Chapter II of the External Normative 100 of 1995 issued by the Financial Supervisory Authority.

[7] To the best of our knowledge, this is the first paper to study the determinants of consumer credit using microdata for Latin America.

[8] The assumption is that permanent income is determined by human capital variables, such as education and experience (proxied by age), and other variables, such as a wealth indicator (proxied by the property ownership – in this sense, it allows us to measure the "house effect"), current income, the real interest rate of the credit, etc.

Credit Union's decision regarding the rejection or reduction of the amount requested and other determinants of credit supply decisions. Finally, we draw some conclusions in Section 5.

2. Evolution of consumer credit and data used

Figure 1 shows the total credit (at the national level), consumer credit, and the consumer credit reported by the Credit Union between 2005 and 2014. During the first four years, the annual growth rate of the total consumer debt exceeded the annual growth rate of total credit, reaching a peak around 43.6 per cent by the end of 2006. Since the slowdown of the economy, which occurred between January 2008 and March 2009,[9] the annual variation of total consumer credit has remained low. Indeed, it was less than 10 per cent at the end of 2014. The growth rate of the Credit Union's consumer credit oscillated between 10 and 30 per cent before the deceleration in 2008. After that, the rate of annual variation remained between 6.0 and 13 per cent until October 2012, when it started to increase, reaching an annual variation rate of 19 per cent by the end of 2014.[10]

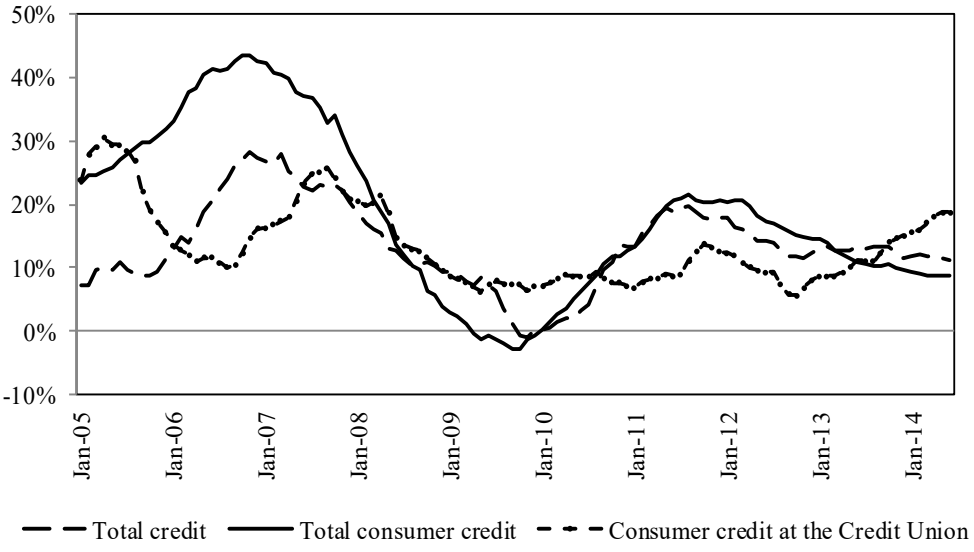
Such swings in the growth of the consumer credit granted by the Credit Union, as well as those experienced by the total credit and total consumer credit at the national level, can be explained by changes in some determinant factors. In the following sections, we try to pin down the determinants of the consumer credit of the Credit Union in the light of the life cycle–permanent income hypothesis, considering the role of liquidity constraints imposed on the customers.

Figure 2 presents the evolution of the amount of credit requested, the average amount of credits approved, and the average amount of credits rejected, between 2007 and 2014. The figure shows that, on the one hand, the amount of consumer credit requested has increased since 2009, reaching a value of COP $8.6 million (US $4,300), on average, by the end of 2014, and, on the other hand, the average amount of rejected credits is higher than the amount approved, suggesting the existence of credit constraints.

[9] For this chronology, see Alfonso et al. (2013) and Arango and Cardona-Sosa (2015). Such chronology is the base of the economic cycle indicator used in the empirical sections below. It consists of a dummy variable that takes the value of 1 when the economy is in slump (between January 2008 and March 2009) and 0 otherwise. This variable is different from the Economic Monitoring Indicator, ISE, produced in a monthly basis by the Official Statistics Bureau (Departamento Nacional de Estadísticas, DANE).

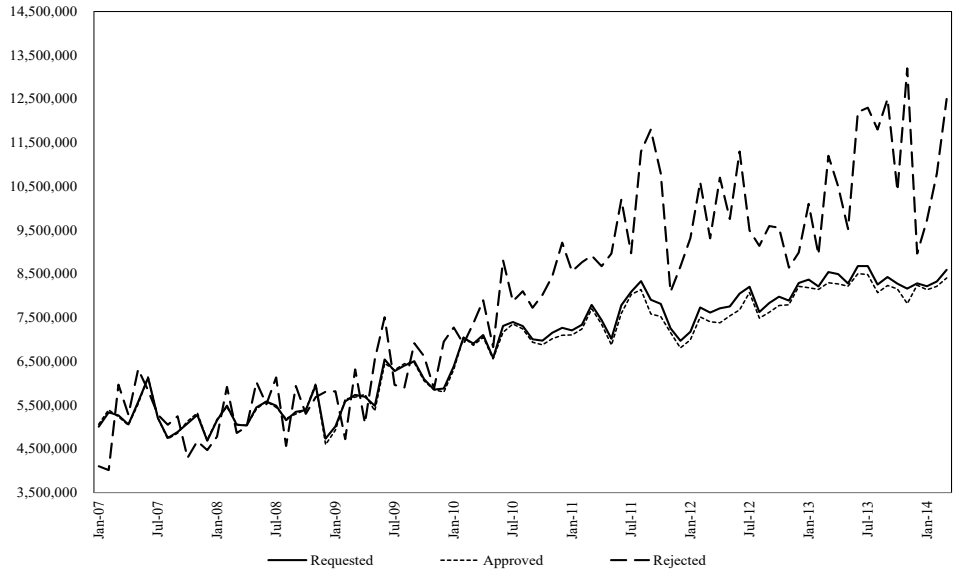
[10] According to Zapata (2014), the different dynamics of the consumer credit granted by the Credit Union and the total consumer credit, especially between 2005 and 2008, are related to the widespread use of direct discounts from the labour wage or payroll deductions (*libranzas* in Spanish) by the commercial banks for the repayment of credits and the consequent displacement undergone by smaller institutions, such as the Credit Union that we are analysing. Zapata (2014, p. 7) said: "… between the last quarter of 2005 and 2006, the Credit Union suffered the greatest effect of traditional banking competition by losing its share in the consumer segment, a market traditionally served by this financial institution."

Figure 1. Annual growth rate of credit: 2005–2014



Source: Office of the Financial Superintendent; authors' calculations.

Figure 2. Average nominal amounts of consumer credits: 2007–2014



Note: The *y*-axis shows the amount in Colombian pesos (COP).
Source: Credit Union; authors' calculations.

Figure 3 shows both the nominal and real interest rates of the credits granted by the Credit Union. The gap between them started out at about six percentage points while at the end of the sample period it finished at about three points. Most importantly, both rates have had important movements over the sample period. In 2007, the increase of the interest rate concurred with the decrease in the consumer credit granted by the Credit Union (see Figure 1). Since 2011, there has been an upward trend, although the level of the average real interest rate is considerably lower than before.

Figure 3. Annual effective interest rate on loans charged by the Credit Union: 2007–2014

Note: The real interest rate is computed as $r = I - \pi$.
Source: Credit Union; authors' calculations.

As we stated above, the information used in this study comes from individual records from a private Credit Union serving Medellín and its surrounding municipalities between January 2007 and March 2014. The number of credit applications with valid information during the seven years was about 222,977,[11] which corresponds to 103,965 individuals. During this period, the financial institution granted around 206,143 loans, for about COP $6.8 million (US $3,400) on average, in real terms for December 2012.

Table 1 reports some descriptive statistics by gender and age groups. Among individuals demanding credit at the Credit Union, 54 per cent are men and, among these men, those aged over 65 demand more credits compared with other age groups, whereas women aged between 56 and 65 demand more credits. The distribution of the credit demand is not homogeneous, with older individuals demanding credit more frequently but requesting amounts below the average.[12] In Table 2, we observe that credit is demanded mainly by low-educated individuals. In fact, 76 per cent of applicants had secondary or lower levels of education. It is important to note that the amount of credit increases

[11] The total number of individuals who approached the Credit Union is about 264,000; however, we exclude individuals who represented individual business, and those individuals at either the top 0.1% or the bottom 0.1% of the credit demand. A similar restriction was applied for the individual's income, with the aim of reducing outliers. Thus, we end up with 222,977 observations.

[12] Crook (2006, p. 66) shows that people aged between 40 and 49 in Japan, the Netherlands and the United States are the most indebted, while in Canada, Germany, Italy and the United Kingdom this characteristic corresponds to households including people between 30 and 39.

monotonically with individuals' levels of education and income, even though the population under study has an average monthly wage below COP $1 million (US $300).[13]

Table 1. Credit applications by gender and age

Age range	Number	Average amount (million COP)	Average interest rate (per cent)	Average number of credits
Women				
Whole sample	103,704	6.7	15.8	3.8
Age 18–25	8,073	4.5	16.0	2.3
Age 26–35	19,850	6.4	15.9	2.7
Age 36–45	18,654	7.2	15.9	3.1
Age 46–55	16,645	8.1	15.9	3.7
Age 56–65	22,916	6.7	15.7	4.8
Age 66+	17,501	6.3	15.7	5.4
Men				
Whole sample	123,303	6.8	15.9	4.3
Age 18–25	10,689	4.2	16.0	2.2
Age 26–35	23,617	6.2	15.9	2.7
Age 36–45	22,148	7.4	15.9	3.3
Age 46–55	20,565	8.0	15.9	4.3
Age 56–65	21,083	7.3	15.8	5.5
Age 66+	25,091	6.3	15.7	6.6

Note: For women, there were 65 credits without a reported age, while for men there were 110.
Source: Credit Union; authors' calculations.

Table 2. Consumer credit requests by education and income of individuals

	Number of observations	Percentage distribution	Average amount of credit (million COP)
Education			
None	822	0.4%	4.4
Primary	73,462	32.4%	5.6
Secondary	97,967	43.2%	6.1
Technical and technological	29,729	13.1%	8.0
College	21,492	9.5%	11.6
Postgraduate	1,015	0.4%	16.2
Missing	2,520	1.1%	5.2
Income range (COP)			
< 1,000,000	146,397	65.0%	4.7
1,000,001–2,000,000	59,599	26.5%	8,8
2,000,001–3,000,000	11,362	5.0%	13.5
3,000,001–4,000,000	4,092	1.8%	15.7
4,000,001–5,000,000	1,556	0.7%	20.3
> 5,000,000	2,101	0.9%	24.8

Note: There were 1,900 credits with no reported income.
Source: Credit Union; authors' calculations.

[13] In contrast, Crook (2006, p. 66) shows that households in the lower income percentiles are less indebted than those in the upper income percentiles.

In terms of the external validity of this study, we can start by saying that the credit provided by this Credit Union is about 0.5 per cent of the consumer credit in Colombia. In the best scenario, our results could be extrapolated to a similar population to the one this Credit Union serves (i.e., low- and middle-income households).

Yet, we can test how different the people are in our sample from individuals who are demanding credit at other credit institutions. To do so, we exploit the administrative records of all individuals holding credits in the country and the financial institution that concede them.[14] In the absence of demographic information for credit holders, we merge the credit data with the demographic information contained in the System of Potential Beneficiaries of Social Programs in Colombia (SISBEN), which is a survey that characterizes more than 60 per cent of the whole population in the country, focusing mainly on low-income households.[15] This dataset contains variables such as individuals' names and national IDs, housing quality (materials used to build the house), education, number of household members, employment status of household members, access to health services, etc. The survey was designed to classify the population into six different levels according to their socio-economic information, where level one refers to the most disadvantaged households (see Bottia, Cardona-Sosa and Medina, 2012).

By using the demographic information of debt holders, we compare individuals from the Credit Union under study with individuals from other credit unions. The average figures reported in Table 3 suggest that individuals from the Credit Union under study are not statistically different from those demanding credit at other financial institutions. Nevertheless, we still prefer to consider this analysis as a case of study.

3. Theoretical guide and empirical specification

An individual's decision about the amount of debt to hold is framed within the life cycle– permanent income hypothesis approach. Thus, the demand of consumer debt results from an individual optimization problem where individuals maximize their expected life-time utility with time-separable preferences, subject to an intertemporal budget constraint. This depends on individuals' time preferences, the intertemporal elasticity of substitution, current assets, the present value of expected future income, and the interest rate at which the market allows the intertemporal transference of

[14] We use administrative records from all bank customers in Colombia from the form-341 provided by the Financial Supervisory Authority.
[15] In the case of Antioquia (the province whose capital city is Medellín), which has 6,221,817 inhabitants, the SISBEN 2009–2010 interviewed 3,956,890 individuals (about 64 per cent of the total population).

resources. In this framework, saving (borrowing) is determined by the difference between the current level of income and the optimal level of consumption.

Table 3. Statistics from the Credit Union and other financial institutions (2004–2014): individuals matched with SISBEN

Variable	Average of other financial institutions overseen by the Office of the Financial Superintendent	Credit Union
Value of credit	COP $3,044,349	COP $4,088,623
Proportion of male customers	0.526	0.539
Average age	42.928	43.660
Primary education	0.540	0.550
Secondary education	0.128	0.061
Technical and college education	0.092	0.065
Strata 0 and 1	0.081	0.106
Stratum 2	0.452	0.558
Stratum 3	0.463	0.333
Stratum 4	0.004	0.003
Proportion married or cohabiting	0.574	0.533
Proportion separated	0.075	0.065
Proportion widowed	0.056	0.084
Proportion single	0.295	0.318
Proportion of workers in labour force	0.956	0.946
Observations	304,174	49,820

Source: Office of the Financial Superintendent; SISBEN; authors' calculations.

The problem that determines consumption $c_{i,t}$ and leisure $l_{i,t}$ of person *i* at time *t* is expressed as

$$\max E_{i,t} \sum_{j=0}^{T} \beta_i^j u(c_{i,t+j}, l_{i,t+j})$$

subject to

$$(1 + r_{i,t+1})D_{i,t} = D_{i,t+1} - c_{i,t} + x_{i,t} + w_t(1 - l_{i,t}).$$

Here, $E_{i,t}$ represents the expectations, conditional on the information set available for the individual *i* at period *t*, β_i is the discount factor, $D_{i,t}$ accounts for the agent's debt, $r_{i,t}$ is the real interest rate, $x_{i,t}$ is the non-labour income and w_t is the real wage.

By assuming that the interest rate is constant over time and across consumers and allowing *T* to go to infinity, after some algebraic manipulation of the restriction we obtain the intertemporal budget constraint:

$$\sum_{j=0}^{\infty} \frac{c_{i,t+j}}{(1+r)^j} = E_{i,t} \sum_{j=0}^{\infty} \frac{w_{t+j}(1-l_{i,t+j})+x_{i,t+j}}{(1+r)^j} - (1 + r)D_{i,t}.$$

In equilibrium, $(1 + r)\beta$=1, consumption can be written as

$$c_{i,t} = E_{i,t} r \sum_{j=0}^{\infty} \frac{w_{t+j}(1-l_{i,t+j})+x_{i,t+j}}{(1+r)^{j+1}} - rD_{i,t},$$

from which we obtain an expression to compute an individual's debt:

$$D_{i,t} = E_{i,t} \sum_{j=0}^{\infty} \frac{w_{t+j}(1-l_{i,t+j})+x_{i,t+j}}{(1+r)^{j+1}} - \frac{c_{i,t}}{r}. \quad (1)$$

As we can observe, the life-cycle model yields this solution only under very restrictive circumstances, such as when the agent faces no credit limits (e.g., there is no need for collateral) or when the borrowing and lending interest rates are equal. Thus, it is convenient to consider the case in which credit limits arise. Attanasio et al. (2008) provide some intuition on the demand for credit in the presence of liquidity constraints under two situations. In the first situation, individuals cannot borrow as much as they want to finance current consumption using future earnings or income. In the second situation, individuals are liquidity-constrained if the interest rate at which they can borrow resources from the market is greater than the interest rate at which they can lend. At the other end of the spectrum, there are the non-liquidity-constrained consumers who find it optimal never to finance goods for consumption. These individuals will never exhibit sensitivity to either the credit maturity or to the interest rate. Yet, another group of unconstrained households will find it optimal to finance consumption. In such cases, they will exhibit high sensitivity to the interest rate, but less sensitivity to the loan's maturity.[16] Another common definition to identify credit-constrained individuals is when they are either precluded or prevented from applying for credit (see Crook, 2006, and references therein).

In this study, agents are liquidity-constrained if their credit request is rejected or if they are discouraged to apply for a loan. Similarly, we consider those cases when the amount requested by the agent is trimmed down by the Credit Union (i.e., when the demand for debt is positive and greater than what was supplied).

Thus, we add to our previous theoretical sketch an upper borrowing limit $\overline{D}_{i,t}$. Such a limit is not only correlated with the difference between current consumption and future income (as in equation 1), but with debt payment habits, recent credit history performance and other personal characteristics of the individual demanding credit,

$$D^{o}_{i,t} \leq \overline{D}_{i,t} = F\left(D^{o}_{i,t-1} \leq \overline{D}_{i,t-1}\right),$$

[16] We will use this argument to invoke the endogeneity of the loan's maturity that we argue below. However, given the amount of the loan, we regard the interest rate and the maturity of the loan as highly collinear.

where $D_{i,t}^{o}$ is the observed level of debt. As in Ludvigson (1999), we define[17]

$$C_{i,t} \equiv \overline{D}_{i,t+1} - \left(1 + r_{i,t+1}\right)D_{i,t}^{o} + [w_t\left(1 - l_{i,t}\right) + x_{i,t}],$$

which gives us an expression that is close to the empirical specification that we use below.

Our first aim in this study is to analyse the determinants of the demand for consumer credit. However, the desired level of debt is not always observable for all individuals. By ignoring this fact, the estimates of the demand will suffer from selectivity bias. Under the current framework, we face different types of selections: an individual's decision to hold positive debt, an individual's decision to request credit from a financial institution and, finally, the credit restrictions imposed by the financial institution but not always observed by the econometrician. These problems, familiar to this body of literature, can be addressed with censoring modelling. As noted by Maddala (1983, p. 5; 1992, p. 341), an accurate procedure should allow us to model all the decisions that produce different demand outcomes, including zero demand at the Credit Union. Our empirical specification of credit demand follows Cox and Jappelli (1993), Duca and Rosenthal (1993) and Crook (2001). We start first with the individual's demand for credit.

A desired level of debt for consumer i in period t, $D_{i,t}$, is a function of some observable characteristics, $X_{i,t}$, plus a random term, $\mu_{i,t}$:

$$D_{i,t+1} = X_{i,t}\gamma + \mu_{i,t}. \qquad (2)$$

As previously stated, $D_{i,t}$ is not always observed. While, on the one hand, individuals might be prevented from taking credit, on the other hand, they might not need the credit or are not pushed by their preferences to hold a positive amount of debt. To account for this, we now define the dummy variable $\widehat{D}_{i,t+1}$, which takes the value of 1 if the individual holds a positive amount of debt, and 0 otherwise. This variable depends on the latent variable $\hat{d}_{i,t+1}$, which is determined by a set of individual variables $\hat{X}_{i,t}$ and a random term $\hat{\mu}_{i,t}$:

$$\hat{d}_{i,t+1} = \hat{X}_{i,t}\hat{\gamma} + \hat{\mu}_{i,t}. \qquad (3)$$

[17] In this case, the first-order condition of the problem is given by $u_c'(c_{i,t}, l_{i,t}) = \max[u_c'(C_{i,t+1}, l_{i,t+1}), \beta_i E_{i,t} u_c'(c_{i,t+1}, l_{i,t+1})(1 + r_{i,t+1})]$. Complementary to this framework, Jappelli (1990) develops an empirical model where a consumer is classified as liquidity-constrained when $c_{i,t} - x_{i,t} - w_t(1 - l_{i,t}) - (1 + r_{i,t+1})D_{i,t}^{o} > \overline{D}_{i,t+1}$. That is, when the desired consumption – once the resources available are subtracted – is greater than the level of debt available for the individual.

Thus, $\widehat{D}_{i,t+1}$ will be observed (equal to 1) when $\hat{d}_{i,t+1} > 0$ and will be zero otherwise. Once an individual has decided to demand credit, the second decision they make refers to the financial institution where the credit is requested. We define a dummy variable $\widehat{D}^{U}_{i,t+1}$, which takes the value of 1 if the individual chooses the Credit Union under analysis, and 0 otherwise. As before, this decision is determined by an underlying latent variable $\hat{d}^{U}_{i,t}$, which depends on some individual characteristics, $\hat{X}^{U}_{i,t}$ and the error term $\hat{\mu}^{U}_{i,t}$:

$$\hat{d}^{U}_{i,t+1} = \hat{X}^{U}_{i,t}\hat{\gamma}^{U} + \hat{\mu}^{U}_{i,t}. \qquad (4)$$

The decision on whether or not to choose the Credit Union, $\widehat{D}^{U}_{i,t+1}$, will be observed (equal to 1) when $\hat{d}^{U}_{i,t} > 0$, and 0 otherwise. Finally, the agents might face liquidity constraints bounding their desired level of debt. Thus, either the observed level of debt might be equal or less than the credit constraint, $D^{o}_{i,t} \leq \overline{D}_{i,t}$, or the desired debt might be higher than the limit imposed by the financial institution, $D_{i,t} > \overline{D}_{i,t}$. To account for this, a dummy variable of not being constrained, $\widehat{D}^{c}_{i,t}$, is defined, as well as the latent variable $\hat{d}^{c}_{i,t}$. The latter is determined by some individual characteristics $\hat{X}^{c}_{i,t}$ as follows:[18]

$$\hat{d}^{c}_{i,t+1} = \hat{X}^{c}_{i,t}\hat{\gamma}^{c} + \hat{\mu}^{c}_{i,t}. \qquad (5)$$

The existence of credit constraints $\left[\widehat{D}^{c}_{i,t} = 1\right]$ is observed when $\hat{d}^{c}_{i,t} > 0$. Note that $\hat{X}$, $\hat{X}^{U}$ and $\hat{X}^{c}$ might share some elements.

Six possible situations emerge from the realizations of the latent variables $\hat{d}_{i,t}$, $\hat{d}^{U}_{i,t}$ and $\hat{d}^{c}_{i,t}$:

$\widehat{D}_{i,t} = 1, \widehat{D}^{c}_{i,t} = 1, \widehat{D}^{U}_{i,t+1} = 1;$

$\widehat{D}_{i,t} = 1, \widehat{D}^{c}_{i,t} = 0, \widehat{D}^{U}_{i,t+1} = 1;$

$\widehat{D}_{i,t} = 1, \widehat{D}^{c}_{i,t} = 1, \widehat{D}^{U}_{i,t+1} = 0;$

$\widehat{D}_{i,t} = 1, \widehat{D}^{c}_{i,t} = 0, \widehat{D}^{U}_{i,t+1} = 0;$

$\widehat{D}_{i,t} = 0, \widehat{D}^{c}_{i,t} = 1, \widehat{D}^{U}_{i,t+1} = 0;$

$\widehat{D}_{i,t} = 0, \widehat{D}^{c}_{i,t} = 0, \widehat{D}^{U}_{i,t+1} = 0.$

[18] Apart from individuals constrained by the banks, credit unions, etc., there are people who do not even go to the financial system for consumer credit because they presume that the application would be denied. Unfortunately, we do not have explicit data on these discouraged potential customers. This is another source of self-selection within the problem at hand (see, e.g., Jappelli, 1990).

Here, the latter two are observationally equivalent as the individual is deciding not to hold any level of debt.[19] This leaves us with only five cells.

Following Cox and Jappelli (1993), consistent estimates of the consumer credit demand can be obtained from the full sample of observable customers of the Credit Union ($\widehat{D}_{i,t}^{c}$ =1, $\widehat{D}_{i,t} = 1$, $\widehat{D}_{i,t+1}^{U} = 1$) by addressing other sources of bias. Assuming that each error term in expressions (3)–(5) is normally distributed with mean equal to zero and constant variance, and also that $\sigma_{\widehat{\mu}} = \sigma_{\widehat{\mu}^U} = \sigma_{\widehat{\mu}^c} = 1$, estimates of $\hat{\gamma}$, $\hat{\gamma}^U$ and $\hat{\gamma}^c$ will be consistent. Accordingly, when considering the demand for consumer debt, the positive demand for debt, the selection of the Credit Union and the existence of credit constraints should be taken into account. This can be expressed as

$$D_{i,t+1} = X_{i,t}\gamma + \sigma\hat{\rho}\frac{\phi(\hat{d})}{\Phi(\hat{d})} + \sigma\hat{\rho}^{c}\frac{\phi(\hat{d}^{c})}{\Phi(\hat{d}^{c})} + \sigma\hat{\rho}^{U}\frac{\phi(\hat{d}^{U})}{\Phi(\hat{d}^{U})}, \qquad (6)$$

where $\hat{\rho}$, $\hat{\rho}^c$ and $\hat{\rho}^U$ are the cross-correlations between $\mu_{i,t}$ and $\hat{\mu}_{i,t}$, between $\mu_{i,t}$ and $\hat{\mu}_{i,t}^{c}$, and between $\mu_{i,t}$ and $\hat{\mu}_{i,t}^{U}$. Because $\phi(.)$ and $\Phi(.)$ are the unit normal density and distribution functions, $\phi(.)/\Phi(.)$ is the inverse of the Mill's ratio, which introduces the selection correction term (see Heckman, 1979; Maddala, 1983, chapter 6).

To obtain estimates of $\sigma\hat{\rho}$, $\sigma\hat{\rho}^c$ and $\sigma\hat{\rho}^U$, we merge data from the country's credit records (form-341) and the SISBEN, which is the system containing the demographic information of potential beneficiaries of social programmes. The merging process between the two databases was carried out by using different criteria.[20] From 1,309,393 individuals located in the relevant geographical area where the Credit Union operates (i.e., Medellin, its Metropolitan Area and some other small municipalities), 505,224 were found in the credit records.[21] This allowed us to estimate the probability that an individual with a low to middle income would demand credit for consumption purposes. Table 4 shows the estimates of this probability. Specifications in columns (1) and (2) include age, gender, educational attainment, ownership of home appliances (e.g., television, cable connection, heating, oven, etc.) and marital status, among others. The estimates suggest that the probability of requesting consumer credit is affected by whether an individual is working, the gender of the head of the household, the level of

[19] Arguably, two more cases could arise: $\widehat{D}_{i,t} = 0$, $\widehat{D}_{i,t}^{c}$ =1, $\widehat{D}_{i,t+1}^{U} = 1$; and $\widehat{D}_{i,t} = 0$ $\widehat{D}_{i,t}^{c} = 0$, $\widehat{D}_{i,t+1}^{U} = 1$. However, the decision not to hold positive debt makes the decision to hold the debt with the Credit Union irrelevant.

[20] We used 17 different matching criteria by combining identification, date of birth, names and surnames with changes in the phonetics of the names and surnames or any other typographical error.

[21] From these 505,224 people, 13,738 were found in the Credit Union and 491,486 in other financial institutions.

education, the presence of home appliances, and the household's strata.[22] In other words, the probability of requesting consumer credit increases with the economic conditions of the individual.

The outcome of the model corresponds to the estimate of the joint probability that an individual observed in the credit records and SISBEN database decides to hold a positive debt and is neither constrained nor discouraged. Thus, instead of having separate estimates for $\sigma\hat{\rho}$ and $\sigma\hat{\rho}^{c}$, in equation (6), we would have only one, $\sigma\hat{\rho}^{c\prime}$; the associated variable is $\phi(\hat{d}^{c\prime})/\Phi(\hat{d}^{c\prime})$ where $\hat{d}^{c\prime}$ is the latent variable linked to the process of a dummy variable $\widehat{D}_{i,t}^{c\prime}$ that takes the value of 1 when the individual holds a positive debt and is neither constrained nor discouraged, and 0 otherwise. The underlying latent variable, determined by some individual characteristics, $\hat{X}_{i,t}^{c\prime}$, can be expressed as

$$\hat{d}_{i,t+1}^{c\prime} = \hat{X}_{i,t}^{c\prime}\hat{\gamma}^{c\prime} + \hat{\mu}_{i,t}^{c\prime}. \qquad (7)$$

Thus, an individual holding positive debt $\left[\widehat{D}_{i,t}^{c\prime} = 1\right]$ will be observed when $\hat{d}_{i,t}^{c\prime} > 0$, and 0 otherwise. In this case, equation (6) for the demand of credit becomes[23]

$$D_{i,t+1} = X_{i,t}\gamma + \sigma\hat{\rho}^{c\prime}\frac{\phi(\hat{d}^{c\prime})}{\Phi(\hat{d}^{c\prime})} + \sigma\hat{\rho}^{U}\frac{\phi(\hat{d}^{U})}{\Phi(\hat{d}^{U})}. \qquad (8)$$

The third element on the right-hand side of equation (8), corresponds to the probability that an individual requests debt from the Credit Union under analysis.[24] The estimates of this model are reported in columns (3) and (4) of Table 4. The coefficients are very different from those of columns (1) and (2), respectively. Being retired, making contributions to the social security system, the level of education and home appliances are important determinants of the decision for holding debt at the Credit Union under analysis.

[22] Each household in Colombia is classified within six different strata depending on both the socio-economic characteristics of both the household and its neighbourhood location.

[23] Crook (2006) shows some empirical findings for the United States and Italy based on two methodologies: sample selection and disequilibrium methods. While, with the first approach, the equations for positive debt and credit constraints of the households are jointly estimated, with the second method, it is required that the credit demand be greater than the supply of credit, the former being positive (Grant, 2007). Thus, some exclusion restrictions are needed to identify the model.

[24] The exclusion restriction is people older than 60 living at home. We regard that, given that retired people are an important segment for the Credit Union, the probability of requesting credit there is affected by this variable, as it is indeed, according to the results in Table 4.

Table 4. Probability of requesting consumer credit and requesting it from the Credit Union

Variables	Requesting consumer credit		Requesting credit from the Credit Union	
	Coefficients	Marginal effects	Coefficients	Marginal effects
Age	0.004***	0.00155***	0.004***	0.000217***
	(0.000)	(0.000)	(0.000)	(0.000)
Male	0.044***	0.0163***	–0.060***	–0.00366***
	(0.003)	(0.001)	(0.009)	(0.001)
Female head of household	0.257***	0.0983***	–0.040***	–0.00240***
	(0.004)	(0.002)	(0.012)	(0.001)
Primary education	0.376***	0.139***	–0.072***	–0.00443***
	(0.003)	(0.001)	(0.009)	(0.001)
Secondary education	0.703***	0.274***	–0.133***	–0.00725***
	(0.006)	(0.002)	(0.016)	(0.001)
College/technical education	0.799***	0.310***	–0.321***	–0.0154***
	(0.006)	(0.002)	(0.017)	(0.001)
Appliances: fridge	0.186***	0.0673***	0.034*	0.00200*
	(0.005)	(0.002)	(0.019)	(0.001)
Appliances: washing machine	0.162***	0.0603***	–0.047***	–0.00289***
	(0.003)	(0.001)	(0.009)	(0.001)
Appliances: colour television	–0.079***	–0.0295***	–0.042	–0.00252
	(0.007)	(0.003)	(0.029)	(0.002)
Appliances: cable connection	–0.107***	–0.0399***	0.042***	0.00256***
	(0.003)	(0.001)	(0.009)	(0.001)
Appliances: heating	–0.087***	–0.0325***	0.055***	0.00332***
	(0.004)	(0.001)	(0.009)	(0.001)
Appliances: oven	–0.139***	–0.0518***	0.085***	0.00518***
	(0.003)	(0.001)	(0.009)	(0.001)
Appliances: air-conditioning	–0.083***	–0.0311***	0.073*	0.00445*
	(0.014)	(0.005)	(0.039)	(0.002)
Married/cohabiting	0.250***	0.0932***	–0.091***	–0.00561***
	(0.003)	(0.001)	(0.009)	(0.001)
Working	0.818***	0.298***	0.009	0.000541
	(0.004)	(0.001)	(0.016)	(0.001)
Looking for a job	0.239***	0.0920***	0.042	0.00262
	(0.008)	(0.003)	(0.032)	(0.002)
House tasks	0.145***	0.0548***	–0.225***	–0.0117***
	(0.005)	(0.002)	(0.021)	(0.001)
Retired	0.984***	0.377***	0.377***	0.0304***
	(0.007)	(0.002)	(0.020)	(0.002)
Living from rent	0.432***	0.169***	–0.119	–0.00643
	(0.045)	(0.018)	(0.159)	(0.008)
Strata 0 and 1	–0.022	–0.00827	0.072	0.00462
	(0.110)	(0.041)	(0.327)	(0.022)
Stratum 2	0.216**	0.0804**	0.027	0.00163
	(0.110)	(0.041)	(0.327)	(0.020)
Stratum 3	0.269**	0.101**	–0.069	–0.00413
	(0.110)	(0.042)	(0.327)	(0.020)
Stratum 4	0.234**	0.0904**	–0.218	–0.0107
	(0.112)	(0.044)	(0.334)	(0.013)
Contribute to health insurance	0.505***	0.186***	0.242***	0.0132***
	(0.003)	(0.001)	(0.011)	(0.001)
Homeownership	0.132***	0.0489***	–0.040***	–0.00245***
	(0.003)	(0.001)	(0.008)	(0.000)
Number of unemployed at home	0.156***	0.0580***	–0.006	–0.000384
	(0.002)	(0.001)	(0.006)	(0.000)
Adults older than 60			0.040***	0.00241***
			(0.006)	(0.000)
Constant	–1.528***		–2.497***	
	(0.114)		(0.340)	
Observations	1,309,393		505,224	
Pseudo R^2	0.212		0.046	
LR	369,953.9		6,334.1	
***p*-value LR**	0.000		0.000	

Note: Standard errors in parentheses. For dummy variables it corresponds to changes from 0 to 1. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.
Source: SISBEN, Financial Supervisory Authority and Credit Union; authors' calculations.

4. Determinants of consumer credit demand

Table 5 shows the ordinary least-squares (OLS) estimates of the determinants of consumer credit demand, including the sample selection correction term as expressed in equation (9). The analysis is restricted to the years 2009–2010 when SISBEN and demographic characteristics of people not demanding credit are available. The estimates correspond to individuals demanding credit for the first time credit from the Credit Union (i.e., the continuous line in Figure 2).[25]

The first set of columns in Table 5 [columns (1)–(4)] includes both the interest rate and the maturity of the credit. Because some collinearity might exist between the interest rate and maturity, columns (5)–(8) exclude maturity, while the last four models exclude the interest rate.

Both selection correction terms are significant in all specifications except in column (10). This suggests that they are important terms and that bias might be controlled for, or at least mitigated. The sign of the first correction term, $\sigma\hat{\rho}^{c\prime}$, suggests that there is a negative correlation between the unobservable variables for the probability of being unrestricted, discouraged and having preferences for positive credit and demand for credit. In other words, unobservable factors that reduce the demand for credit increase the probability of being unrestricted or discouraged while having preferences for positive credit. Given the significance of the coefficient, it could be the case that some individuals with low to middle income are credit-constrained. This is one of the main findings of this study.

However, the estimate of $\sigma\hat{\rho}^{U}$ indicates the existence of a positive correlation between unobservable factors that explain the probability of requesting credit from the Credit Union and the amount of debt desired. That is, unobservable factors that increase the probability of requesting credit from the Credit Union also increase the desired amount of debt.

When we include both correction terms together or individually, we do not observe sizeable changes in the estimated coefficients of the interest rate, maturity, real income and indebtedness levels (columns (1)–(4)). Some small changes are observed in other coefficients, such as gender, education and homeownership. This is the case with the other two sets of estimates (columns (5)–(8) and columns (9)–(12)).

[25] The SISBEN survey is collected every three/four years; nevertheless, there are updates, which include individuals who asked to be interviewed with the aim of being beneficiaries of different programmes.

Table 5. Determinants of consumer credit demand (first credits): 2009–2010, OLS

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Real interest rate (*r*)	–0.014***	–0.015***	–0.013**	–0.014***	–0.036***	–0.037***	–0.033***	–0.035***				
	(0.005)	(0.005)	(0.005)	(0.005)	(0.009)	(0.009)	(0.009)	(0.009)				
Maturity in months	0.042***	0.043***	0.043***	0.043***					0.043***	0.043***	0.043***	0.043***
	(0.001)	(0.001)	(0.001)	(0.001)					(0.001)	(0.001)	(0.001)	(0.001)
Log of real labour income	0.505***	0.515***	0.515***	0.520***	0.765***	0.788***	0.791***	0.803***	0.507***	0.518***	0.516***	0.522***
	(0.022)	(0.022)	(0.022)	(0.022)	(0.031)	(0.031)	(0.031)	(0.031)	(0.022)	(0.022)	(0.022)	(0.022)
Indebtedness	0.222***	0.219***	0.224***	0.221***	0.911***	0.905***	0.918***	0.912***	0.248***	0.246***	0.248***	0.246***
	(0.043)	(0.043)	(0.043)	(0.043)	(0.065)	(0.065)	(0.065)	(0.065)	(0.042)	(0.042)	(0.042)	(0.042)
Age	0.006**	0.006**	0.006**	0.007***	0.039***	0.040***	0.041***	0.041***	0.006**	0.006**	0.006**	0.006**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Age^2	–0.000	–0.000*	–0.000	–0.000*	–0.000***	–0.000***	–0.000***	–0.000***	–0.000	–0.000*	–0.000	–0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.052***	0.047***	0.048***	0.045***	0.076***	0.065***	0.067***	0.061***	0.052***	0.047***	0.049***	0.046***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.023)	(0.023)	(0.023)	(0.023)	(0.014)	(0.014)	(0.014)	(0.014)
High school	0.026	0.034*	0.034*	0.039**	0.017	0.035	0.039	0.047	0.028	0.036**	0.035*	0.040**
	(0.018)	(0.018)	(0.018)	(0.018)	(0.030)	(0.029)	(0.029)	(0.029)	(0.019)	(0.018)	(0.018)	(0.018)
Technical	0.088***	0.099***	0.102***	0.107***	0.192***	0.215***	0.228***	0.238***	0.091***	0.101***	0.104***	0.109***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.047)	(0.047)	(0.047)	(0.046)	(0.029)	(0.029)	(0.029)	(0.029)
College	0.171***	0.191***	0.189***	0.200***	0.201***	0.246***	0.247***	0.271***	0.172***	0.193***	0.188***	0.201***
	(0.041)	(0.040)	(0.040)	(0.040)	(0.062)	(0.061)	(0.061)	(0.060)	(0.041)	(0.040)	(0.040)	(0.040)
Family house	–0.037*	–0.036*	–0.037*	–0.037*	–0.182***	–0.181***	–0.183***	–0.182***	–0.036*	–0.036*	–0.037*	–0.036*
	(0.020)	(0.020)	(0.020)	(0.020)	(0.034)	(0.034)	(0.034)	(0.034)	(0.020)	(0.020)	(0.020)	(0.020)
Homeownership	0.047***	0.051***	0.050***	0.053***	0.012	0.021	0.021	0.026	0.047***	0.051***	0.051***	0.053***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.028)	(0.028)	(0.028)	(0.028)	(0.017)	(0.017)	(0.017)	(0.017)
Payment made through wage	0.013	0.009	0.013	0.010	0.150***	0.141***	0.150***	0.144***	0.020	0.016	0.020	0.017
	(0.021)	(0.021)	(0.021)	(0.021)	(0.035)	(0.035)	(0.035)	(0.035)	(0.021)	(0.021)	(0.021)	(0.021)
Mill's inverse ratio: probability of requesting credit	–0.062***	–0.043**			–0.158***	–0.115***			–0.058**	–0.038*		
	(0.022)	(0.021)			(0.037)	(0.035)			(0.023)	(0.021)		
Mill's inverse ratio: probability of requesting credit from the Credit Union	0.111***		0.079**		0.247***		0.166***		0.115***		0.085**	
	(0.039)		(0.036)		(0.060)		(0.056)		(0.039)		(0.036)	
Constant	6.318***	6.432***	6.161***	6.289***	3.042***	3.286***	2.626***	2.888***	6.006***	6.110***	5.880***	6.000***
	(0.328)	(0.328)	(0.323)	(0.319)	(0.475)	(0.472)	(0.468)	(0.458)	(0.307)	(0.307)	(0.302)	(0.299)
Control for other active people at home	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control for strata	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control for number of dependent people at home	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for labour participation conditions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,553	4,553	4,553	4,553	4,553	4,553	4,553	4,553	4,553	4,553	4,553	4,553
Adjusted R^2	0.754	0.753	0.753	0.753	0.333	0.331	0.331	0.330	0.754	0.753	0.753	0.753

Note: Standard errors in parentheses. *, ** and *** denote significance at the 10, 5 and 1 per cent levels, respectively.
Source: Credit Union; authors' calculations.

After controlling for liquidity constraints, some key variables related to the life cycle–permanent income hypothesis are still significant determinants of consumer credit demand, such the real interest rate[26] (or credit maturity), current income, age, educational attainment[27] and homeownership. Except for the interest rate, all these variables are expected to affect positively the demand for credit. In the case of the interest rate, an increase of one percentage point reduces the demand for consumer debt by 1.4 per cent, suggesting that individuals care about the credit price when demanding for it. This result contrasts with the extended belief that, in Colombia, interest rates are not considered by individuals when requesting consumer debt.

Credit maturity explains the demand for credit. This can be understood by the fact that monthly instalments become smaller as the maturity becomes longer: one additional month in the credit maturity increases the amount demanded by 4.20 per cent.

Similarly, an increase of 1.0 per cent in income increases the demand for credit by about 0.5 per cent.[28] The higher the indebtedness rate is (i.e., the proportion of current income assigned to repay debts), the higher the demand for consumer credit. This indicates that once individuals are indebted, they demand more debt to smooth out consumption. Some rationale about the sign of this coefficient might suggest that individuals could have some diffuse information about their debt limits when acquiring new debt, or that these borrowers have a higher taste for debt. Paying the credit directly through monthly payroll deductions (*libranza*), although positive, is not significant. In terms of individuals' characteristics, higher levels of education and age are also linked to a higher amount of debt demanded, as is being female.

Specifications in columns (5)–(8) exclude credit maturity while columns (9)–(12) exclude the interest rate. This is to avoid potential collinearity between them (both variables are also potentially correlated with the amount requested). With respect to the results presented in columns (1)–(4), in columns (5)–(8) we can observe numerical changes in the coefficients but not in the signs. This is the case for the interest rate, real labour income, indebtedness rate and age. Being a homeowner is not significant, while paying the debt through wage deduction does become significant. Similarly, the

[26] Unlike Cox and Jappelli (1993) and Duca and Rosenthal (1993), who used Survey of Consumer Finance information and kept the interest rate as a constant term, we can use our estimates to exploit the time variation of the interest rate.
[27] We recognize some collinearity between income and the age–education pair; however, we prefer to include both under the assumption that education and age are not the only sources of income. Income includes permanent and transitory components while education and age are mostly related to the permanent component of income.
[28] Our estimates of the supply function are comparable to those of Grant (2007) in the sense that he studies "unsecured" debt. The income elasticity he finds is 0.2.

estimate for credit maturity is robust. However, the fit of the models is rather low in contrast to the other sets of columns (1)–(4) and (9)–(12).

Even though we have found that credit maturity explains the amount of credit demanded by an individual, such an amount could also be the result of an agreement between the customer and the financial institution. If this reverse causality exists, then the OLS estimates might be biased. This would be in addition to the bias originated by unobservable factors explaining the requested amount of credit, the interest rate and the credit maturity. This could be the case when signals related to the phase of the business cycle produce simultaneous increases in the interest rate and the amount of credit requested. Such signals might also convey information about an individual's expected transitory income. If the expectations are that the economy will have a transitory but persistent expansion, then the monetary authority could increase the interest rate. In the meantime, an individual might increase demand for credit.

Thus, in some cases, a rise in the requisitions for credit could be accompanied by an increase in the interest rate or an increase in credit maturity. Hence, the unobservable term, $\varepsilon_{i,t}$, would comprise two elements, $\varepsilon_{i,t} = \nu_t + u_{it}$, where ν_t corresponds to the new information on the future phase of the business cycle and u_{it} corresponds to a well-behaved individual heterogeneity.

Table 6 reports the estimates of consumer credit demand following an instrumental variables approach. We do this to account for the endogeneity of the interest rate and the reverse causality of the loan's maturity.[29] For the 2009–2010 subsample, the inverse of the Mill's ratio becomes not significant when the interest rate is not included in the models.

Once the maturity is excluded from the models (columns (5)–(8)), most of the coefficients have the expected sign. The exceptions are homeownership and education, which become not statistically significant. Even though the fit of the models is low, the instruments are relevant, and the null hypothesis of weak instruments can be rejected. Nevertheless, for specifications in columns (1)–(4) and (9)–(12), the sets of instruments are not relevant, according to Cragg–Donald statistics.

[29] Columns (1)–(4) include as instrumental variables: the six-month lagged interbank interest rate, the economic cycle indicator and the three-month lagged indicator of the *El Niño* phenomenon. Columns (5)–(12) include as instrumental variables: the nine-month lagged interbank interest rate, the economic cycle indicator, an indicator for the presence of *El Niño* phenomenon, and the precipitation regime. The size of this lag corresponds to the time expected that the intervention interest rate can influence the market interest rate (see Becerra and Melo, 2009). The instruments are valid under the assumptions that they affect the interest rate and credit maturity without affecting, at least not directly, the amount of credit demanded.

Table 6. Determinants of consumer credit demand (first credits): 2009–2010, instrumental variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Real interest rate (*r*)	–0.038*	–0.039*	–0.036*	–0.037*	–0.045***	–0.047***	–0.043***	–0.044***				
	(0.021)	(0.021)	(0.021)	(0.020)	(0.009)	(0.009)	(0.009)	(0.009)				
Maturity in months	0.020	0.021	0.020	0.021					0.067***	0.067***	0.066***	0.067***
	(0.015)	(0.014)	(0.015)	(0.014)					(0.011)	(0.010)	(0.011)	(0.011)
Log of real labour income	0.640***	0.651***	0.658***	0.662***	0.763***	0.786***	0.790***	0.801***	0.355***	0.356***	0.361***	0.359***
	(0.094)	(0.095)	(0.098)	(0.098)	(0.031)	(0.031)	(0.031)	(0.031)	(0.070)	(0.072)	(0.077)	(0.077)
Indebtedness	0.565**	0.545**	0.566**	0.551**	0.893***	0.887***	0.900***	0.894***	–0.171	–0.176	–0.159	–0.169
	(0.250)	(0.241)	(0.249)	(0.243)	(0.065)	(0.065)	(0.065)	(0.065)	(0.185)	(0.181)	(0.194)	(0.191)
Age	0.023*	0.023**	0.025**	0.024**	0.039***	0.040***	0.041***	0.041***	–0.013	–0.014	–0.013	–0.013
	(0.012)	(0.012)	(0.012)	(0.012)	(0.004)	(0.004)	(0.004)	(0.004)	(0.009)	(0.009)	(0.009)	(0.009)
Age^2	–0.000*	–0.000*	–0.000*	–0.000*	–0.000***	–0.000***	–0.000***	–0.000***	0.000*	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.064***	0.056***	0.057***	0.052***	0.076***	0.065***	0.066***	0.060***	0.038**	0.036*	0.038**	0.036**
	(0.019)	(0.018)	(0.018)	(0.018)	(0.023)	(0.023)	(0.023)	(0.023)	(0.019)	(0.018)	(0.018)	(0.018)
High school	0.019	0.033	0.035	0.042*	0.016	0.033	0.038	0.046	0.031	0.034	0.032	0.034
	(0.023)	(0.022)	(0.022)	(0.022)	(0.030)	(0.029)	(0.029)	(0.029)	(0.023)	(0.023)	(0.022)	(0.023)
Technical	0.141***	0.156***	0.167***	0.172***	0.191***	0.213***	0.227***	0.237***	0.029	0.031	0.032	0.032
	(0.051)	(0.053)	(0.056)	(0.057)	(0.047)	(0.047)	(0.047)	(0.046)	(0.044)	(0.046)	(0.048)	(0.049)
College	0.187***	0.218***	0.220***	0.236***	0.201***	0.245***	0.248***	0.271***	0.154***	0.159***	0.156***	0.160***
	(0.049)	(0.050)	(0.051)	(0.052)	(0.062)	(0.060)	(0.061)	(0.060)	(0.051)	(0.052)	(0.052)	(0.053)
Family house	–0.114**	–0.110**	–0.114**	–0.111**	–0.182***	–0.181***	–0.183***	–0.183***	0.047	0.048	0.044	0.046
	(0.056)	(0.055)	(0.056)	(0.055)	(0.033)	(0.034)	(0.034)	(0.034)	(0.044)	(0.044)	(0.046)	(0.045)
Homeowner	0.028	0.035	0.035	0.039*	0.012	0.021	0.021	0.026	0.067***	0.068***	0.067***	0.068***
	(0.024)	(0.023)	(0.023)	(0.022)	(0.028)	(0.028)	(0.028)	(0.028)	(0.022)	(0.022)	(0.022)	(0.021)
Payment made through wage	0.079	0.070	0.078	0.072	0.145***	0.136***	0.145***	0.139***	–0.065	–0.067	–0.063	–0.066
	(0.055)	(0.052)	(0.055)	(0.053)	(0.035)	(0.035)	(0.035)	(0.035)	(0.044)	(0.043)	(0.046)	(0.044)
Mill's inverse ratio: probability of requesting credit	–0.116***	–0.084**			–0.161***	–0.118***			–0.006	0.001		
	(0.043)	(0.035)			(0.037)	(0.035)			(0.037)	(0.032)		
Mill's inverse ratio: probability of requesting credit from the Credit Union	0.180***		0.119**		0.244***		0.161***		0.033		0.032	
	(0.066)		(0.053)		(0.060)		(0.056)		(0.059)		(0.050)	
Constant	4.853***	5.096***	4.562***	4.802***	3.256***	3.496***	2.834***	3.088***	8.159***	8.212***	8.082***	8.177***
	(1.329)	(1.249)	(1.389)	(1.312)	(0.476)	(0.473)	(0.469)	(0.459)	(0.989)	(0.944)	(1.083)	(1.033)
Control for other active people at home	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control for strata	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control for number of dependent people at home	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for labour participation conditions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hansen test *p*-value	0.4730	0.5056	0.5234	0.5377	0.6950	0.7059	0.7359	0.7342	0.3744	0.3783	0.3707	0.3742
Sargan test *p*-value	0.4711	0.5038	0.5216	0.5359	0.6724	0.6829	0.7133	0.7113	0.3788	0.3821	0.3737	0.3767
Cragg–Donald Wald *F*-statistic	2.422	2.517	2.466	2.527	12.000	12.000	12.000	12.000	3.662	3.858	3.287	3.489
Stock–Yogo weak ID test critical values												
10% maximal IV size	13.43	13.43	13.43	13.43	24.58	24.58	24.58	24.58	24.58	24.58	24.58	24.58
15% maximal IV size	8.18	8.18	8.18	8.18	13.96	13.96	13.96	13.96	13.96	13.96	13.96	13.96
20% maximal IV size	6.40	6.40	6.40	6.40	10.26	10.26	10.26	10.26	10.26	10.26	10.26	10.26
25% maximal IV size	5.45	5.45	5.45	5.45	8.31	8.31	8.31	8.31	8.31	8.31	8.31	8.31
Observations	4,553	4,553	4,553	4,553	4,553	4,553	4,553	4,553	4,553	4,553	4,553	4,553
Adjusted R^2	0.635	0.643	0.637	0.643	0.333	0.331	0.330	0.329	0.614	0.611	0.622	0.615

Note: Standard errors in parentheses. *, ** and *** denote significance at the 10, 5 and 1 per cent levels, respectively. Columns (1)–(4) include as instrumental variables: six-month lag of interbank interest rate, economic cycle indicator, three-month lag of the *El Niño* phenomenon indicator. Columns (5)–(12) include: nine-month lag of interbank interest rate, economic cycle indicator, *El Niño* phenomenon indicator and the precipitation (rain) regime.

Source: Credit Union; author´s calculations.

Columns (4)–(8) and (9)–(12) do not include the individual selection correction term. As we can observe, this leads to very similar estimates to those when the correction terms are included. This suggests that the lack of data to correct for selection using data for the whole period should not prevent us from producing unbiased estimates of credit demand determinants. In Table 7, we report the estimates of our model using the whole sample and excluding the Mill's inverse ratio.

Table 7 shows the estimates using all credit requests between 2007 and 2014 with the pooled sample. The first three columns show the OLS estimates, whereas columns (4)–(6) show the two-stage least-squares (2SLS) results. In both cases, the interest rate and credit maturity are significant. However, the 2SLS estimates seem to have good properties in terms of the signs and significance of the coefficients as well as the statistics that validate the instruments.

If we ignore the potential collinearity between the interest rate and credit maturity, the specification of the consumer credit demand of column (4) is our preferred specification. In this, all the coefficients have the expected sign and sensible magnitudes. This is the case of the interest rate (–0.014), the credit maturity (0.045) and the income (0.467).[30]

An individual can demand new consumer credit either after the previous credit has been completely settled or while paying the current debt. In the latter case, part of the new credit is used to pay the outstanding amount. To consider this, we can take advantage of the panel structure of the data and we conduct two types of estimations: fixed effects (FE) and 2SLS, which appear in columns (7)–(9) and (10)–(12) of Table 7, respectively. In the FE specifications, variables linked to education are not significant, and nor is living in a family home. For the 2SLS specifications, the interest rate is not significant and neither is the individual's educational attainment. Credit maturity has a negative sign, a result that could reflect the act of repaying debt with new credit.

Thus, the evidence from Tables 6 and 7 suggests that among the determinants of the consumption credit demand remain variables linked to the life cycle–permanent income hypothesis (i.e. the real interest rate, labour income, age, level of education and homeownership).[31]

[30] The overidentification restriction is not rejected for the model of column (4); thus, in this case, the instrument set is appropriate. The results are different in the models of columns (5) and (6).
[31] As pointed out by one referee, this result could be due to unrestricted customers.

Table 7. Determinants of consumer credit demand: 2007–2014

Variables	Pooled OLS		PANEL 2SLS		FE	2SLS						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Real interest rate (*r*)	–0.014***	–0.006***		–0.014***	–0.172***		–0.025***	–0.009***		0.014	–0.046***	
	(0.001)	(0.001)		(0.003)	(0.013)		(0.001)	(0.001)		(0.012)	(0.004)	
Maturity in months	0.039***		0.039***	0.045***		0.039***	0.037***		0.037***	–0.027***		–0.018***
	(0.000)		(0.000)	(0.002)		(0.002)	(0.000)		(0.000)	(0.008)		(0.003)
Log of real labour income	0.493***	0.667***	0.493***	0.467***	0.664***	0.495***	0.284***	0.359***	0.283***	0.405***	0.358***	0.396***
	(0.004)	(0.006)	(0.004)	(0.010)	(0.005)	(0.009)	(0.012)	(0.018)	(0.012)	(0.031)	(0.018)	(0.022)
Indebtedness	0.208***	0.724***	0.207***	0.135***	0.795***	0.213***	0.193***	0.338***	0.186***	0.473***	0.377***	0.397***
	(0.007)	(0.012)	(0.007)	(0.034)	(0.011)	(0.024)	(0.010)	(0.016)	(0.010)	(0.039)	(0.016)	(0.023)
Age	0.004***	0.021***	0.004***	0.002*	0.021***	0.004***	0.041***	0.155***	0.049***	0.260***	0.137***	0.214***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.005)	(0.003)	(0.032)	(0.006)	(0.011)
Age^2	–0.000***	–0.000***	–0.000***	–0.000**	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.028***	0.050***	0.028***	0.027***	0.053***	0.029***						
	(0.003)	(0.005)	(0.003)	(0.003)	(0.004)	(0.002)						
High school	0.022***	0.022***	0.022***	0.022***	0.019***	0.022***	0.002	0.002	0.002	0.009	0.007	0.003
	(0.003)	(0.006)	(0.003)	(0.003)	(0.005)	(0.003)	(0.008)	(0.012)	(0.008)	(0.017)	(0.012)	(0.014)
Technical	0.057***	0.084***	0.057***	0.051***	0.081***	0.055***	0.004	0.024	–0.001	0.028	0.025	0.030
	(0.005)	(0.010)	(0.005)	(0.005)	(0.007)	(0.004)	(0.013)	(0.020)	(0.013)	(0.029)	(0.020)	(0.024)
College	0.112***	0.093***	0.112***	0.119***	0.090***	0.112***	0.005	0.035	0.001	0.047	0.039	0.044
	(0.007)	(0.012)	(0.007)	(0.006)	(0.009)	(0.006)	(0.019)	(0.029)	(0.019)	(0.042)	(0.030)	(0.035)
Family house	–0.042***	–0.100***	–0.042***	–0.035***	–0.102***	–0.042***	–0.002	–0.026**	–0.003	–0.046	0.003	–0.011
	(0.004)	(0.007)	(0.004)	(0.004)	(0.005)	(0.004)	(0.007)	(0.011)	(0.007)	(0.091)	(0.065)	(0.077)
Homeowner	0.035***	0.033***	0.035***	0.038***	0.034***	0.034***	0.010*	0.029***	0.010*	0.229**	0.171**	0.320***
	(0.003)	(0.006)	(0.003)	(0.003)	(0.005)	(0.003)	(0.006)	(0.009)	(0.006)	(0.101)	(0.068)	(0.078)
Payment made through wage	0.053***	0.264***	0.053***	0.026*	0.299***	0.056***	0.173***	0.443***	0.174***	–0.049***	–0.032***	–0.036***
	(0.004)	(0.006)	(0.004)	(0.014)	(0.005)	(0.010)	(0.010)	(0.015)	(0.010)	(0.016)	(0.010)	(0.013)
Constant	6.898***	5.028***	6.680***	7.158***	7.951***	6.658***	9.172***	3.613***	8.418***			
	(0.055)	(0.086)	(0.053)	(0.108)	(0.231)	(0.094)	(0.170)	(0.254)	(0.168)			
Control for other active people at home	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control for strata	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control for number of dependent people at home	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls for labour participation conditions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Control for years	Yes	Yes	Yes	Yes	Yes	Yes						
Hansen test *p*-value				0.7033	0.1805	0.9154				0.1768	0.067	0.2783
Sagan test *p*-value				0.7033	0.1802	0.9157				0.1757	0.067	0.210
Cragg–Donald Wald F-statistic				54,114	3,438.086	95,075				36,316	6,504.377	152,379
Stock–Yogo weak ID test critical values												
10% maximal IV size				16.87	19.93	22.30				16.87	19.93	22.30
Observations	210,326	210,326	210,326	180,156	188,261	203,044	210,326	210,326	210,326	139,443	139,443	154,648
R^2	0.729	0.276	0.729	0.717	0.257	0.730	0.624	0.165	0.621			
Adjusted R^2	0.729	0.276	0.729	0.717	0.257	0.730	0.624	0.165	0.621			

Note: Standard errors in parentheses. *, ** and *** denote significance at the 10, 5 and 1 per cent levels, respectively. The set of instruments used in the different models are: column (4), nine-month lag of interbank interest rate, six-month lag of indicator of the *El Niño* phenomenon, six-month lag of Economic Monitoring Indicator and six-month lag of the precipitation (rain) regime; column (5), six-month lag interbank interest rate and six-month lag of Economic Monitoring Indicator; column (6), six-month lag of Economic Monitoring Indicator, current indicator of the *El Niño* phenomenon and current precipitation regime; column (10), six-month lag of interbank interest rate, three-month lag of indicator of the *El Niño* phenomenon, six-month lag of Economic Monitoring Indicator and three-month lag of the precipitation regime; column (11), six-month lag of interbank interest rate and six-month lag of Economic Monitoring Indicator; column (12), economic cycle indicator, three-month lag of indicator of the *El Niño* phenomenon and three-month lag of the precipitation regime.
Source: Credit Union; authors' calculations.

5. Two further steps: adding constraints and considering the supply side

According to our previous findings, the general determinants of consumer credit demand fit the life cycle–permanent income hypothesis mainly for unconstrained customers. However, apart from the corrections of the previous section, customers can also be constrained when the Credit Union does not grant the exact amount requested by the customer. The financial institution might either reject the request completely[32] or grant a proportion of the original request depending on the customer's default probability.

The restrictions imposed by the Credit Union occur in two stages. In the first stage, the Credit Union decides whether the amount requested will be granted. In deciding whether to grant credit, the Credit Union uses the score computed externally by the credit *bureau*, which is inversely related to the probability that a customer's will default. To compute the score, the external rating agency uses information of an individual's credit payment history, previous debts, as well as an individual's economic activity, asset ownership and some characteristics of the credit demanded.[33] In short, the external credit score maps specific information about individuals into their probability of defaulting. In the second stage, the financial institution decides on the amount to be granted, taking the demand as a starting point.

The credit limits imposed by the Credit Union are determined by the external score, $S_{i,t}$. In this case, an individual's payment habits and credit history determine the amount of debt: $D^{o}_{i,t} \leq \overline{D}_{i,t} = F(D^{o}_{i,t-1} \leq \overline{D}_{i,t-1})$.[34] Once we include this information in the model, we have two possible cases: one case when the score received by an individual is below an optimal threshold ($\bar{S}$) and nothing is supplied, and another case when an individual receives a score above the threshold. That is,

$$\begin{cases} \overline{D}_{i,t} = 0 < D^{o}_{i,t} & \text{if} \quad S_{i,t} \leq \bar{S} \\ 0 < D^{o}_{i,t} \leq \overline{D}_{i,t} & \text{if} \quad \bar{S} < S_{i,t} \end{cases}, \tag{10}$$

where $\overline{D}_{i,t}$ represents the credit supply.

[32] These customers, whose requirements have been denied, are supposed to be captured by the selection correction in the previous estimates (Table 5 and 6) for years 2009–2010.

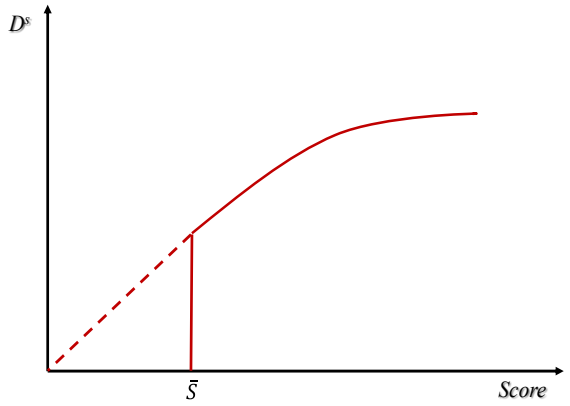
[33] The scoring-type models are classification instruments used by financial institutions to support the decision to grant credit, or not.

[34] Of course, the score depends on many other observable determinants, which are included in the model that generates such scores; however, for ease of exposition, we focus on these two main determinants of the score.

The individual's credit score takes a value between 0 and 1,000 points and it can be defined as the latent variable driving the Credit Union's decision on whether to grant credit.[35] Figure 4 shows the relationship between an individual's score and the consumer credit supplied by the institution. While the Credit Union does not offer any credit for individuals with scores below the threshold, the supply behaves as usual for individuals with scores higher than the threshold. Figures 5(a) and (b) show the density of individuals' scores for credits granted and rejected, respectively.

As can be inferred from Figure 5(a), there is an important mass of individuals' scores at 600 points. The density of the score of granted credits is, as expected, skewed to the right (the higher the score, the higher the probability of being approved). However, Figure 5(b) shows how the score density is almost uniformly distributed. Figure 5(c) compares the score distributions of rejected and granted credits.

Figure 4. Applicant's availability of resources and score



Source: Author's construction.

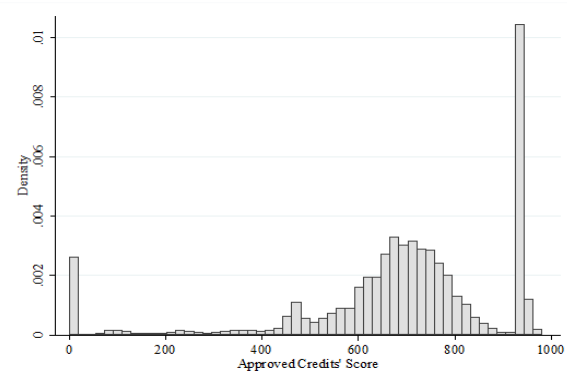
From the raw data, our estimates suggest that 7.2 per cent of customers were completely restricted (i.e., the requested credits were denied). Recall that Hall and Mishkin (1982) estimated that about 20 per cent of households are constrained, similar to the figures found by Hubbard and Judd (1986), Jappelli (1990) and Mariger (1987). However, Grant (2007) found that the proportion of constrained households was close to 30 per cent. We assume that some of the differences in the proportion of constrained households observed for developed countries, and the

[35] It is important to mention that a small percentage of individuals who are below the threshold are not exempted from receiving consumer credit in this Credit Union.

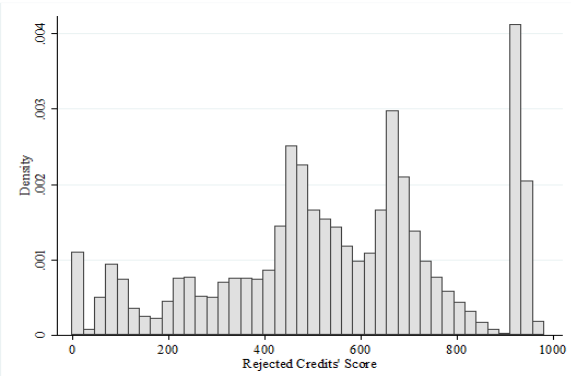
difference found in this study, are a result of the presence of discouraged individuals who do not even approach the Credit Union. Using the 1983 Survey of Consumer Finances (SCF), Jappelli (1990) estimated that discouraged borrowers composed 34 per cent of the total number of credit-constrained individuals.

Figure 5. Distribution of consumer credit scores

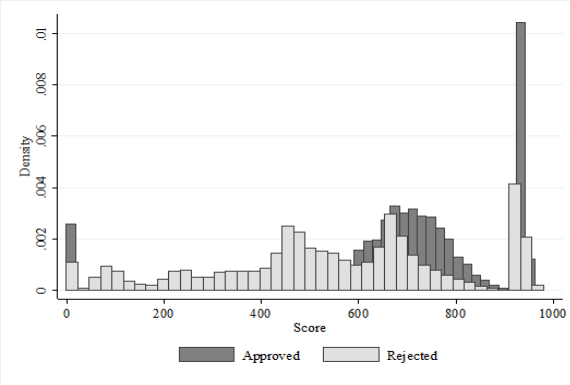
(a) Scores for granted credits



(b) Scores for rejected credits



(c) Scores for granted and rejected credits



Source: Credit Union; authors' calculations.

Table 8 reports some Credit Union outcomes by the status of the credit (rejected and granted). The preferred maturity of loans is between two and four years, followed by five years or more. The average age of a credit holder is around 49 while the average age of a rejected customer is around 39. This finding matches that of Jappelli (1990), who finds that restricted people are younger.

Table 8. Descriptive statistics of credit applications in the Credit Union: 2007:01-2014:03

Variable	All credits		Approved credits		Rejected requests		Mean difference	SD
	Mean	SD	Mean	SD	Mean	SD		
Proportion of credits with 1–24 months of maturity	0.21	0.41	0.22	0.41	0.18	0.38	–0.00***	0.000
Proportion of credits with 25–48 months of maturity	0.50	0.50	0.49	0.50	0.56	0.50	0.07***	0.004
Proportion of credits with 49 months of maturity and more	0.29	0.45	0.29	0.45	0.26	0.44	–0.03***	0.004
Log of real labour income	13.68	0.54	13.67	0.52	13.78	0.67	0.11***	0.004
Indebtedness	0.51	0.21	0.50	0.21	0.61	0.20	0.11***	0.000
Age	48.75	16.77	49.50	16.74	39.08	13.92	–10.42***	0.135
Female	0.46	0.50	0.46	0.50	0.47	0.50	0.02***	0.004
Married/cohabiting	0.51	0.50	0.52	0.50	0.32	0.46	–0.21***	0.004
Single	0.28	0.45	0.28	0.45	0.27	0.44	–0.02***	0.004
Separated/divorced	0.06	0.25	0.07	0.25	0.04	0.19	–0.03***	0.002
Widow	0.11	0.31	0.12	0.32	0.03	0.16	–0.09***	0.003
Elementary school	0.33	0.47	0.34	0.47	0.18	0.39	–0.15***	0.004
High school	0.43	0.50	0.42	0.49	0.51	0.50	0.09***	0.004
Technical	0.13	0.34	0.13	0.33	0.17	0.38	0.04***	0.003
College	0.09	0.29	0.09	0.29	0.12	0.32	0.03***	0.002
Postgraduate	0.00	0.07	0.00	0.07	0.00	0.06	–0.00	0.001
Education not reported	0.01	0.10	0.01	0.10	0.01	0.10	–0.00	0.001
Employee	0.39	0.49	0.37	0.48	0.65	0.48	0.28***	0.004
Independent worker	0.04	0.20	0.03	0.18	0.14	0.35	0.11***	0.002
Retired	0.25	0.43	0.26	0.44	0.13	0.33	–0.13***	0.004
Other	0.32	0.47	0.34	0.47	0.08	0.27	–0.26***	0.004
Open ended contract	0.27	0.44	0.26	0.44	0.45	0.50	0.20***	0.004
Fixed-term labour contract	0.09	0.29	0.09	0.29	0.14	0.35	0.05***	0.002
Learning contract	0.00	0.01	0.00	0.01	0.00	0.02	0.00***	0.000
Contract by association	0.01	0.11	0.01	0.11	0.01	0.11	0.00	0.001
Temporal contract	0.00	0.05	0.00	0.05	0.00	0.06	0.00**	0.000
For tasks	0.01	0.12	0.01	0.11	0.04	0.20	0.03***	0.001
No contract – independent	0.61	0.49	0.63	0.48	0.35	0.48	–0.28***	0.004
Strata 1	0.19	0.39	0.18	0.39	0.20	0.40	0.01***	0.003
Strata 2	0.28	0.45	0.28	0.45	0.26	0.44	–0.03***	0.004
Strata 3	0.45	0.50	0.45	0.50	0.45	0.50	–0.00	0.004
Strata 4–6	0.07	0.26	0.07	0.26	0.09	0.29	0.02***	0.002
Strata not reported	0.01	0.10	0.01	0.10	0.01	0.10	–0.00	0.001
Family house	0.17	0.38	0.18	0.38	0.12	0.33	–0.05***	0.003
Homeowner	0.50	0.50	0.52	0.50	0.24	0.43	–0.28***	0.004
Rented	0.30	0.46	0.30	0.46	0.29	0.45	–0.01**	0.004
Another type of house	0.04	0.18	0.01	0.10	0.35	0.48	0.34***	0.001
Active people at home: 1	0.35	0.48	0.36	0.48	0.30	0.46	–0.05***	0.004
Active people at home: 2	0.43	0.49	0.43	0.49	0.46	0.50	0.04***	0.004
Active people at home: 3	0.15	0.36	0.15	0.36	0.16	0.37	0.01***	0.003
Active people at home: 4	0.05	0.21	0.05	0.21	0.05	0.22	0.00	0.002
Active people at home: 5 or more	0.01	0.11	0.01	0.11	0.01	0.12	0.00**	0.001
Number of dependent people at home: 1	0.31	0.46	0.31	0.46	0.31	0.46	0.01*	0.004
Number of dependent people at home: 2	0.21	0.41	0.21	0.41	0.20	0.40	–0.01**	0.003
Number of dependent people at home: 3	0.11	0.31	0.11	0.32	0.09	0.28	–0.02***	0.003
Number of dependent people at home: 4	0.04	0.20	0.04	0.21	0.03	0.17	–0.01***	0.002
Number of dependent people at home: 5 or more	0.01	0.09	0.01	0.09	0.00	0.07	–0.00***	0.001
Payment through deductions from monthly payroll	0.69	0.46	0.74	0.44	0.14	0.34	–0.60***	0.004
Observations	222,977		206,874		16,103			

Source: Credit Union; authors' calculations.

It can be inferred from the table that the economic conditions of people demanding credit are quite homogeneous. More than 90 per cent of the credits are requested by people living in strata 1, 2 and 3, with monthly earnings of less than COP $1,000,000 (US $500). Among approved customers, 52 per cent are homeowners, while among rejected customers this figure is only about 24 per cent. 74 per cent of approved credits are repaid through monthly wage. In the case of rejected applications, this proportion is only 14 per cent. This supports the idea that even in the case of unsecured credits (not collateralized), the Credit Union prefers credit holders with characteristics related to the possibility of repayment. An important finding is that people with rejected applications allocate, on average a high proportion of their income (61 per cent) to repay current debts, while customers with approved applications allocate, on average half of their monthly income to this.

First, we identify liquidity-constrained individuals when their application has been rejected (denied) by the Credit Union. Then, we estimate the probability that the Credit Union will grant the entire requested amount.

With respect to the decision of whether to grant a credit (see Table 9), the evidence suggests that the credit score is an important determinant. Additional variables, such as income, payment through monthly payroll deduction and indebtedness rate, are also significant and have the expected sign. In other words, the Credit Union does not allow the restricted borrowers to completely smooth out consumption. This finding goes against the life cycle–permanent income hypothesis and is one of the most important results of this paper. Note that we differ from many others (e.g., Grant, 2007) who use demographic and socio-economic characteristics to provide evidence for the probability of being restricted. Rather, we use the variable that the Credit Union employs to make this decision, which is the individual's score that is not included in most previous studies.

As we have stated, an individual who has been approved for credit might have the requested amount restricted. The Credit Union uses additional information, such as indebtedness and internal score, to decide the amount to be disbursed.[36]

[36] The internal score, which corresponds to a risk grade of the individual, is built by the Credit Union by looking at the individual's performance with regards to all their outstanding debts in the financial market. Because information is needed across the financial system, the internal score is understood as the "alignment" of the agent with the system.

Table 9. Probability of being approved (marginal effects of a probit model): 2007–2014

Variable	Model 1	Model 2
Score	0.058***	0.030***
	(0.001)	(0.001)
Income	0.006***	0.002***
	(0.001)	(0.000)
Payment from the monthly wage	0.179***	0.138***
	(0.002)	(0.002)
Indebtedness		–0.014***
		(0.001)
Fixed time effects	Yes	Yes
Observations	212,262	202.026
Adjusted R^2	0.280	0.273

Note: Standard errors in parentheses. *, ** and *** denote significance at the 10, 5 and 1 per cent levels, respectively.
Source: Credit Union; authors' calculations.

It is important to mention that the amount disbursed by the Credit Union takes into account that customers must leave a deposit of, at least, 10 per cent of the amount approved in a saving account at the Credit Union. This is another way of restricting the amount of credit and, of course, a difference that is higher than 10 per cent between the amounts requested and granted might be indicative of further restrictions. This situation might reflect the presence of borrowers who are regarded as high-risk customers.

Before discussing the results of this trimming-down process, it is important to mention that some customers who have an outstanding debt are interested in new credit in order to repay the current debt and enjoy newer resources. In such cases, the difference between the amount requested and the amount granted might be less than 10 per cent. The whole difference is modelled as a function of an individual's indebtedness, payment through the payroll (*libranza*), an individual's income and the internal credit grade (internal score) awarded by the Credit Union for this credit request.

The estimates of these differences are shown in Table 10. The evidence suggests that an individual's indebtedness rate is an important determinant of the credit limit. Thus, the higher the level of indebtedness, the higher the difference between the amount requested and the amount disbursed. The coefficient for the income of individuals is negative and significant for granted credits (column (1)), and is smaller in magnitude for those with a difference of less than 10 per cent (column (2)). The higher the income of the customer, the smaller the difference between the amount requested and the amount disbursed. Something similar occurs with the grade of

individuals, a variable computed internally by the Credit Union. An interesting result comes from the method used to repay the debt. When this is done through the monthly payroll, the restriction is even higher – a result than seems counterintuitive as this way of repayment seems to be safer. Nevertheless, Tables 9 and 10 collect all the information that the Credit Union uses to implement what we call credit restrictions.

Table 10. Determinants of the difference between amounts requested and disbursed

Variable	Any difference between the requested and disbursed amounts	Credits with differences between 0% and 9.99%
	(1)	(2)
Level of indebtedness	0.048***	0.005***
	(0.004)	(0.000)
Income	–0.030***	–0.001***
	(0.001)	(0.000)
(Internal score) Grade "excellent"	–0.052***	–0.001*
	(0.008))	(0.000)
(Internal score) Grade "good"	–0.126***	–0.002***
	(0.009)	(0.000)
Payment from the labour income	0.164***	0.018***
	(0.009)	(0.000)
Constant	0.523***	0.024***
	(0.021)	(0.001)
Year fixed effects	Yes	Yes
Interaction between grade and payment from the labour income	Yes	Yes
Observations	199,139	98,845
Adjusted R^2	0.153	0.457

Source: Credit Union; *Banco de la República*; authors' calculations.

Using the information provided by the Credit Union, we can construct, for each individual, the amount effectively supplied. That is, we use information about actually granted resources (including zeroes, for those whose request was completely denied). Once we introduce these restrictions into our empirical model (9), we end up with a specification for the credit supply. Table 11 reports the OLS and Tobit estimates corresponding to equation (9). The latter approach allows us to account for selectivity bias. This is the same model as in equation (9) but instead of predicting the requested amount, it predicts the amount disbursed.

Table 11. Determinants of consumer supply: 2007–2014

Variable	OLS			Tobit		
	(1)	(2)	(3)	(4)	(5)	(6)
Real interest rate	0.028***	0.037***		0.041***	0.051***	
	(0.003)	(0.004)		(0.004)	(0.004)	
Maturity in months	0.035***		0.035***	0.036***		0.036***
	(0.001)		(0.001)	(0.001)		(0.001)
Log of real labour income	0.172***	0.328***	0.171***	0.173***	0.330***	0.172***
	(0.020)	(0.020)	(0.020)	(0.021)	(0.021)	(0.021)
Indebtedness rate	–1.477***	–1.031***	–1.479***	–1.481***	–1.026***	–1.484***
	(0.035)	(0.034)	(0.035)	(0.036)	(0.035)	(0.036)
Score	0.377***	0.383***	0.374***	0.466***	0.471***	0.462***
	(0.022)	(0.023)	(0.022)	(0.026)	(0.026)	(0.026)
(Internal score) Grade “excellent”	1.162***	1.055***	1.166***	1.252***	1.135***	1.260***
	(0.034)	(0.035)	(0.034)	(0.038)	(0.039)	(0.038)
(Internal score) Grade “good”	0.559***	0.432***	0.561***	0.638***	0.496***	0.642***
	(0.037)	(0.037)	(0.037)	(0.041)	(0.042)	(0.041)
Age	0.036***	0.048***	0.036***	0.038***	0.051***	0.038***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Age^2	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***	–0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	0.043***	0.061***	0.043***	0.041***	0.061***	0.042***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)
High school	0.122***	0.117***	0.121***	0.126***	0.121***	0.125***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)	(0.014)
Technical	0.285***	0.307***	0.284***	0.298***	0.321***	0.298***
	(0.024)	(0.025)	(0.024)	(0.026)	(0.027)	(0.026)
College	0.423***	0.415***	0.422***	0.439***	0.430***	0.438***
	(0.031)	(0.032)	(0.031)	(0.033)	(0.034)	(0.033)
Postgraduate	0.890***	0.819***	0.889***	0.923***	0.850***	0.921***
	(0.095)	(0.097)	(0.095)	(0.098)	(0.101)	(0.098)
Family house	–0.049***	–0.101***	–0.049***	–0.050***	–0.103***	–0.050***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)	(0.017)
Homeowner	0.128***	0.130***	0.128***	0.119***	0.121***	0.119***
	(0.015)	(0.015)	(0.015)	(0.016)	(0.016)	(0.016)
Payment made through wage (payroll deduction)	0.990***	1.104***	0.990***	1.047***	1.164***	1.047***
	(0.017)	(0.017)	(0.017)	(0.019)	(0.019)	(0.019)
Restricted/refill	–2.118***	–1.764***	–2.119***	–2.169***	–1.805***	–2.170***
	(0.016)	(0.016)	(0.016)	(0.018)	(0.017)	(0.018)
Constant	8.058***	6.456***	8.509***	7.399***	5.812***	8.064***
	(0.302)	(0.305)	(0.298)	(0.330)	(0.334)	(0.325)
Variance				5.677***	5.960***	5.679***
				(0.062)	(0.062)	(0.062)
Control for other active people at home	Yes	Yes	Yes	Yes	Yes	Yes
Control for strata	Yes	Yes	Yes	Yes	Yes	Yes
Control for number of dependent people at home	Yes	Yes	Yes	Yes	Yes	Yes
Controls for labour participation conditions	Yes	Yes	Yes	Yes	Yes	Yes
Controls for year	Yes	Yes	Yes	Yes	Yes	Yes
Observations	202,026	202,026	202,026	202,026	202,026	202,026
Censured observations				11,258	11,258	11,258
Adjusted R^2	0.571	0.550	0.571			
PseudoR^2				0.1713	0.1628	0.1713

Note: Standard errors in parentheses. *, **, and *** correspond to 10%, 5.0% and 1.0% level of significance, respectively.
Source: Credit Union; authors’ calculations.

The estimates suggest that the higher the interest rate, the higher the supply of credit. Similarly, the credit supply increases with the score, age, educational attainment, homeownership and repayment through the monthly payroll. More revealing are the sign and coefficient of the indebtedness rate. This variable and the interest rate now have opposite signs with respect to the signs observed in Tables 5–7. Finally, Table 11 provides evidence that OLS models underestimate the effects of the interest rate and score. The bottom line is that this revision of data from the Credit Union has allowed us to specify both the demand and supply of consumer credit.

6. Conclusions

We estimate the determinants of consumer credit using microdata from the Credit Union between 2007 and 2014, accounting for credit constraints. This is the first study using this type of data in Colombia and Latin America.

The richness of the data allows us to observe some features of the credit, such as the interest rate, credit maturity, individual's indebtedness rate, (internal and external) scores assigned by the Credit Union to credit applicants, and the demographic characteristic of borrowers. The internal score is the result of payment habits and performance regarding all outstanding debts that individuals have in the financial market. The information is quite homogeneous in terms of the customers and final use of the credit (consumption).

The number of observations (over 220,000) gives robustness to the results and provides evidence about liquidity constraints in different ways. First, we control for people who do not show any preference for having a positive debt or who are credit-constrained. Then, after introducing these Heckman-type corrections, we estimate the consumer's demand for credit. The results provide evidence that variables linked to the life cycle–permanent income hypothesis are important determinants of consumer credit demand. That is, the real interest rate, the credit maturity, current income, educational attainment, homeownership and age, among other variables, determine the demand for consumer credit. The elasticity of current income is between 0.3 and 0.5, while the semi-elasticity of the real interest rate is around –1.4 per cent. The semi-elasticity of credit maturity is between 0.03 and 0.05. Individuals with higher educational attainment demand more consumer credit, as do those who are homeowners.

A highly robust result is the one related to the indebtedness rates of individuals. A higher proportion of monthly income allocated to pay previous debts increases the demand for credit, a result that should be of interest to the industry and authorities.

In this study, we also analyse the determinants of credit restrictions imposed by the Credit Union that take place in, at least, two stages. In the first stage, the financial institution uses the (external) score and other variables, such as income, repayment method and indebtedness rate, to determine which applications are rejected and which are accepted. All these variables are significant. In the second stage, the credit constraints occur when the Credit Union decides to trim down the amount of some requested credits, after considering the indebtedness rate of the customer and other indicators, such as the internal score or grade. The results allow us to conclude that liquidity constraints do exist in Colombia if the Credit Union follows common practices. Interestingly, once the scores are considered in the specification, the model becomes a credit supply model.

In terms of policy implications, with knowledge of the sensitivity of consumer credit to the interest rate, it is possible to affect the consumer credit demand by the monetary authority. Similarly, macro prudential policies used to affect the way in which financial entities compute an individual's scores could also be used to deal with any abnormal behaviour of consumer credit in periods where uncertainty about the future behaviour of fundamentals increases.

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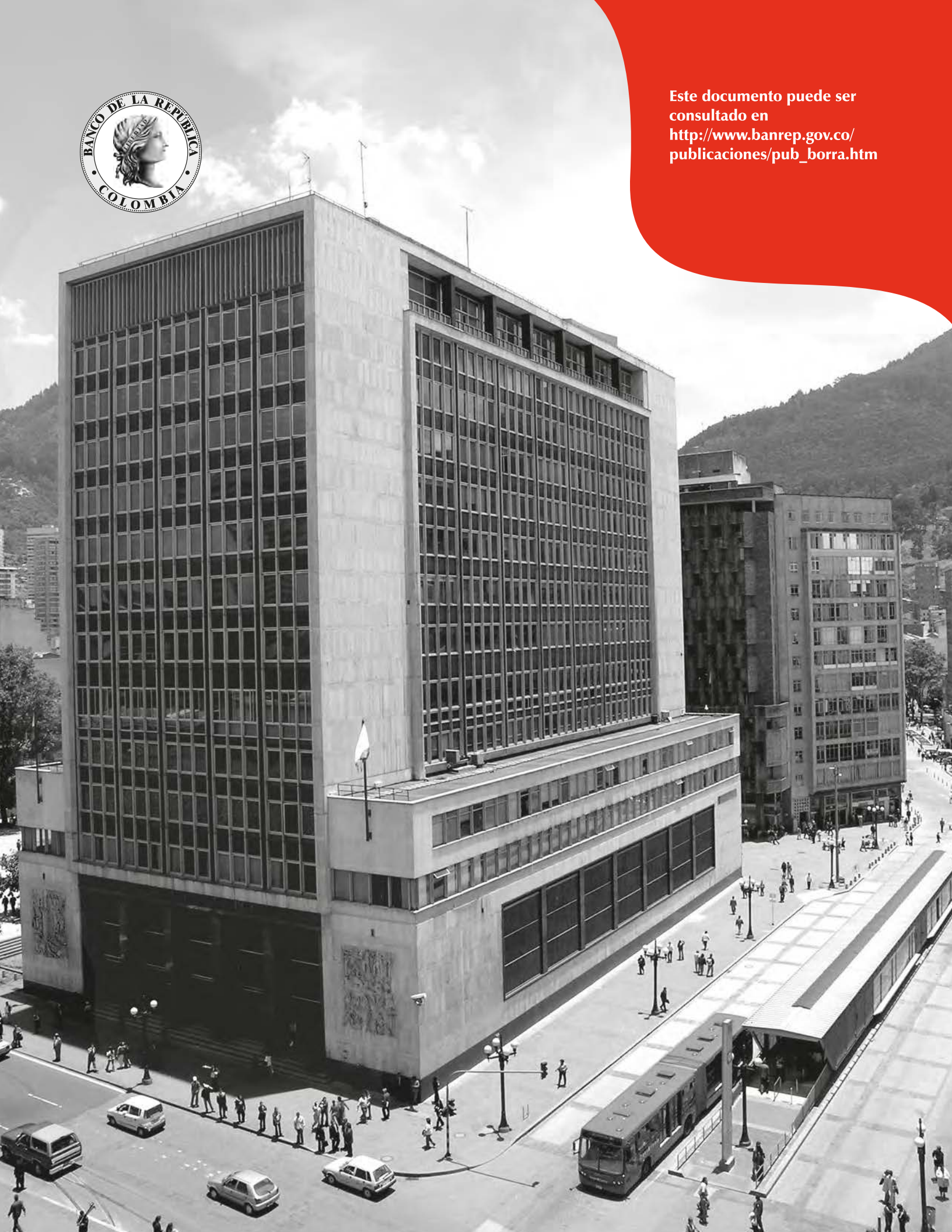

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