

Determinants of consumer credit within a debt constrained framework. Evidence from microdata

By

Luis E. Arango
Banco de la República

Lina Cardona-Sosa*
Banco de la República

Abstract

Determinants of consumer credit are estimated by using information from a Credit Union located in Medellín-Colombia. To the best of our knowledge, this is the first investigation using this kind of data in Colombia. We find that life cycle-permanent income hypothesis (LC-PIH) related variables are the main determinants of demand for consumer debt. The current income elasticity is about 0.5% while the real interest rate semi-elasticity is around -2%. Being a homeowner and having college education (undergraduate and postgraduate) increases the demand for debt. Once we consider the credit limits and other credit supply related variables, such as the score assigned to each credit application, the determinants of the consumer credit are also estimated. In this case, the statistical significance of the determinants remains with the exception of house ownership. Thus, LC-PIH variables are determinants of credit demand and the consumer credit regardless of credit restrictions. Nevertheless, in the latter case the semi-elasticity of the interest rate and the current income elasticities turn to -0.56% and 0.37%, respectively. Sample selection and endogeneity issues are also addressed.

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

* The opinions expressed here are not necessarily those of neither the Banco de la República nor its Board of Directors. We are grateful with the manager, officials and representatives of the Credit Union for providing us with the data and explaining all the contents of the information. Comments and suggestions of the Credit Union's staff are also appreciated. The authors also acknowledge comments and suggestions of David Pérez and the assistants to the 2015 LASA Congress that took place in San Juan-Puerto Rico, the IDB seminar "Household Debt in Latin American" held in Santiago-Chile, July 1-2, 2015 and the seminars at Universidad Javeriana and Banco de la República in Bogotá and Medellín-branch.

The authors are, respectively, senior researcher of the Research Unit (larangth@banrep.gov.co) and researcher of the Regional Unit of Economic Studies in Medellín (lcardoso@banrep.gov.co). Corresponding author: Luis E. Arango, phone + 57 1 3430676; Carrera 7 No. 14-78, Banco de la República, Bogotá - Colombia.

1. Introduction

The behavior, determinants and consequences of consumer credit have been extensively studied by economists. Danielian (1927) focused on welfare implications of consumer credit while Westerfield (1938) studied its relationship with the business cycle and Mors (1944), described the concept of consumer credit in depth. Bouveng (1966), on the other hand, analyzed the connection between consumer credit and new products, economic growth and development.

More recently, research questions have included the relevance of the business cycle (Correa, Marins, Neves and Silva, 2011), the effect of interest rates (Alessie, Hochguertel and Weber, 2005)¹, precautionary saving, the role of assets and human capital, and so on. However, since the publication of the stochastic version of the life cycle-permanent income hypothesis² (Hall, 1978), borrowing constraints have been one of the most crucial aspect of the consumer credit given the enormous content related to household's consumption behavior (see, for example, Ludvigson, 1999; Crook, 2006; Attanasio, et al., 2008.)³

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

One of the purposes of this paper is to establish the determinants of the demand of consumer credit and, once we allow for supply considerations, to analyze the determinants of the consumer credit in equilibrium. The approach we use to study the determinants of consumer debt is close to Grant's (2007), except for the type of information used. Rather than using survey data (as did Cox and Japelli, 1993; Magri, 2002 and 2007, among many others), we make use of a data set provided by a Credit Union that supplies mainly, but not exclusively, consumer credits through their agencies in Medellín, the second largest city in Colombia, and ten more municipalities located in the surrounding area.

The data we use contains information for 222,977 credits requested by 103,965 different individuals between July 2007 and March 2014 on a monthly frequency. During this period, the institution granted around 206,143 loans, each of them for COP\$6.8 million (US\$ 3,400) on average in real terms (prices of December 2012). The share of the credit provided by this Credit Union in the Colombian consumer credit is about 0.5%. The dataset includes information on the credit amount, the interest rate for each credit, the credit maturity, the amount of installments and the way in which these are paid each month (either by means of a debit operation or direct discount from the monthly salary). It also contains individual characteristics of customers such as age, education, current income, marital status, and so on.

The database also contains the score; that is, the number assigned by the Credit Union to each individual that demands credit. This individual variable is built by the Credit Union who rates

¹ They explicitly state how monetary policy relies significantly on changes in the interest rate to affect aggregate demand. Certainly, in Colombia the behavior of consumer credit is one of the most important variables for monetary authority.

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 The volume of Bertola, Disney and Grant (2006) surveys recent contributions on this area and compiles new studies.

information provided by two private agencies based on payment habits and credit history of each person as well as demographic characteristics and other economic information. If the score of an individual who is applying for credit is greater than the threshold established by the Credit Union, the credit is granted; otherwise the credit amount requested is reduced or, even, completely denied⁴. The score plays the role of the latent variable that allows the Credit Union to decide whether or not to grant a credit. We will use it that way. Thus, this variable allows us to deal directly with credit restrictions. We define a household as credit-constrained one if their application for a loan is rejected or if the amount of the credit available for him or her is trimmed down by the financial institution.

The criteria used by the Credit Union to classify an active operation as a “consumer credit” is consistent with the definition given by the Financial Superintendence (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.⁵

To estimate the determinants of consumer credit demand, first, we invoke the life cycle - permanent income hypothesis. Thus, among the explanatory variables are: the level of education, the amount of assets⁶, the real interest rate, the current income, etc. The determinants of credit demand are estimated for all the consumer credit applicants regardless of whether the loan was granted or not.

The empirical analysis is based on OLS regressions (pooled data) in which we disregard the endogeneity of real interest rate (as well as the amount of installments and the credit term), any possible correlation of this variable and the error term, and the self-selection of people included into the sample (individuals demanding consumer credits at that particular Credit Union). Thus, we estimate the joint probability of approaching to that Credit Union by using information of the population in the same area in which this financial institution operates, as it will be explained below.

To account for the endogeneity of the interest rate and credit maturity, we instrument them using the interbank interest rate as proxy of the monetary policy intervention rate which defines the stance of monetary policy and the dates (years) of the sample. The results suggest a negative effect of the real interest rate on the consumer credit demand and positive effects of education, current income and being a homeowner.

As we mentioned above, the lender also has indicators for each individual who asks for a loan, such as the score, which is a variable used by the Credit Union to decide whether the credit will be approved or not in the amount requested by the consumer. Additional variables such as cash availability and solvency of the Credit Union also affect the supply of loans; however, our analysis focuses only on the score to reassess the determinants of consumer credit.

We also introduce additional factors, which allow us to study consumer credit, not only the demand for consumer credit. The key element of this step is the availability of a new dependent variable: the amounts disbursed instead of amounts requested which correspond to the demand. Otherwise, the model is the same. The conjunction of demand and supply of credit allows us to estimate the determinants of consumer credit in Medellín and the surrounding area, one of the most

⁴ It is important to mention that a small percentage of individuals who are below the threshold are not exempted of receiving a consumer credit in this Credit Union.

⁵ See chapter II of the external normative 100 of 1995 issued by the Financial Supervisory Authority.

⁶ In this case, they are proxied by the property of a house; in this sense, we measure the “house effect”.

important regions in Colombia. The main conclusions from the sign and magnitude of the main variables used remain similar to the credit demand results.

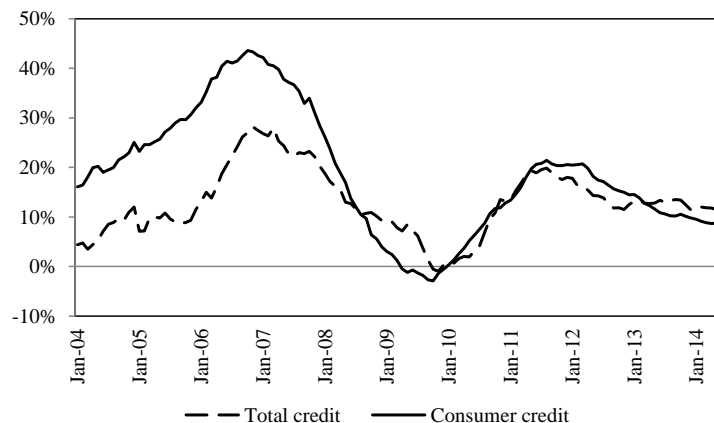
From our point of view, this document has a number of advantages and contributes to the understanding of the determinants of consumer credit in Colombia. First, it contains not only individual's demographic information but also credit information such as the interest rate, maturity, and score. Second, it is quite homogeneous in terms of its final use, given that they meet the definition of consumer credit stated by the Financial Supervisory Authority in Colombia. In addition, the number of entries (over 200,000) gives robustness to the results, which, to a great extent, support the life cycle - permanent income hypothesis even after controlling for credit constraints. Finally, the paper deals with the different sources of biases specific to this kind of analysis.

The paper is organized as follows. The first section is this Introduction. The second shows some facts about consumer credit in Colombia and the Credit Union to motivate this investigation. The third section sketches the theoretical approach that guides the interpretation of the results. Section four describes the data, discusses the empirical approach and shows the results while the last section draws some conclusions.

2. Some behavioral facts

The consumer debt to the Colombian financial system as a whole during the past ten years has behaved in a way that suggests that some of its determinants have also experienced variations. According to Figure 1, between 2004 and 2008 the annual growth rate of this type of credit exceeded the annual growth rate of total credit. After the slowdown of the economy occurred between January 2008 and March 2009 (for this chronology see Alfonso et al. 2013; Arango and Cardona-Sosa, 2015), the annual variation of each of the two variables has been close to each other. Nevertheless, none of them have had the same behavior as before the downturn of the economy since 2008.

Figure 1. Annual growth rate of credit. 2001-2014



Source: Financial Superintendence; authors' calculations.

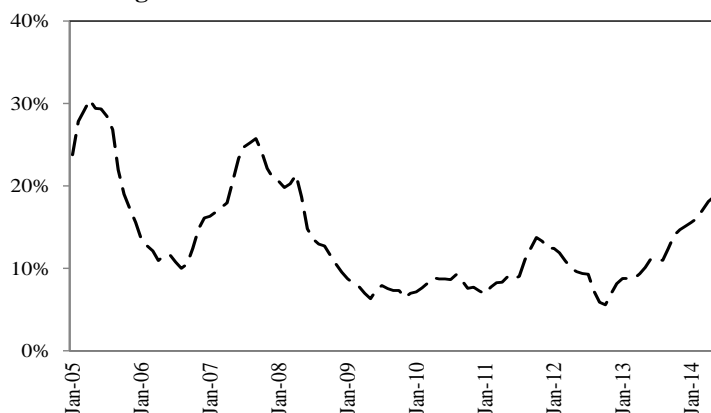
Figure 2, on the other hand, shows that consumer credit of the Credit Union had an annual growth rate between 10% and 30% before the 2008 crisis. After that, the annual variation rate has

remained between 6% and 13%; nevertheless, since October 2012 it started to increase until it reached a variation of 19% at the end of the sample period. These changes of consumer credit growth should be explained by the determinants of both demand and supply of credit that we submit to scrutiny below.

During the sample period, the Credit Union received about 222,977 applications for consumer credit of which it granted about 206,143 loans, not all of them for the requested amount. These loans were granted to 103,965 customers that surpassed the minimum punctuation (threshold) established according to the score computed by the financial institution (the lender) following its own mechanisms to assign the resources. Some customers have obtained more than one loan during the sample period. Thus, given the structure of the data, we can exploit not only the crossed section structure of the data but also the panel one.

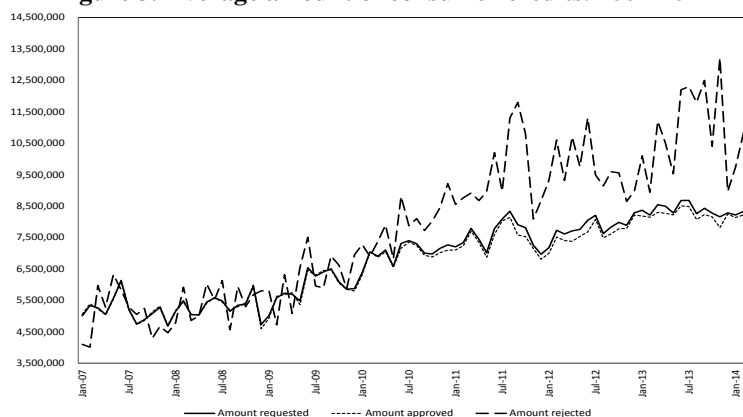
Following Figure 3, the average amount of consumer credit has increased in the last years, reaching the COP\$8.6 million at the end of the period. The difference between the amount requested and the amount disbursed is evident in the figure: the granted and rejected amounts are higher on average than the credit amount for those that were approved.

Figure 2. Annual growth rate of consumer credit of the Credit Union. 2005-2014



Source: Credit Union; authors' calculations.

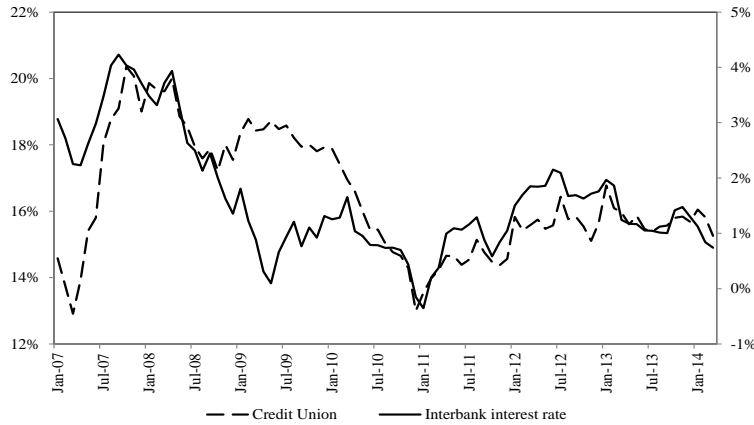
Figure 3. Average amount of consumer credits. 2007-2014



Source: Credit Union; authors' calculations.

Figure 4 shows the real interest rate charged by the Credit Union as well as the interbank real interest rate (which is also the variable used as a proxy for the intervention policy rate and one of the instruments used to deal with the endogeneity problems). Both of them have had movements over the sample period. However, since 2010 these changes are quite close to each other, even though the difference is over 13 percentage points. The bottom line of these pictures is that consumer credit of the Credit Union has had some movements which deserve some explanations oriented by economic theory. This is what we do in next section.

Figure 4. Effective real interest rate on loans charged by Credit Union and Interbank real interest rate. 2007-2014



Note: the interest rate of the Credit Union is measured on the left hand axis; the interbank rate (the proxy of the intervention interest rate) is measured in the right hand side. Source: Credit Union, Banco de la República; authors' calculations.

3. Theoretical approach

An agent's debt holding is consistent with the life cycle-permanent income (LC-PIH) approach. In this context, the maximization of the lifetime utility function of a household subject to an intertemporal budget constraint, determines the demand for consumer debt which also depends on the rate of time preference and the intertemporal elasticity of substitution, the current assets of the household, the present value of expected future income, and the interest rate at which the market allows the intertemporal transference of resources. Accordingly, saving (or borrowing) is determined by the difference between permanent income and optimal consumption. As it is customary, to determine consumption of person i at time t , $c_{i,t}$, and leisure, $l_{i,t}$, each period, we could assume that the individual maximizes expected life-time utility with time-separable preferences as follows:

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

subject to:

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

where $E_{i,t}$ represents the expectations operator conditional on the information set available for the individual i at period t , β_i is the discount factor while $D_{i,t}$ accounts for the agent's debt. $r_{i,t}$, is the

real interest rate, $x_{i,t}$ is the non-labor income and w_t is the real wage. The first order conditions of this problem corresponds to: $u'_c(c_{i,t}, l_{i,t}) = u'_l(c_{i,t}, l_{i,t})/w_t$, and $u'_c(c_{i,t}, l_{i,t}) = \beta_i E_{i,t} u'_c(c_{i,t+1}, l_{i,t+1})(1 + r_{i,t+1})$.

After some algebra manipulation we obtain the intertemporal budget constraint,

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

By assuming that interest rate is constant and allowing T to go to infinite, this expression can be written as:

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

In equilibrium, $(1 + r_i)\beta_i=1$, consumption is given by:⁷

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

After rearranging terms from the previous expression, the individual's contemporary debt can be computed as:

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

Nevertheless, the life-cycle model yields this solution only under very restrictive circumstances; for instance, when the agent faces no credit limits or when the borrowing and lending interest rates are equal. Thus, it is also convenient to consider the case in which some credit limit arises. Attanasio, et al. (2008) use a theoretical framework backed in the first order condition of a standard life-cycle intertemporal optimization problem to advance some intuition on the demand for credit in the presence of liquidity constraints. Such a situation corresponds to two definitions. While the first one, refers to the case in which an individual cannot borrow as much as he/she wants to finance current consumption using future earnings or income; under the second definition, an individual is liquidity constrained if the interest rate at which she/he can borrow resources from the market is greater than the interest rate at which she/he can lend.⁸ On the other hand, households who are not liquidity constrained will find it optimal to never finance consumer goods so that they will never exhibit sensitivity to neither the credit maturity nor to the interest rate; however, another group, also not constrained will find it optimal to finance so that they will exhibit high sensitivity to the interest rate but low sensitivity to the maturity of the loans. Another common definition (see Crook, 2006 and the references therein) identifies an agent as credit-constrained if she/he is either precluded or prevented from applying for a credit.

Given the previous consideration about credit constraints, a closed form solution for consumption is not straightforward; however, we can still use the first-order condition of the optimization problem (Hayashi, 1985). Moreover, the introduction of credit constraints compels us to work with the Euler equation.⁹

⁷ On empirical grounds, the propensity to consume derived from this expression has been controversial (see Carroll, 2001).

⁸ In this sense, Pissarides (1978) links liquidity constraints with the transaction costs. Assets are liquid if transaction costs are zero in the current period.

⁹ Under certain conditions, this approach requires that consumption growth be unpredictable with information available at time t (Hall 1978; Magri, 2002).

As previously stated, we define a household as credit constrained if its application for a loan is rejected or the amount of the credit available for she/he is diminished by the Credit Union; that is, the demand for debt is positive and greater than the supply, being the latter non-negative. Thus, we assume, as an indicative theoretical framework, that there is an upper borrowing limit ($\bar{D}_{i,t}$) which is not only correlated with the difference between current and future income as in equation (1) above, but also with payment habits, recent credit history performance and other personal characteristics of the consumer. That is,

$$D_{i,t} \leq \bar{D}_{i,t} = F(D_{i,t-1} \leq \bar{D}_{i,t-1})$$

Following Ludvigson (1999), we define:

$$C_{i,t} \equiv \bar{D}_{i,t+1} - (1 + r_{i,t})D_{i,t} + [w_t(1 - l_{i,t}) + x_{i,t}],$$

so that the Euler equation of the life cycle intertemporal model can be written as:

$$u'_c(c_{i,t}, l_{i,t}) = \max[u'_c(C_{i,t+1}, l_{i,t+1}), \beta_i E_{i,t} u'_c(c_{i,t+1}, l_{i,t+1})(1 + r_{i,t+1})]$$

which explicitly includes the credit ceiling imposed by the Credit Union.¹⁰

4. Data description and empirical approach

The information used in this study comes from individuals' credit dataset of a private Credit Union serving Medellín and its surrounding area between January of 2007 and March of 2014. The number of credit applications with valid information during the seven years was about 222,977¹¹ corresponding to 103,965 individuals.¹² During this period, the financial institution granted around 206,143 loans, each of them for COP\$6.8 million (US\$ 3,400) on average, and in constant prices (2012:12=100).

Table 1 shows the number of credits by gender and age. By gender, 54.3% of the individuals demanding consumer credit are men and, among them, persons above 65 years of age demand more credits in comparison to other age groups. Among women, persons between 56 and 65 years old demand more credits. Even though older individuals demand credit with more frequency, the amount requested is below the average amount.

In Table 2, we observe that the credits are requested mainly by people with lower levels of education: 75.9% of applications were made by people with high-school or less. Worthy mentioning, the amount of the credit increases monotonically with the human capital of the applicants and their current level of income, regardless of the fact that the highest percentage of credits is demanded by people earning less than COP\$1 million each month (see Table 2).

¹⁰ Attanasio (1999) considers a version of the Euler equation with a slack variable (a Kuhn-Tucker multiplier) associated to the borrowing limit.

¹¹ The total amount of individuals approaching to the Credit Union were about 264,000; however, we exclude individuals who represented individual business, those either at the top 1% of the credit demand or at the bottom 1%. A similar restriction was applied for the individual's income with the aim of reducing outliers. After that, we end up with 222,977 observations.

¹² This is because, some individuals not only applied several times (with either success or failure), but because the same individuals can have several credits during the sample period.

Table 1. Average amount of credit applications by gender and age

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

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

Table 2. Average amount of credit demanded by education and income

Education	Number of observations	Percentage distribution	Average amount of credit (Million COP)	Income range (COP)	Number of observations	Percentage distribution	Average amount of credit (Million COP)
None	822	0.4%	4.4	< 1,000,000	146,397	65.0%	4.7
Primary	73,462	32.4%	5.6	1,000,001-2,000,000	59,599	26.5%	8.8
High school	97,967	43.2%	6.1	2,000,001-3,000,000	11,362	5.0%	13.5
Technical and Technological	29,729	13.1%	8.0	3,000,001-4,000,000	4,092	1.8%	15.7
College	21,492	9.5%	11.6	4,000,001-5,000,000	1,556	0.7%	20.3
Postgraduate	1,015	0.4%	16.2	>5,000,000	2,101	0.9%	24.8
Missing	2,520	1.1%	5.2				

Note: there were 1900 credits without income reported. Source: Credit Union; authors' calculations.

The empirical specification to estimate the demand of consumer credit includes variables that determine indebtedness involved in the Euler equation defined in the previous section. Hence, the demand for consumer credit of individual i in period t , $D_{i,t}$, is given by:

$$D_{i,t}^d = \beta_0^d + \beta_r^d r_{i,t} + \beta_y^d y_{i,t} + \beta_h^d h_{i,t} + \beta_X^d X_{i,t} + \varepsilon_{i,t}, \quad (2)$$

where $r_{i,t}$ represents the real interest rate charged to the credit of individual i in period t , $y_{i,t}$ refers to the individual's current income in period t , and $h_{i,t}$ refers to house ownership. Similarly, the vector $X_{i,t}$ includes some demographic characteristics such as education, age, gender, socioeconomic strata, presence of active people in the household, etc. Finally, $\varepsilon_{i,t}$ refers to all the unobservable determinants of consumer credit demand.

Even though, the interest rate and the credit maturity determine the amount of credit demanded by an individual, the latter could also explain the credit maturity and the interest rate offered by the financial institution (reverse causality). If that is the case, the OLS estimation could lead us to biased estimates of the interest rate and credit maturity. In addition, we envisage, at least, one source of error encapsulated in the unknown term: the presence of unobservable factors determining the amount of credit demanded by an individual could also be related to unobserved factors affecting the interest rate and the maturity assigned. This could be the case if, for instance, an individual has a different set of information about his or her expected future income stream (either permanent or transitory) which makes him/her to demand an amount of credit misaligned

from LC-PIH fundamentals observable for commercial agent of the Credit Union. Moreover, if the commercial agent does not know that information, he/she could classify the customer as a highly risky individual due to the fact that the amount demanded is above the average expected, increasing the interest rate offered to that individual. Hence, the unobservable term, $\varepsilon_{i,t}$, is the sum of two components: $\varepsilon_{i,t} = v_{it} + u_{it}$, where the former corresponds to the new information about the future stream of individual's income (transitory or permanent) while the latter corresponds to a well-behaved individual heterogeneity. We tackled these issues in the following sections. According to our interpretation of the life cycle-permanent income hypothesis, the determinants of demand for credit are linked to education level, real interest rate, assets represented by a house ownership, and current income.

Additional sources of bias emerge when we consider the fact that people who demand consumer credit are not a randomly selected from the population. Moreover, costumers of the Credit Union are also self-selected. To account for these types of selectivity bias, we correct the estimation using the two stages Heckman (1979) procedure. To that end, we use the information of the Potential Beneficiaries of Social Programs Identification System (Sisben).

The Sisben survey collects information about socioeconomic and demographic conditions of the population with the aim of classifying persons as potential beneficiaries of some public and social programs (see Medina and Cardona, 2011).¹³ The Sisben dataset contains variables such as individual's names and national ID, housing quality (materials used to build the house), education, number of household members, employment of household members, access to health services, etc. The survey was designed to classify the population into six different levels according to their socioeconomic information, where level 1 refers to the more disadvantaged household. Even though the survey is not a census of the total population, it is a census for low-to-middle income individuals. In the case of Antioquia, which had 6,221,817 inhabitants, Sisben 2009-2010 interviewed 3,956,890 individuals (about 64% of the total population).¹⁴

As long as the Credit Union focuses on low-to-middle income families, it is possible to match this dataset with the information contained in Sisben to gain more information in terms of demographic characteristics of households. The matching process among the two data bases was carried out by using different criteria¹⁵ aimed at overcoming any misleading information regarding identification in any of the two datasets that could lead us to exclude some person from the matching.

After conducting the matching procedure, we found 47,099 individuals in the records of Sisben out of the 103,965 individuals demanding credits at the Credit Union. The fact that some applicants for credit were not found in Sisben could be explained by changes in municipalities, new arrivals to the county that were not interviewed in 2009-2010 by Sisben, or middle-to-high income members of the credit union that are not the target of the Sisben. Then, we estimate the joint probability that a person from the Sisben database (potential borrowers) went to the Credit Union

¹³ Sisben is applied all over the country. Here we focus in Antioquia and in particular, Medellín and the surrounding area.

¹⁴ Since most of the individuals living in municipalities distant from Medellín do not have access to the Credit Union, we restrict the potential credit-demanding group to those individuals living in municipalities located in the metropolitan area of Medellín to give the sample more comparability. In this case, the population consists of 1,835,909 individuals, 103,965 borrowers of the Credit Union and 1,731,944 remaining, not demanding consumer credit.

¹⁵ We used seventeen different match criteria by combining identification, date of birth, names and surnames with changes in the phonetics of the names and surnames or any other typo.

for a consumer credit. In the Appendix we show some descriptive characteristics of the population indexed by Sisben splitting it by applicants and not applicants for consumer credit at the Credit Union. The Appendix also shows the estimated model of the probability of going to the Credit Union which is used in the consumer credit models to make the selection correction. Thus, the model of equation (2) turns to:

$$D_{i,t}^d = \tilde{\beta}_0^d + \tilde{\beta}_r^d r_{i,t} + \tilde{\beta}_y^d y_{i,t} + \tilde{\beta}_h^d h_{i,t} + \tilde{\beta}_x^d X_{i,t} + \theta_{i,t}^d \lambda_{i,t} + \tilde{\varepsilon}_{i,t}, \quad (3)$$

where $\lambda_{i,t}$ corresponds to the inverse of mills ratio estimated using the Heckman two stages approach and accounts for the joint probability that an individual demand credit for consumption and does so approaching to the private Credit Union for which the information is available. With the model of equation (3) we are estimating the determinants of the requested credits which correspond to the continuous line of Figure 3, illustrated above.

4.1. Estimates of consumer credit demand

Table 3 shows the OLS estimates of the determinants of consumer credit demand during 2009-2010. The reason for estimating the model for these years is that for those years the Sisben was collected.¹⁶ In addition, the model is estimated for first credits requested by customers (members of the Credit Union). We focus our attention on four key variables of the life cycle-permanent income hypothesis: real interest rate, current income, education level,¹⁷ and the property of assets (represented in this case by the ownership of a house).

Column (1) of Table 3 shows the estimates without correcting for self-selection. All the aforementioned coefficients are significant and with the expected sign. An increase of one percentage point on the interest rate will reduce the demand for consumer debt about 2%. Hence the belief that the interest rate is not an important variable for individuals in Colombia when deciding upon the demand for consumer credit seems not to have any validity according to this piece of evidence. Interestingly, the variables indicating the maturity of the credit (i.e., the dummy variables indicating credits due between 25 and 48 months and, within more than 48 months), are positive and statistically significant; this could be explained by the fact that the installment get smaller for longer periods.

Regarding the current income, according to the coefficient, a 1% increase of this variable will increase demand for credit about 0.55%. A possible explanation for such magnitude is that it is pointing to the permanent component of the current income; if we had the permanent component of the income apart from the transitory component, the theory predicts that the elasticity would be higher. Having (some) technical and college education increases the demand for debt with respect to those having less than primary education. Being a homeowner increases the amount of debt requested by individuals. Some other coefficients are noteworthy. These are the cases of age and age-squared, which have both the expected signs while being a woman increases the amount of credit requested.

Column (2) of Table 3 includes the probability of applying for debt in the Credit Union (Mills' inverse ratio). However, this variable is not significant. This result may be explained because either

¹⁶ The Sisben survey is collected every three/four years; nevertheless, there are yearly updates which include individuals who asked to be interviewed with the aim of being beneficiaries of different programs.

¹⁷ We recognize some collinearity between income and education; however, we prefer to include both under the assumption that education is not the only source of (permanent and transitory) income.

the population included into the Sisben might not be the appropriate universe for making the correction (hard to believe) or the Sisben population applies for a debt in the Credit Union at random or the standard deviation of the inverse of the ratio is so high that it invalidates the estimate from the statistical point of view. Given the lack of statistical significance of the Mills' inverse ratio, the estimated coefficients remain almost the same.

**Table 3. Determinants of consumer credit demand with ex ante real interest rate.
First credits requested. 2009-2010**

Variables	No selection correction	Correction selection
	(1)	(2)
Ex ante real interest rate (r)	-2.018*** (0.682)	-1.999*** (0.683)
Maturity 25 to 49 months	1.038*** (0.013)	1.038*** (0.012)
Maturity 49 months and over	1.763*** (0.020)	1.763*** (0.021)
Log of real labor income	0.546*** (0.015)	0.545*** (0.015)
Age	0.012*** (0.002)	0.012*** (0.002)
Age ²	-0.000*** (0.000)	-0.000*** (0.000)
Female	0.045*** (0.011)	0.045*** (0.011)
High school	0.042*** (0.014)	0.043*** (0.014)
Technical	0.106*** (0.022)	0.107** (0.022)
College	0.217*** (0.028)	0.218*** (0.028)
Family house	-0.098*** (0.016)	-0.098*** (0.016)
Homeowner	0.105*** (0.014)	0.105*** (0.014)
Payment made through wage	-0.046*** (0.013)	-0.046*** (0.013)
Mills' inverse ratio		0.011 (0.017)
Constant	6.595*** (0.358)	6.564*** (0.370)
Control for other active people at home	Yes	Yes
Control for strata	Yes	Yes
Control for number of dependent people at home	Yes	Yes
Controls for labor participation conditions	Yes	Yes
Observations	11,049	11,049
Adjusted R^2	0.625	0.625

Note: standard errors in parenthesis. *, **, and *** correspond to 10%, 5% and 1% level of significance, respectively Source: Credit Union; authors' calculations.

Table 4 presents the estimates corresponding to the whole period for which the Credit Union information is available. The specification in columns (1)-(3) includes only the first credits

demanded by an individual. Column (1) does not correct by selection, while Column (2) does so.¹⁸ In both cases, estimated by OLS, the ex-ante real interest rate is significant; moreover, when using the whole sample, the sensitivity of credit demand to the real interest rate is lower than before: an increase of 1 percentage point in the real interest rate reduces the demand for credit in around 1.5% (in contrast to the 2% increase previously found).

The informative content of the interest rate is variable is abundant. It reflects, at least, the supply capacity of the Credit Union, the stance of the monetary policy and the counterparty risk. However, according to our previous discussion regarding the correlation between the real interest rate and the unobserved term in specification (3), an additional term might be present within this variable depending on the judgement carried out by the commercial agent of the Credit Union¹⁹. This feature of the estimation will be considered below.

The sign of the coefficient of credit's maturity suggest that, the longer the term of the credit, the higher the amount of the credit requested while the elasticity of consumer credit to real current income remains at about 0.5%.

The specifications of columns (1) and (2) also show that the demand for credit is higher for women, high educated individuals (technical, college and postgraduate), and homeowners, whereas in the case of individuals living in family houses, the demand of credit is reduced. Tellingly, the demand for consumer credit also increases when customers repay the debt by installments taken directly from the monthly wage.

Given the potential endogeneity of the real interest rate and the maturity of credits (reverse causality) as well as the possible correlation among this variable and the unobserved term, explained above, a 2SLS estimator is implemented. The instruments we employ are the interbank rate (the proxy of the intervention rate shown in Figure 4) and year dummies. In this case, instead of a dummy for the maturity of credits, we use the number of months. Under this specification, the 2SLS estimates do not show important changes apart from the semi-elasticity of the real interest rate and the payment of the credit via monthly wages. While the coefficient of the former is higher than those estimated in columns (1) and (2), the coefficient of the method of payment is reduced from 0.6 to 0.25.

As previously stated, the above results correspond to an approximation of consumer credits demanded by first time in the Credit Union. However, sometimes the individuals decide to demand a new consumer credit either after the previous one has been completely settled or while paying the previous debt. In that case, the new credit is used to pay the outstanding amount and to enjoy some fresh resources. Thus, columns (4) and (5) show the results using the panel structure in the estimation processes. Column (4) corresponds to a fixed effects specification whereas column (5) corresponds to the instrumental variables approach, to have into account the potential reverse causality of the interest rate and the maturity of the credits and the correlation with the error term and the interest rate. In column (5) the semi-elasticity with respect to interest rate is just above 2% while the elasticity with respect to current income is about 0.33%. At the same time the coefficients linked to level of education and ownership of assets (house) are clear determinants of the consumer credit demand. The change occurred in the coefficient of age with respect to previous estimates is

¹⁸ The sample corresponding to these regressions is made of entries that matched the Sisben population. In the 112,896 entries there should be some individuals more than once.

¹⁹ This additional term, could be though as part of the counterpart risk.

remarkable. The higher coefficient is in line with the descriptive statistics (Table 2) which show that the average numbers of credits increases with age but start to decrease at some point.

Table 4. Determinants of consumer credit demand with ex ante real interest rate. 2007 – 2014

Variables	First credits. OLS (pooled observations)			All credits requested. Panel	
	No selection correction	Correction selection	2SLS	FE	GMM
	(1)	(2)	(3)	(4)	(5)
Ex ante real interest rate (<i>r</i>)	-1.555*** (0.156)	-1.556*** (0.156)	-1.872*** (0.144)	-1.338*** (0.103)	-2.094*** (0.101)
Maturity 25 to 48 months (dummy)	0.993*** (0.005)	0.993*** (0.005)		0.955*** (0.004)	
Maturity 49 months and over (dummy)	1.668*** (0.007)	1.668*** (0.007)		1.543*** (0.005)	
Maturity (in months)			0.028*** (0.001)		0.018*** (0.001)
Log of real labor income	0.505*** (0.007)	0.505*** (0.007)	0.532*** (0.008)	0.265*** (0.009)	0.332*** (0.011)
Age	0.007*** (0.001)	0.007*** (0.001)	0.011*** (0.001)	0.004* (0.002)	0.090*** (0.004)
Age ²	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
Female	0.023*** (0.005)	0.023*** (0.005)	0.021*** (0.005)		
High school	0.028*** (0.006)	0.027*** (0.006)	0.034** (0.006)	0.020*** (0.008)	0.022*** (0.007)
Technical	0.070*** (0.009)	0.069*** (0.009)	0.085*** (0.009)	0.083*** (0.012)	0.089*** (0.013)
College	0.153*** (0.013)	0.152*** (0.013)	0.167*** (0.013)	0.138*** (0.016)	0.137*** (0.022)
Postgraduate	0.245*** (0.058)	0.244*** (0.058)	0.273*** (0.062)	0.205*** (0.031)	0.169*** (0.053)
Family house	-0.059*** (0.007)	-0.059*** (0.007)	-0.076*** (0.006)	-0.008*** (0.006)	-0.023*** (0.006)
Homeowner	0.081*** (0.006)	0.080*** (0.006)	0.070*** (0.006)	0.032*** (0.006)	0.030*** (0.006)
Payment from the labor income	0.060*** (0.004)	0.060*** (0.005)	0.025*** (0.005)	0.243*** (0.006)	0.332*** (0.011)
Mills' inverse ratio		-0.004 (0.007)			
Constant	7.241*** (0.145)	7.252*** (0.146)	6.529*** (0.164)	11.24*** (0.205)	
Control for other active people at home	Yes	Yes	Yes	Yes	Yes
Control for number of dependent people at home	Yes	Yes	Yes	Yes	Yes
Control for strata	Yes	Yes	Yes	Yes	Yes
Dummies per year	Yes	Yes	Yes	Yes	Yes
Observations	50,385	50,385	50,385	222,977	167,051
Adjusted <i>R</i> ²	0.653	0.653	0.679	0.143	0.283
<i>F</i> (validity of instruments) ^b			255.2		257.3
Sargan (<i>p</i>)			84.9 (0.0)		
Hansen (<i>p</i>)					777.7 (0.0)
Endogeneity test (<i>p</i>)			246.9 (0.0)		406.4 (0.0)

Note: standard errors in parenthesis. *, **, and *** correspond to 10%, 5% and 1% level of significance, respectively Source: Credit Union; authors' calculations. The (Cragg-Donald) *F* tests whether the instruments are correlated with the endogenous regressors.

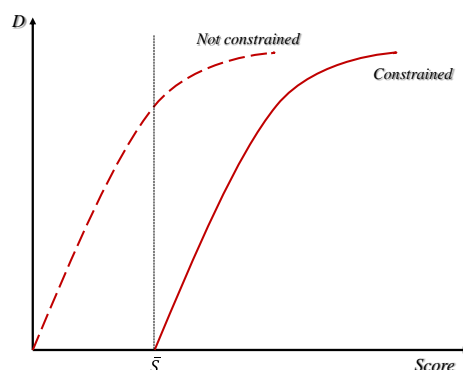
The instruments are valid under the assumptions that they are independent of the unobserved terms of the main equation, and that are correlated with the endogenous regressor. The latter assumption can be tested by means of the *F*-statistic initially proposed by Steiger and Yogo (1997).

For several instruments, the Cragg-Donald Wald F -statistic tests the hypothesis of whether the estimator is weakly identified. The statistic is reported in the rows at the bottom of Table 4. In both cases, when using only the first credits (column 3) or when exploiting the panel structure of the data (column 5), the F -statistic is high, suggesting that the instruments are highly correlated with the endogenous regressor. However, the test of the exogeneity of instruments, i.e., the test for overidentification (Hansen, J -statistic), strongly rejects the null. However, we still consider they are accurate.

4.2. Consumer credit estimates

According to the previous analysis, the general determinants of the demand for consumer credit included in the specification of column (1), Table 4 would fit with the life cycle-permanent income hypothesis. However, the Credit Union does not always provide all the resources demanded by the individuals. Instead, the financial institution might constrain the amount demanded depending on the probability of default of each customer. The probability of this event is inversely related to the individual's score²⁰ which is estimated with information on payment habits and credit history of each person as well as on other demographic and economic characteristics such as economic activity, tenure of assets and the conditions of the credit the individual demands. In a nutshell, this variable maps the information into the probability of default of each individual. Based upon this variable the Credit Union could either deny the request or reduce it. Figure 5, shows the relationship between the score and the consumer credit supplied. Figure 6, on the other hand presents the individual's score densities for granted and rejected credits, respectively.

Figure 5. Availability of resources and score of the applicant

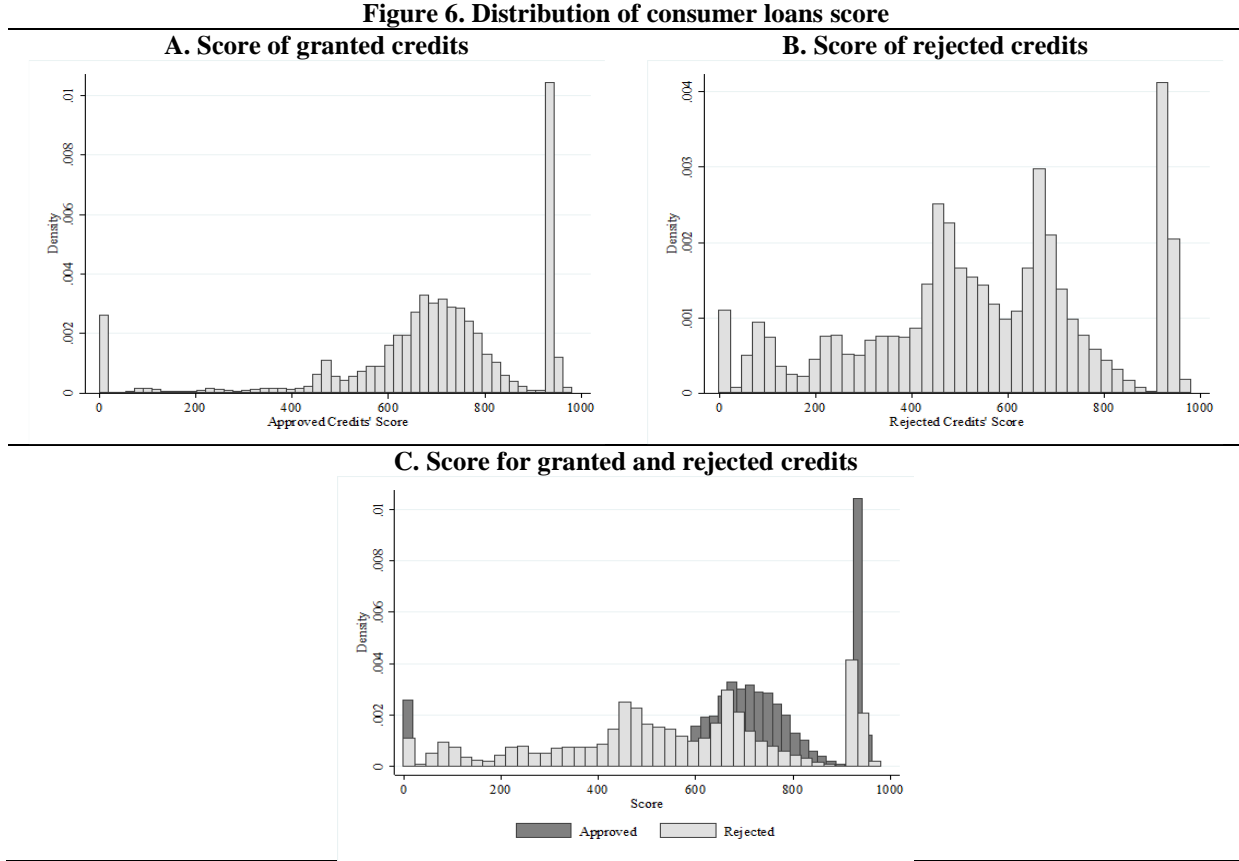


Source: authors' design.

As it can be inferred from Figure 6, Panel A, there is an important mass of the score starting at about 600 points. The density of the score for granted credits is accumulated to the right, as expected (higher the score, more credits are approved). In Panel B, on the other hand, the score density is spread with some relative uniformity along the distribution. Panel C shows the contrast

²⁰ The *scoring*-type models are classification instruments used by financial institutions to support the decision of granting a credit.

between the two distributions of credits' score requested to the Credit Union. Thus, the score seems to be a characteristic of the credits not only granted but also rejected.



Source: Credit Union; authors' calculations

As we mentioned before, we consider that an agent is credit-constrained if his application for a loan is rejected or the amount of the credit available for him is trimmed down by the Credit Union: $D_{i,t} \leq \bar{D}_{i,t} = F(D_{i,t-1} \leq \bar{D}_{i,t-1})$, a decision that heavily depends on the score, $S_{i,t}$. In this expression, payment habits and credit history determine the amount of debt.²¹ Accordingly, once this aspect of the supply of loans is included into the analysis, the problem turns to:

$$\begin{cases} \bar{D}_{i,t}^s = 0 < D_{i,t}^d & \text{if } S_{i,t} \leq \bar{S} \\ 0 < D_{i,t}^d \leq \bar{D}_{i,t}^s & \text{if } \bar{S} < S_{i,t} \end{cases}$$

where \bar{S} , is the threshold defined by the Credit Union to grant a credit. Table 5 shows the estimates of the difference between the logarithm of amount requested and the logarithm of amount granted

²¹ Of course, the score depends on many other observable determinants which are included into the model that generates such punctuation; however, for ease of exposition we focus on these two main determinants of the score.

as function of the score, the maturity of the (intended) credit and the form of payment.²² In the five specifications the score has the expected sign; that is, the higher the score, the less is the difference between the two amounts. This is a clear evidence of a credit constraint, at least in this Credit Union which performs within a competitive market. The consequence of this result is that consumers cannot maximize the utility as they would if these restrictions were removed. Other interesting results are those linked to the maturity of the credits irrespective on the way this is measured either as a dummy or in months. Thus, according to the estimates, the higher the maturity the higher the difference between the amounts; this, shows the preferences of the Credit Union with respect to this variable of the loan. Conversely, if the individual is going to repay the credit as a direct payment from the employer to the Credit Union (*libranza* in Spanish) the difference among the amounts is less.

Table 5. Determinants of the difference between amounts requested and granted

Variable	(1)	(2)	(3)	(4)	(5)
Score	-2.254*** (0.035)	-2.379*** (0.035)	-2.467*** (0.037)	-2.401*** (0.035)	-2.492*** (0.033)
Maturity 25 to 48 months (dummy)		0.835*** (0.021)	0.811*** (0.020)		
Maturity 49 months and over (dummy)		1.138*** (0.023)	1.281*** (0.022)		
Maturity (in months)				0.0307*** (0.000)	0.0343*** (0.000)
Payment from the labor income			-2.444*** (0.017)		-2.472*** (0.017)
Constant	3.239*** (0.026)	2.584*** (0.029)	4.310*** (0.031)	2.003*** (0.032)	3.621*** (0.033)
Observations	221,789	221,789	221,789	221,789	221,789
Adjusted R²	0.018	0.029	0.111	0.036	0.120

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

Our interest is to estimate the determinants of the credit amounts. In such case, provided that: $\bar{S} < S_{i,t}$, the empirical model is given by:

$$D_{i,t} = \beta_0 + \beta_r r_{i,t} + \beta_y y_{i,t} + \beta_h h_{i,t} + \beta_X X_{i,t} + \beta_\lambda \lambda_{i,t} + \mu_{i,t} \quad (4)$$

From now on we will not refer to consumer credit demand but to consumer credit since we are also bringing supply factors into play. With the model of equation (4) we are estimating the determinants of amounts disbursed by the Credit Union identified with the small-dashed line (the lowest) of Figure 3 shown above. For the subsequent analysis, we disregard applications rejected (not granted), in which case the sample size is reduced to 206,143 entries. That is, during the sample period 16,103 applications for consumer credit were rejected while others were trimmed down but included into the 206,143 entries.

Columns (1) and (3) of Table 6 show the estimates of equation (4), the former is a pooled-2SLS estimate while the latter is a GMM-IV panel estimation. The instruments used are the interbank interest rate (the proxy of the intervention interest rate) and the dummies per year. The GMM-IV estimate provides what we regard as our preferred estimation; this is because of the responses of

²² It is important to mention that for computing the difference between the request and the granted credit in the cases in which the credit was denied we set the amount of this credit in 1 so that the $\ln(1)=0$.

the main variables we considered in the specification. Even though house ownership is not statistically significant, the real interest rate, the level of education, the current income level and the individual's age are determinants of the consumer credit (the equilibrium between the demand and the supply of credit), which has not been estimated before for the Colombian case using micro data.

Table 6. Determinants of consumer credit. Whole sample

Variable	POOLED-2SLS		PANEL GMM-IV	
	No score (1)	With score (2)	No score (3)	With score (4)
Real interest rate ex ante	-1.739*** (0.122)	-2.354*** (0.120)	-0.509*** (0.203)	-0.564*** (0.213)
Maturity (in months)	0.015*** (0.001)	0.019*** (0.001)	-0.011*** (0.001)	-0.011*** (0.001)
Log of real labor income	0.574*** (0.005)	0.562*** (0.005)	0.368*** (0.021)	0.370*** (0.021)
Age	0.004*** (0.009)	0.001 (0.001)	0.151*** (0.009)	0.145*** (0.009)
Age ²	-0.000*** (0.000)	-0.000*** (0.000)	-0.001*** (0.000)	-0.001*** (0.000)
High school	0.013*** (0.045)	0.011** (0.004)	0.031** (0.013)	0.016 (0.013)
Technical	0.064*** (0.048)	0.055*** (0.048)	0.105*** (0.024)	0.045* (0.023)
College	0.160*** (0.008)	0.156*** (0.008)	0.210*** (0.036)	0.087*** (0.033)
Postgraduate	0.267*** (0.030)	0.289*** (0.030)	0.306*** (0.080)	0.124* (0.074)
Family house	-0.072*** (0.005)	-0.064*** (0.005)	-0.040*** (0.013)	-0.039*** (0.013)
Homeowner	0.050 (0.006)	0.054 (0.005)	-0.002 (0.011)	-0.014 (0.011)
Payment from the labor income	-0.341*** (0.004)	-0.365*** (0.004)	0.125*** (0.025)	0.134*** (0.025)
Score		-0.0003*** (0.000)		-0.0001*** (0.000)
Constant	6.838*** (0.218)	7.329*** (0.229)		
Control for other active people at home	Yes	Yes	Yes	Yes
Control for number of dependent people at home	Yes	Yes	Yes	Yes
Dummies per year	Yes	Yes	Yes	Yes
Observations	206,143	205,699	161,111	160,661
Adjusted R ²	0.385	0.405		
F (validity of instruments) ^a	1623	1424	93.6	96.7
Sargan (<i>p</i>)				
Hansen (<i>p</i>)	244.8 (0.0)	269.8 (0.0)	145.4 (0.0)	157.6 (0.0)
Endogeneity test for interest rate and maturity (<i>p</i>)	390.4 (0.0)	191.1 (0.0)	329.5 (0.0)	392.3 (0.0)

Note: standard errors in parenthesis. *, **, and *** correspond to 10%, 5% and 1% level of significance, respectively Source: Credit Union; authors' calculations. a. Tests weak identification; that is whether the instruments are correlated with the endogenous regressors. The *F* statistic reported is an F-version of Cragg-Donald Wald test.

Arguably, the coefficients of these specifications are biased since we are including only amounts disbursed (amounts greater than zero). One way to solve this problem is including the variable used to classify the credits among granted and denied; that is, the score. In this case, the model turns to:

$$D_{i,t} = \beta_0 + \beta_r r_{i,t} + \beta_y y_{i,t} + \beta_h h_{i,t} + \beta_x X_{i,t} + \beta_\lambda \lambda_{i,t} + \beta_S S_{i,t} + \mu_{i,t} \quad (5)$$

Columns (2) and (4) introduce this correction. The most important changes in the estimates occur with the semi-elasticity of the interest rate and education level. The inclusion of the score increases the former and reduces the latter in the panel estimation.

We also test the validity of the instruments when estimating the consumer credit equation. When estimating the first credits, the F -statistic also rejects the null of no correlation of the instruments with the endogenous regressor, but, the exogeneity assumption is not supported for the overidentification test. A similar conclusion reaches for the panel version of our estimates: Cragg-Donald test supports the correlation of the instrument with the endogenous regressor but rejects the exogeneity assumption (Hansen J test).²³

5. Conclusions

In this work we use micro data of observed transactions carried out between a Credit Union and its members (customers) between 2007 and 2014 to study the determinants of consumer credit. This financial institution is located in Medellín, the second city of Colombia in terms of the population, and ten more surrounding municipalities. To the best of our knowledge this is the first investigation with this kind of data in Colombia.

The micro data includes not only demographic characteristics but also aspects of the credits such as the interest rate, maturity, amount of installments and score assigned by the Credit Union to the applicants for consumer credit. The information is quite homogeneous in terms of the customers and goods it finances, since this loan meets the definition of consumer credit used by the Financial Superintendence (the Financial Supervisory Authority in Colombia). The number of entries (over 220,000) gives robustness to the results which support to a great extent the life cycle-permanent income hypothesis (LC-PIH). That is, real interest rate, current income, the education level, ownership of assets and age determine the demand for consumer credit. The current income elasticity is about 0.3% while the real interest rate semi-elasticity is around -2%.

Once we consider the credit limits and other aspects on the side of the supply, the determinants of consumer credit remain. However, the reductions of the semi-elasticity of the real interest rate and the coefficients of education are sizable. The former is about -0.56%. Importantly, the ownership of a house is no longer part of the set of explanatory variables.

Regarding policy implications, knowing the sensitivity of consumer credit to the interest rate we have estimated, we can assert that the monetary authority is capable of affecting both, the demand for consumer credit and the equilibrium amount of the consumer credit. At the same time, some macro prudential policy addressed to affect the way in which financial entities compute the individual's score could also be used to face any abnormal behavior of consumer credit in periods where uncertainty about the future behavior of the fundamentals increases.

²³ Other alternative instruments were used such as the lag and lead values of the interbank interest rate and the lagged value of credit granted but the main conclusions did not change (we observe a negative relationship between interest rate and credit demand, and between interest rate and equilibrium credit). We also exploit the heterogeneity of the interbank interest rate by interacting this variable with the maturity rather than year dummies. In these cases the main conclusions holds at the same time the F statistic of the first stage provides evidence that the variables explain the interest rate and the maturity. However, as in the case of credit demand, we reject the Hansen test for overidentification.

References

- Alessie R., Weber G., and Hochguertel S., 2005, Consumer credit: Evidence from Italian micro data, *Journal of the European Economic Association* Vol. 3. No. 1, pp. 144-178.
- Alfonso, V., Arango, L. E., Arias, F., Cangrejo, G., & Pulido, J., 2013, Ciclos de Negocios en Colombia, 1975-2011, *Lecturas de Economía*, 78, 115-149.
- Arango, L.E., and L. Cardona-Sosa, 2015, Consumer credit performance over the business cycle in Colombia: some empirical facts, Banco de la República, *Borradores de Economía*, 861.
- Attanasio O.P., 1999, Consumption, Handbook of Macroeconomics, in Taylor J.B and Woodford M. (ed.), *Handbook of Macroeconomics* edition1, Vol. 1B, Chapter 11, pp. 741-814.
- Attanasio O.P., Goldberg P.K. and Kyriazidou E., 2008, Credit constraints in the market for consumer durables: Evidence from micro data on car loans, *National Economic Review* Vol.49, No.2, pp. 401- 436.
- Bertola G., Disney R. and Grant C., 2006, The economics of consumer credit demand and supply, The economics of consumer credit, in Bertola G., Disney R. and Grant C. (ed.), *The economics of consumer credit*, MIT Press Book, edition 1, Vol. 1, pp. 1-26.
- Bouveng, C.J., 1966, Consumer credit: some long term economic aspects, *The Swedish Journal of Economics*, Vol. 68, No. 4, pp. 234-260.
- Bottia, M., Cardona-Sosa, L. and Medina, C., 2012. “El SISBEN como mecanismo de focalización individual del régimen subsidiado en salud en Colombia: ventajas y limitaciones. *Revista de Economía del Rosario*, 137-177.
- Carrol C.D., 2001, A theory of the consumption function, with and without liquidity constraints, *Journal of Economic Perspectives*, Vol. 15, No. 3, pp. 23-45.
- Correa A.S., Marins J.T.M., Neves, M.B.E., and Silva, A.C.M., 2011, Credit Default and Business Cycles: An Empirical Investigation of Brazilian Retail Loans, Banco Central do Brasil, *Working Paper Series*, 260.
- Cox D. and Jappelli T., 1993, The effect of borrowing constraints on consumer liabilities, *Journal of Money, Credit and Banking*, Vol. 25. No. 2, pp. 197-213.
- Crook J.N., 2001, The demand for household debt in the USA: evidence from the 1995 Survey of Consumer Finance, *Applied Financial Economics*, Vol. 11. No. 1, pp. 83-91.
- Crook J.N., 2006, Household debt demand and supply: A Cross-Country comparison, The economics of consumer credit, in Bertola G., Disney R. and Grant C. (ed.), *The economics of consumer credit*, MIT Press Book, edition 1, Vol. 1, pp. 63-92.
- Danielian N.R., 1929, The theory of consumers' credit, *The American Economic Association*, Vol. 19, No. 3, pp. 393-411.
- Florez, L.A., Posada C.E. y Escobar J.F., 2005, Crédito y depósitos bancarios en Colombia (1990-2004): una relación de largo plazo, *Ensayos sobre política económica*, Vol. 23, No 48, pp. 12-63.
- Friedman, M., 1957, *A Theory of Consumption Function*, Princeton University Press.

Grant C., 2007, Estimating credit constraints among US households, *Oxford Economic Papers*, 59, 583-605.

Gross D.B. and Souleles N.S., 2001, Consumer response to changes in credit supply: Evidence from credit card data, *Center for Financial Institutions Working Papers* 01-10, The Wharton School Center for Financial Institutions, University of Pennsylvania.

Hall, R., 1978, Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence, *Journal of Political Economy*, vol. 86, no. 6, 971-987.

Heckman, J., 1979, Sample selection bias as a specification error, *Econometrica*, 47:153-162.

Jaffee D.M. and Russell T., 1976, Imperfect information, uncertainty, and credit rationing, *The Quarterly Journal of Economics*, MIT Press, Vol. 90. No. 4, pp. 651-666.

Jappelli T. and Pagano M., 2006, The role and effects of credit information sharing, The economics of consumer credit, in Bertola G., Disney R. and Grant C. (ed.), *The economics of consumer credit*, MIT Press Book, edition 1, Vol. 1, pp. 347-371.

Ludvigson S., 1999, Consumption and credit: A model of time-varying liquidity constraints, *The Review of Economics and Statistics*, Vol. 81. No. 3, pp. 434-447.

Magri S., 2002, Italian households' debt: determinants of demand and supply, Banca d'Italia, *Temi di Discussione (working papers)*, No. 454.

Magri S., 2007, Italian households' debt: the participation to the debt market and the size of the loan, *Empirical Economics*, 33:401-426.

Modigliani, F., and R. Brumberg, 1954, Utility analysis and the consumption function: an interpretation of cross-section data", in K.K. Kurihara (ed) *Post-Keynesian Economics*, Rutgers University Press.

Mors, W.P., 1944, Consumer-Credit Theories: a Historical and Critical Analysis, *Journal of Business of the University of Chicago*, supplement on Studies in Business Administration, 2, April, pp. 1-17.

Murcia A., 2007, Determinantes del acceso al crédito de los hogares colombianos, *Borradores de Economía*, No. 449, Banco de la República.

Pissarides C.A., 1978, Liquidity considerations in the theory of consumption, *Quarterly Journal of Economics*, MIT Press, Vol. 92. No. 2, pp. 279-296.

Runkle D.E., 1991, Liquidity constraints and the hypothesis, *Journal of Monetary Economics* Vol. 27, No. 1, pp. 73-98.

Villar L., Salamanca D.M. y Murcia A., 2005, Crédito, represión financiera y flujos de capitales en Colombia: 1974-2003, Banco de la República, *Borradores de Economía*, No. 322.

Westerfield, Ray B., 1938, Effect of Consumer Credit on the Business Cycle. *Annals of the American Academy of Political and Social Science*, Vol. 196, 99-110.

Zeldes S.P., 1989, Consumption and liquidity constraints: An empirical investigation, *Journal of Political Economy*, Vol. 97, No. 2, pp. 305-343.

Appendix

Table A1. Descriptive statistics of the restricted sample

Variable	Demanding credit	Not Demanding Credit at the Credit Union	Difference in means	Standard errors
	(1)	(2)	(3)	(4)
Age	48.08	35.57	12.51***	0.06
Woman	0.45	0.54	-0.09***	0.00
Log of real income	13.22	12.79	0.43***	0.00
Labor force participation	0.55	0.41	0.15***	0.00
Working	0.53	0.36	0.17***	0.00
Looking for a job	0.02	0.05	-0.02***	0.00
Studying	0.02	0.22	-0.20***	0.00
Home duties	0.07	0.22	-0.14***	0.00
Living from rent	0.00	0.00	0.00***	0.00
Retired	0.31	0.03	0.27***	0.00
Contribute to health insurance	0.85	0.44	0.41***	0.00
Health is subsidized	0.09	0.41	-0.32***	0.00
Without Health Insurance	0.06	0.15	-0.09***	0.00
Married or in a couple	0.54	0.39	0.15***	0.00
Separated	0.07	0.05	0.01***	0.00
Widow	0.11	0.05	0.07***	0.00
Single	0.28	0.51	-0.23***	0.00
Primary education	0.50	0.52	-0.02***	0.00
Secondary education	0.06	0.03	0.02***	0.00
University degree	0.05	0.04	0.01***	0.00
Female-headed household	0.20	0.12	0.08***	0.00
Not in a couple	0.36	0.36	-0.00*	0.00
Partner's education: secondary	0.03	0.02	0.01***	0.00
Partner's education: technical or university	0.02	0.01	0.00***	0.00
Partner working	0.16	0.16	-0.00***	0.00
Number of people in the household	4.41	4.90	-0.49***	0.01
Children under five years old	0.21	0.29	-0.08***	0.00
Individuals above 60 years old	0.65	0.44	0.21***	0.00
Presence of pregnant women at home	1.32	1.37	-0.04***	0.00
Presence of people with disabilities	0.00	0.01	-0.00**	0.00
Number of unemployed people at home	0.18	0.21	-0.03***	0.00
Floor material of house –ceramic	0.71	0.60	0.12***	0.00
Floor material of house –concrete	0.28	0.38	-0.10***	0.00
Floor material of house –bricks	0.99	0.97	0.02***	0.00
Floor material of house –wood	0.00	0.02	-0.02***	0.00
Aqueduct	0.91	0.89	0.02***	0.00
No aqueduct pipeline	0.04	0.05	-0.01***	0.00
Water from aqueduct	0.97	0.95	0.01***	0.00
Water from other source	0.03	0.04	-0.01***	0.00
Strata 1	0.10	0.19	-0.09***	0.00
Strata 2	0.56	0.53	0.02***	0.00
Strata 3	0.34	0.27	0.06***	0.00
Strata 4	0.00	0.00	-0.00**	0.00
Home Ownership	0.64	0.51	0.12***	0.00
Number of rooms in the house	3.72	3.39	0.33***	0.00
Observations (entries)	112,983	1,853,716		

Sources: Credit Union, SISBEN, own calculations.

Table A2. Estimates of the probability of demanding credit at the Credit Union.
Marginal effects

	OLS	Probit
Age	0.001*** (0.000)	0.009*** (0.000)
Woman	-0.002*** (0.001)	-0.014** (0.007)
Primary education	0.013*** (0.001)	0.161*** (0.007)
Secondary education	0.030*** (0.002)	0.291*** (0.014)
University Degree	0.012*** (0.002)	0.162*** (0.014)
Amenities: fridge	0.003*** (0.001)	0.074*** (0.012)
Amenities: Color TV	-0.002** (0.001)	-0.012 (0.017)
Amenities: Cable TV	0.009*** (0.001)	0.094*** (0.007)
Amenities: heating	-0.003*** (0.001)	-0.029*** (0.008)
Amenities: oven	-0.008*** (0.001)	-0.066*** (0.008)
Amenities: air-conditioning	0.003 (0.004)	0.032 (0.033)
Amenities: washing machine	-0.002*** (0.001)	-0.022*** (0.007)
Married or in a couple	0.007*** (0.001)	0.047*** (0.007)
Working	0.050*** (0.001)	0.671*** (0.010)
Looking for a job	0.020*** (0.001)	0.479*** (0.016)
House tasks	-0.006*** (0.001)	0.036** (0.014)
Retired	0.290*** (0.003)	1.321*** (0.016)
Lives from rent	0.046** (0.020)	0.597*** (0.142)
Strata 1	0.034*** (0.011)	0.290* (0.161)
Strata 2	0.043*** (0.011)	0.412** (0.161)
Strata 3	0.027** (0.011)	0.265* (0.161)
Strata 4	0.002 (0.012)	0.052 (0.168)
Contribute to health insurance	0.047*** (0.001)	0.565*** (0.007)
Rented house	-0.005*** (0.001)	-0.053*** (0.011)
Mortgage	0.010*** (0.002)	0.089*** (0.016)
Home Ownership	0.004*** (0.001)	0.032*** (0.011)
Observations	1,966,699	1,966,699

Note: standard errors in parentheses; (d) for discrete change of dummy variable from 0 to 1; * = $p < 0.10$, ** = $p < 0.05$, *** = $p < 0.01$. Source: Sisben and Credit Union; authors' calculations.



Este documento puede ser
consultado en
[http://www.banrep.gov.co/
publicaciones/pub_borra.htm](http://www.banrep.gov.co/publicaciones/pub_borra.htm)

