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An Experimental Analysis of the Brazilian Personal Credit Market

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Abstract: This paper aims to investigate some important questions of the personal credit demand of a group that is not that much studied in the academic literature: the middle income class in a large emerging market, Brazil. In order to do so, a database was used from an experiment carried out by a large credit card Brazilian issuer, in which offers of different interest rates were randomly sent to clients of two different groups. One of them comprises clients with median income of USD 20.000, and the other of USD 8.000. The first hypothesis to be investigated is on the interest sensitivity of personal credit demand, both on the extensive margin and on the intensive margin. The second group of hypotheses concerns the existence or not of problems of adverse selection in this sample and the third group of questions deals with moral hazard on whether the customer will decide to repay the loan. Results indicate that for the higher income group the demand is sensitive to the interest rates – both on the extensive margin (elastic demand) – and on the intensive margin (inelastic demand). As for the Information Asymmetries, for both groups of consumers, the pool of customers who accepted the offer are worse credit risks than those who did not accept, although there was no evidence of different credit risks among those who accepted worse offers from those who accepted better offers. The results also indicate moral hazard to be an important problem for the lower income group.

Resumo: Este artigo tem por objetivo investigar algumas questões importantes sobre a demanda por crédito pessoal em um grupo que não é muito estudado na literatura acadêmica: a classe média em um grande mercado emergente, o Brasil. Para isto, foi usada uma base de dados de um experimento feito por um grande emissor de cartões de crédito, em que ofertas com diferentes taxas de juros foram enviadas aleatoriamente para clientes em dois grupos diferentes – um deles de renda mediana de USD 20 mil, e outro de USD 8 mil. Foi investigada a sensibilidade a juros da demanda por crédito, tanto na margem extensiva e intensiva, assim como a existência de problemas de seleção adversa e risco moral. Em termos dos resultados, a demanda é mais sensível a taxa de juros para o grupo de renda mais alta, os dois grupos apresentam evidências de seleção adversa em observáveis e os problemas de risco moral podem ser mais importantes para o grupo de renda mais baixa.

Keywords: Credit Demand, Adverse Selection, Moral Hazard

JEL Codes: D12, D14

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1. Introduction

There is a large literature on the Development Economics field on the workings of the credit market and its importance for economic growth and inequality. After the innovations from experimental techniques, recent studies were able to draw sharper conclusions on interest sensitivity of the demand for credit and the extent of informational problems on this market, and the literature on the subject has grown accordingly.

However the literature is still scarce for higher income groups in emerging countries. The current studies either focused middle income groups in developed countries (such as in Gross and Souseles (2000, 2002) or Ausubel (1999)) or they analyze poorer groups in developing countries (as in Karlan and Zinman (2008 and 2009)), more specifically and in connection to microcredit institutions. This paper tries to bridge this gap, looking at the credit market for middle income groups in a large emerging country, Brazil.

The analysis used a database from a large credit card issuer in Brazil, covering an experiment in which pre-approved credit offers were sent to two different consumer groups. The first one, called Premium, was composed of customers with median income of USD 20.000, whereas the second one called Inter had median had median income of USD 8.000. For each group, a separate experiment was carried out, in which different interest rates were randomly offered to customers. These customers were followed during the following twelve months after the experiment.

These data was used to identify the interest sensitivity of credit demand, as well as the effects of adverse selection on observables (Ausubel, 1999) and Moral Hazard on the default. In order to do so, this paper comprises five sections, the first one being this introduction. The following section details the relevant literature and the third one describes the experiment. The fourth focuses on the data analysis and the testing of hypotheses and the last one concludes.

2. Literature Review

In a much cited paper, Ausubel (1991) argues credit card interest rates are quite stable and the most important American issuers consistently earned three to five times the usual rate of return of commercial banks from 1983 to 1988. Even though these returns are not uncommon in imperfectly competitive markets, the author lists various characteristics that make the credit card market in the US one of the most competitive in the world. According to Ausubel, then, there must be something beyond the simple lack of competition to explain these returns.

Besides other possible causes, Ausubel indicates the role of adverse selection: since credit cards are an expensive credit line, it is to be expected most customers do not intend to finance their expenditures using credit cards, even though they sometimes do that. This sort of customer is very profitable from the bank's point of view: they borrow at high interest rates, honor their

commitments and are not sensitive to interest rate changes. However, other customers do want to use the credit card as a financing alternative. They are worse credit risks and, thus, have fewer financing options and are more likely to compare interest rates from different issuers.

Given these demand characteristics, banks do not compete by reducing interest rates, for they will attract customers who intend to use credit cards as a financing facility, having worse credit risks and higher default likelihood. This conclusion of Ausubel's (1991) paper is opposite to another much cited paper, of Stiglitz and Weiss (1981). The latter paper posits an increase in interest rates attract worse credit risks, customers who do not have options or do not compare their credit options.

Ausubel further exploits the issue of asymmetric information in another paper of 1999, in which the responses of pre-approved offers by credit card customers. The main hypothesis studied there was the so-called "Adverse Selection in Observables", implying the customers who accept the offer were worse credit risks than those who do not accept the offer; furthermore, those who accept offers with worse terms (higher interest rates, for instance) are even worse credit risks than those who accept offers with better terms. Ausubel also investigated what he called "Adverse Selection in Unobservables", under which customers who accepted worse offers have higher likelihood of default[3], after controlling for available information.

Since this study, the literature on personal credit increased greatly, due to the availability of more data, as well as the new experimental techniques. The most common application was on databases from microcredit lenders in developing countries. An Academic Google Search query on "Microcredit interest elasticity experiment" returns 1.950 papers on this subject. Some examples are DEHEJIA, MONTGOMERY e MORDUCH (2005), Salazar et. al. (2010), Karlan and Zinman (2008, 2009), Annim (2011), Giné and Karlan (2009). One common thread running through all these papers is the estimation of interest rate sensitivity of demand, for which these papers point to an inelastic demand. These papers usually find inelastic demand, depending on which margin – intensive or extensive – is studied.

On the other hand, papers as Gross and Souseles (2002) and Alessie, Hochguertel and Weber (2005), also using microdata, look at interest sensitivity of credit demand in developed countries, and find the demand to be elastic. Alan, Dumitrescu and Loranth (2010), using a database of subprime borrowers in the United Kingdom, do not find an interest elastic demand for credit, using their experimental results.

Depending on the sample studied, the papers above also have different concerns besides interest sensitivity of demand. The earlier literature with microdata, such as Ausubel's (1999) paper, had focused on informational problems, such as moral hazard and adverse selection. The more recent literature with a greater focus on microcredit, as Karlan and Zinman (2008, 2009) kept that focus, and the more recent studies for developed countries investigated questions of presence of liquidity constraints.

Given this literature, the present paper is focused on the credit demand in a large developing country, investigating two sets of hypotheses. The first one tries to fill a gap in the literature, trying

[3] Ausubel (1999) idenfitied this effect only with Asymmetric Information and not with Moral Hazard because he considered the range of offers not wide enough to elicit important moral hazard effects.

to quantify the interest sensitivity of demand for credit for the middle income population, both in the extensive and intensive margins.

The second one is concerned with the importance of informational problems discussed above, both adverse selection and moral hazard. The Adverse Selection on Observables of Ausubel (1999) will be the subject of a separate analysis, and the effects of Adverse Selection on Unobservables and Moral Hazard will be also investigated.

Before the analyses, the experiment and the credit line characteristics will be described on the next section.

3. The experiment

The experiment was carried out by one of the largest credit card issuers in Brazil, in which it an additional credit was offered line besides the revolving credit card limit. If the customer does accept the offer, only the installment reduces the credit balance and the full amount is deposited in the customer's checking account. The installments are added to the amount due of the credit card and are the minimum amount required to be paid every month[4] [5]. If the customer defaults on the minimum payment, the whole balance - the credit offer and the revolving balance – becomes due and no further purchases could be made. This reduces the incentives for default, and will be used to identify the moral hazard effects on default probability.

In the sample studied, two different sub-population were offered this sort of credit – the so-called "Premium", with median income of BRL 3500 per month (approximately USD 20000/year, using the exchange rate prevailing at the time of 2,25 BRL/USD) and the "International", with median income of BRL 1500 per month (using the same exchange rate, approximately USD 8000/year). Depending on the definition of middle class, both groups could be considered so; the median income level of USD 20000/year is quite near to the per capita income of developed countries and the latter value of USD 8000/year is now considered part of the middle class of the emerging countries, as in Kharas (2010).

At the time of the experiment, the issuer's credit policy for the experiment implied the following conditions:

- Repayment schedule: three to eighteen installments
- Credit limit: equal to the highest revolving credit limit for the customer, provided it is below BRL 29700.
- Minimum installment: BRL50/month
- Interest rates: randomized in the experiment, and different for each group. For the Premium group, three different rates were offered (2.85%/month, 3.85%/month or

[4] As an example, if a customer has a revolving credit limit of BRL 2.000 and is offered an additional credit line of BRL 2.000, to be paid in 24 installments of BRL 100. Only these BRL 100 reduce the revolving credit.
[5] The installments are determined by the Price amortization system and they are due at the same time as the revolving credit.

4.35%/month). For the International group, two different rates were offered (3.85%/month and 4.65%/month).

The experiment relied on a large extent on how the customer database was organized. All customers were recorded according to their CPF codes (analogous to the Social Security numbers in the US), and the same CPF code could have more than one credit card. It is not uncommon for Brazilian issuers to offer different credit cards to the same customer.

At the moment a new customer is added to the database, he or she receives a code called RDG (for *Random Digit Group*), from 00 to 99 and is randomly attributed to the CPF code of the customer. All credit cards for this CPF receive the same RDG.

From this RDG are defined the policies for product offers, including the present experiment. The largest number of customers received the so-called "champion" strategy, and a smaller percentage receives the "challenger" strategy. Another group, with similar characteristics does not receive any offer and is retained as a control group. There could be more than one challenger strategy, as the offer profile for the premium group defined above shows[6]:

- Champion: 3.85% per month, offered to 66% of all customers (RDG from 00 to 65)
- Challenger 1: 2.85% per month, offered to 10% of all customers (RDG from 66 to 75)
- Challenger 2: 4.35% per month, offered to 20% of all customers (RDG from 76 to 95)
- Control Group: no offer, RDG from 96 to 99.

The customer can use any of his or her accounts to accept the offer, either by phone or through the Internet. If the same customer received more than one offer, the earlier one is rescinded and the most recent one is valid. The only feature different between offers was the interest rate, all other characteristics were constant between strategies. The offers were mailed by the regular credit card bill in a separate form indicating the terms and conditions in accordance to Brazilian law.

The database consisted of offers made in March and April 2009, and the offers were grouped by CPF code. If more than one offer was sent to the same CPF code (one in March and another in April), the most recent one was considered. For the cases of customer response, it was considered as a success only if the money changed hands.

The original dataset included 264,123 offers, 178,166 of which for the Premium group and 85,966 for the International one. After the grouping of the offers by CPF code, the resulting database included 131,693 offers, 85,337 of which for Premium and 45,356 for International. The distribution of the

[6] Before any offer was sent, all regular credit checks were carried out. If any problem was found during the money transfer to the destination account, the offer was rescinded.

Premium offers was discussed on the previous section, and for the International group half received an offer of 4.65% per month and the remainder an offer of 3.65% per month.

The accounts were followed for 12 months after the offer, on credit card usage and on the payment history. The behavior score and customer characteristics were also monitored. Some statistics for both groups are presented on the next pages, separated according to the offer received.

The table below provides some evidence on the random assignment of the offers, since there is not any important differences in mean values of all variables presented, confirmed by formal statistical testing. For the Premium group, the mean offer was at about BRL 9,980, and the average balance due in the revolving credit was BRL 950, at about 10% of the limit. The average number of accounts was 1.26 and the share of customers with repayment problems within 12 months after contracting the credit was 1.4% for the Premium Group.

Table 1 – Summary Statistics – Premium Group

	Offer – 3.85%/month			Offer – 2.85%/month			Offer – 4.35%/month		
Variable	Obs	Mean	Std. Deviation	Obs	Mean	Std. Deviation	Obs	Mean	Std. Deviation
Credit Offer	59229	9984.508	5660.527	9333	9991.241	5667.011	17774	9979.297	5614.945
Revolving Credit Balance	59229	950.1228	1438.38	9333	967.6782	1462.219	17774	934.081	1402.822
Behavior Score	59229	574.7328	41.49899	9333	574.357	41.8571	17774	574.8921	41.40047
Age	59229	50.62559	11.79647	9333	50.69324	11.79899	17774	50.74074	11.76168
In Default? (0-No, 1-Yes)	59229	0.014554	0.119759	9333	0.0145719	0.119838	17774	0.0147406	0.1205162
Amount Due in Revolving Credit as a % of Limit	59229	0.100411	0.13251	9333	0.1033524	0.1379514	17774	0.0985021	0.1296641
Days late on the month of offer	59229	0.161762	1.309355	9333	0.2043287	1.572077	17774	0.1485316	1.228011
Number of Accounts	59229	1.258387	0.468564	9333	1.257473	0.465976	17774	1.261224	0.4691661
Gender	59229	0.633963	0.481724	9333	0.6330226	0.4820061	17774	0.6345786	0.4815617
Married?	59229	0.610799	0.487573	9333	0.6082717	0.4881626	17774	0.6160122	0.4863687
Own House?	59229	0.833274	0.372734	9333	0.8393871	0.3671932	17774	0.8287949	0.3766987

Table 2 – International Group

	Offer – 4.65%/month			Offer – 3.85%/month		
Variable	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
Credit Offer	22712	5781.981	3274.237	22644	5761.414	3289.221
Revolving Credit Balance	22712	613.6047	840.1341	22644	613.1134	849.1373
Behavior Score	22712	571.2424	39.34624	22644	570.9943	41.53942
Age	22712	44.31692	12.65306	22644	44.37409	12.68413
In Default? (0-No, 1-Yes)	22712	0.018316	0.134096	22644	0.0194312	0.1380379
Amount Due in Revolving Credit as a % of Limit	22712	0.114623	0.139539	22644	0.1154809	0.1444488
Days late on the month of offer	22712	0.195095	1.444564	22644	0.1879968	1.382005
Number of Accounts	22712	1.230055	0.4425	22644	1.224298	0.4358707
Gender	22712	0.51541	0.499774	22644	0.5218601	0.4358707
Married?	22712	0.489873	0.499908	22644	0.4922717	0.4999513
Own House?	22712	0.85752	0.349549	22644	0.8568274	0.3502565

For the International group, the results were quite similar, without any important differences between groups who received different offers. The average offer was of BRL 5,700, and the average balance due was BRL 610 (about a third lower than for the Premium group), about 11% of the revolving credit limit. As for perceived credit risks, both groups – Premium and International – were quite similar, with behavior scores at about 570. The default ratio for the International group was a little higher than for the Premium group, at 1,6%.

The majority of customers in the International Group were single, in opposition to the Premium group, and for the gender the majority was male, as in the Premium group. Both groups were predominantly homeowners. The experiment results for both groups are presented on the next table:

Table 3 - Experiment Results

Premium Group					
Offer	# of Offers	# of Contracts	% Success	Avg. Credit	% Default of Borrowers
3.85%/month	59,229	389	0.657%	6,472.82	9.00%
2.85%/month	9,333	114	1.221%	7,290.00	6.14%
4.35%/month	17,774	74	0.416%	5,881.08	14.86%
Total	86,336	577	0.668%	6,563.10	
Inter Group					
Offer	# of Offers	# of Contracts	% Success	Avg. Credit	% Default of Borrowers
4.65%/month	22,712	100	0.440%	3,940.70	11.00%
3.85%/month	22,644	113	0.500%	4,042.36	10.62%
Total	45,356	213	0.470%	8,508.57	

The first point to be noticed for these tables is the quite low response rate these initiatives presented, at about 0.67% for the premium group and 0.47% for the Inter group. The amount borrowed is lower than the average offer amount on the previous section. This table also point out to some interest sensitivity of demand for both groups, since the rate of success is higher for lower offers in both groups and the average credit is higher. This sensitivity will be investigated in further detail in the next section.

Furthermore, the rate of default for borrowers is higher for customers who received worse offers in both groups, indicating some support for the adverse selection on observables that will be further investigated on the following sections.

4. Empirical Analysis

Three hypotheses are to be investigated in this paper. The first one is about the interest elasticity of demand for loans. Previous studies, such as of Karlan and Zinman (2008 and 2009), found an inelastic demand for Microcredit in South Africa, whereas Gross and Souseles (2002) find an interest elastic demand for credit in the United States. Is the interest sensitivity of credit demand for the middle and high income groups in a large emerging market similar to the demand for comparable income groups for developed countries? Or is it to be expected the demand to be similar to lower income groups in other developing countries? In a related issue, which margin is more interest elastic, the extensive, offer acceptance, or the intensive, amount borrowed?

The second question is derived directly from the Adverse Selection on Observables by Ausubel (1999). According to this hypothesis, it is to be expected customers who accept a credit offer would to be worse credit risks than those who do not accept. Furthermore, and as a corollary of this hypothesis, those who accept worse offers (in the present case, with higher interest rates) are even worse credit risks than those who accept better offers.

Finally, the last hypothesis to be investigated is on the *ex post* moral hazard effects on the repayment probability of the accepted credit. Since the default in the credit offer also implies the blocking of the credit card for future purchases, it is to be expected the credit card limit to be a perceived cost associated with the non-payment decision. Thus, it is to be expected customers with higher credit card limits to be less likely to default. For each question, the identification strategy is presented on the next subsection.

a. Identification Strategy

For the first question, the interest sensitivity of credit demand, the classic identification problem is clearly presented in Karlan and Zinman (2008). With observational data, the contract terms relevant for the customer choice are likely to be correlated with unobserved characteristics from both the borrower and the lender. For instance, observed amounts and interest rates are equilibrium results and without further identifying assumptions one is unable to identify the interest sensitivity of demand.

In the present paper, the experimental strategy discussed makes possible to identify the demand function, since the interest rates were randomly assigned to customers. The similar characteristics

for each group who received different interest rates indicates the success of the random assignment and this obviates the need for instrumental variables and identifying assumptions.

For the second question, about the Adverse Selection on Observables, the identification also comes from the random nature of the experiment together with the fact the proposals are pre-approved. In the absence of this sort of adverse selection, the characteristics of groups that accepted or not the offers should be similar. Furthermore, the credit profile of customers who accept any offer would be similar, regardless of the offer to be composed of better or worse terms.

Finally, to identify the ex post moral hazard, a crucial fact is the offered credit to be linked to a credit card account with revolving credit. Thus, the higher the available credit card limit, the higher the loss incurred from nonpayment of the credit offer and the higher the marginal benefit from the repayment effort.

In order to investigate these hypotheses, three models for the conditional expectation of the dependent variable. The first model is concerned with the probability of acceptance of a credit offer, from the following functional form:

$$\Pr(D = 1) = \alpha + \beta_1 \boldsymbol{X_1} + \beta_2 \boldsymbol{X_2} + \beta_3 \boldsymbol{X_3} + \beta_4 \boldsymbol{X_4} + \varepsilon$$

In which D is a dummy variable indicating whether the customer accepted the offer. $\boldsymbol{X_1}$ represents a set of covariates characterizing the offer, the interest rate (in % per annum) and the maximum amount allowed to be borrowed. The set of variables represented by $\boldsymbol{X_2}$ includes the borrower's credit quality variables, such as:

- Days late in payment in the month of the offer
- Amount late in payment in the month of the offer
- Number of accounts (credit cards) in the month of the offer
- Bounced check in the month of the offer
- Worst customer's behavior score (in all accounts)
- Behavior score in other credit card accounts
- Age of account
- Percentage of credit card limit used

Besides the credit characteristics, the following variables collect the account characteristics twelve months after the offer, composing the $\boldsymbol{X_3}$ group of variables including the following:

- Bounced check
- Worst behavior score of the customer in all accounts
- Behavior score in other accounts than the one that received the offer
- In default until 12 months after the offer

And finally, the group represented by $\boldsymbol{X_4}$ includes demographic characteristics, such as gender, age, marital status and income.

The second model aims to investigate the amount borrowed. Given the large amount of zeros, the model to be estimated is a TOBIT:

$$V = \alpha_0 + \beta_1 \boldsymbol{X_1} + \beta_2 \boldsymbol{X_2} + \beta_3 \boldsymbol{X_3} + \beta_4 \boldsymbol{X_4} + \varepsilon$$

The same grouping of variables of the previous model is used here, including offer characteristics, credit characteristics of the potential borrower at the time of the offer, credit characteristics unti 12 months after the offer and demographics. The single difference is that in the grouping $\boldsymbol{X_1}$ we have the installment amount besides the amount borrowed.

And finally, the third model aims to explain the default likelihood of the contracted credit. This is also an application of a discrete choice model.

$$\Pr(D = 1) = \alpha + \beta_1 \boldsymbol{X_1} + \beta_2 \boldsymbol{X_2} + \beta_3 \boldsymbol{X_3} + \beta_4 \boldsymbol{X_4} + \varepsilon$$

In this model, the only major difference is in the $\boldsymbol{X_2}$ grouping, including the amount borrowed as a share of maximum amount offered, as well as the revolving credit card limit in the quarter after the offer was accepted and in the quarter before default. If the borrower did not default, the second variable was the credit limit twelve months after the offer.

These models are directly linked to all three questions of the paper. The first model, for the probability of acceptance of the offer, investigates the interest sensitivity of the extensive margin of the credit market, whereas the second one is focused on the interest sensitivity of the intensive margin of credit demand. Both models also provide indirect light on the validity of the Adverse Selection on observables of Ausubel (1999). For the $\boldsymbol{X_2}$ group of variables, it is to be expected worse credit characteristics to be associated with larger probabilities of credit acceptance – as well as larger

amounts borrowed. Test of difference of means will also be carried out between groups which accepted the offer and groups which did not accept, and also between groups which received different offers.

The third model will be used for the third research question. The coefficient of the variable of the revolving credit limit on the quarter immediately before default would capture part of the default cost and the effects of ex post moral hazard from the borrower.

The next section presents the main results for the estimated models and for the paper hypotheses.

b. Results: Interest sensitivity of credit demand

The first research question is concerned with interest sensitivity of credit demand, both in the extensive and intensive margins. Both Table 4 and Table 5 on the next pages present the estimates of the PROBIT model, and the robust standard errors. The elasticities are also reported, with robust t statistics:

Table 4 – Model Results – Extensive Margin

	Premium Group – PROBIT								Inter Group– PROBIT							
	Coefficient		Elasticity		Coefficient		Elasticity		Coefficient		Elasticity		Coefficient		Elasticity	
Offered Rate	-2.093	***	-2.735	***	-2.148	***	-2.832	***	-0.541		-0.807		-0.524		-0.785	
	(-7.68)		(-7.61)		(-7.82)		(-7.74)		(-1.03)		(-1.03)		(-0.99)		(-0.99)	
Amount Borrowed	-0.00000982	**	-0.279	**	-0.00000813	*	-0.233	*	0.0000224	*	0.382	*	0.0000236	*	0.404	*
	(-3.11)		(-3.11)		(-2.55)		(-2.55)		(2.44)		(2.43)		(2.55)		(2.54)	
Days Late (t=0)	-0.0281		-0.0131		-0.0384	*	-0.0180	*	0.00822		0.00465		-0.00125		-0.000711	
	(-1.84)		(-1.83)		(-2.26)		(-2.26)		(0.60)		(0.60)		(-0.09)		(-0.09)	
Amount Late(t=0)	0.000477	*	0.00155	*	0.000569	*	0.00187	*	-0.00185		-0.00477		-0.00153		-0.00396	
	(2.01)		(2.00)		(2.38)		(2.38)		(-1.02)		(-1.02)		(-0.82)		(-0.82)	
Number of Accounts (t=0)	0.137	***	0.489	***	0.130	***	0.470	***	0.192	***	0.695	***	0.199	***	0.723	***
	(4.89)		(4.87)		(4.59)		(4.57)		(4.29)		(4.26)		(4.36)		(4.34)	
Bounced Check (t=0)	0.0108		0.0000365		-0.210		-0.000718		0.685		0.00147		0.703		0.00152	
	(0.03)		(0.03)		(-0.48)		(-0.48)		(1.51)		(1.51)		(1.55)		(1.55)	
Other Behavior Scores (t=0)	-0.00396	***	-3.393	***	-0.00353	***	-3.048	***	-0.00402	*	-3.548	*	-0.00345	*	-3.061	*
	(-4.02)		(-4.01)		(-3.50)		(-3.49)		(-2.42)		(-2.41)		(-2.05)		(-2.05)	
Worst B. S. (t=0)	-0.000637	***	-1.030	***	-0.000560	***	-0.913	***	-0.000565	*	-0.941	*	-0.000493	*	-0.825	*
	(-4.20)		(-4.20)		(-3.35)		(-3.35)		(-2.49)		(-2.49)		(-2.04)		(-2.04)	
Date of Oldest Account of Cust. (t=0)	-0.000637	**	-0.231	**	-0.00402	**	-1.468	**	-0.00186	**	-0.526	**	-0.00168		-0.478	
	(-2.85)		(-2.85)		(-2.96)		(-2.94)		(-3.27)		(-3.25)		(-1.64)		(-1.64)	
Amount Due of Credit Card/Limit (t=0)	0.214	*	0.0610	*	0.147		0.0425		0.383	**	0.130	**	0.340	*	0.116	*
	(2.23)		(2.23)		(1.45)		(1.45)		(2.84)		(2.84)		(2.44)		(2.43)	
Worst BS of Customer (t+12)					-0.000196		-0.291						-0.000106		-0.162	
					(-1.51)		(-1.50)						(-0.70)		(-0.70)	
Date of Oldest Account of Cust. (t+12)					0.00357	**	1.327	**					-0.000147		-0.0438	
					(2.66)		(2.65)						(-0.15)		(-0.15)	
Bounced Check (t+12)					0.457	***	0.00676	***					0.202		0.00314	
					(3.77)		(3.77)						(0.91)		(0.91)	
Other Behavior Scores (t+12)					0.000198		0.165						0.000264		0.219	
					(1.00)		(1.00)						(0.84)		(0.84)	
Defaulted until t+12 months					0.812	***	0.0340	***					0.570	***	0.0319	***
					(9.88)		(9.75)						(5.36)		(5.33)	
Constant	-0.0692				-0.252				-1.100	*			-1.370	*		
	(-0.21)				(-0.74)				(-1.99)				(-2.40)			
Demographics	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Revolving Credit	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
N	86336		86336		86336		86336		45356		45356		45356		45356	
Pseudo-R2	.02801		.02801		.04677		.04677		.02382		.02382		.03753		.03753	
Revolving Credit=0 (p-val)	.1493		.1493		.3137		.3137		.6679		.6679		.9376		.9376	

T Stats in Parentheses. Demographics = Gender, Marital Status, Own Home and Income

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

Table 5 – Intensive Margin – TOBIT Models

	Premium - TOBIT								Inter - TOBIT							
	Coefficient		Elasticity		Coefficient		Elasticity		Coefficient		Elasticity		Coefficient		Elasticity	
Offered Rate	-6850.4	**	-0.187	***	-7050.0	**	-0.194	***	-1513.3		-0.102		-1437.8		-0.0989	
	(-2.96)		(-3.97)		(-3.04)		(-4.12)		(-1.11)		(-1.12)		(-1.08)		(-1.09)	
Installment Value	21.67	***	0.00545	***	21.34	***	0.00541	***	19.47	***	0.00474	***	19.15	***	0.00475	***
	(32.10)		(7.38)		(32.94)		(7.33)		(21.11)		(7.51)		(21.54)		(7.49)	
Credit Accepted	-0.243	***	-0.144	***	-0.230	***	-0.137	***	-0.135	**	-0.104	**	-0.132	**	-0.103	**
	(-6.57)		(-4.99)		(-6.38)		(-4.83)		(-3.18)		(-2.85)		(-3.18)		(-2.86)	
Days Late (t=0)	-67.10		-0.000651		-101.0		-0.000989		17.93		0.000459		5.866		0.000153	
	(-1.03)		(-1.06)		(-1.42)		(-1.49)		(0.76)		(0.77)		(0.26)		(0.26)	
Amount Late (t=0)	1.435	*	0.0000974	*	1.796	*	0.000123	**	-2.478		-0.000288		-2.255		-0.000268	
	(2.10)		(2.45)		(2.57)		(3.14)		(-0.95)		(-0.97)		(-0.81)		(-0.82)	
Number of Accounts (t=0)	515.5	**	0.0385	**	482.2	*	0.0363	**	560.4	***	0.0919	***	557.2	***	0.0931	***
	(2.67)		(2.99)		(2.51)		(2.77)		(4.47)		(6.17)		(4.42)		(6.14)	
Bounced Check (t=0)	-2646.9	***	-0.000187	*	-2891.6	***	-0.000206	**	1304.9		0.000127	*	1294.8		0.000128	*
	(-3.73)		(-2.56)		(-3.62)		(-2.83)		(1.91)		(2.05)		(1.91)		(2.05)	
Other Behavior Scores (t=0)	-5.330		-0.0952		-3.964		-0.0714		-5.093		-0.203		-3.912		-0.159	
	(-0.85)		(-0.92)		(-0.65)		(-0.69)		(-1.07)		(-1.03)		(-0.83)		(-0.80)	
Worst Behavior Score Customer (t=0)	-2.543	***	-0.0856	***	-2.303	**	-0.0783	***	0.424		0.0319		0.519		0.0399	
	(-3.52)		(-3.98)		(-3.06)		(-3.32)		(0.30)		(0.30)		(0.36)		(0.36)	
Date of Oldest Account of Cust. (t=12)	-2.137		-0.0161		-14.92	**	-0.114	**	-5.660		-0.0724		-3.824		-0.0499	
	(-0.91)		(-0.97)		(-2.80)		(-3.22)		(-1.68)		(-1.89)		(-1.16)		(-1.19)	
Amount Due of Credit Card/Limit (t=0)	566.6		0.00337		333.2		0.00200		117.9		0.00181		6.232		0.0000976	
	(0.98)		(1.03)		(0.57)		(0.59)		(0.26)		(0.26)		(0.01)		(0.01)	
Worst B. S. Customer (t+12)					-0.748		-0.0231						0.165		0.0115	
					(-1.37)		(-1.38)						(0.46)		(0.47)	
Date of Oldest Account of Cust. (t+12)					13.53	**	0.105	**					-1.918		-0.0263	
					(2.78)		(2.95)						(-0.64)		(-0.66)	
Bounced Check (t+12)					1473.1	**	0.000454	***					457.1		0.000327	
					(2.90)		(3.49)						(1.23)		(1.24)	
Other Behavior Score (t+12)					1.261		0.0219						0.450		0.0171	
					(1.24)		(1.20)						(0.74)		(0.74)	
Default in until t+12					2947.6	***	0.00257	***					753.7	**	0.00194	***
					(5.04)		(9.44)						(3.28)		(3.84)	
Constant	-5004.1	**			-5639.0	**			-3190.1				-3719.9	*		
	(-2.72)				(-3.06)				(-1.95)				(-2.19)			
Sigma	4246.0	***			4190.8	***			1809.8	***			1772.1	***		
	(5.90)				(5.91)				(5.75)				(5.81)			
Demographics	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Revolving Credit	Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
N	86336		86336		86336		86336		45356		45356		45356		45356	
Pseudo-R2	.2617		.2617		.265		.265		.3121		.3121		.314		.314	
Revolving Credit=0 (p-val)	.5103		.5103		.5257		.5257		.003474		.003474		.005341		.005341	
Obs Value>0	577		577		577		577		213		213		213		213	

T Stats in Parentheses. Demographics = Gender, Marital Status, Owns Home and Income

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

For each group – either Premium or Inter – two versions of all models were estimated. In the first one, only variables that were observed at the moment of the offer were included (these marked (t=0)), for individual characteristics, observed behavior score and credit card usage. In the second one were also included variables for the borrower's credit quality in twelve months after the credit offer (marked (t+12)), in order to capture part of the unobserved customer characteristics at the moment of the experiment.

As for the interest elasticity of credit demand, the two groups present an important difference. For the higher income group, Premium, the demand seems to be interest rate elastic on the extensive margin, and inelastic (but significant) on the intensive margin. These results indicate a decrease in interest rates to be accompanied by a strong increase in credit acceptance, but a lower than proportional decrease in amount borrowed. On the other hand, for the lower income group, International, a different picture is presented. For both margins the credit demand seems to be interest inelastic.

The other offer component, the amount borrowed, some differences also present themselves. For the International group, the amount borrowed is positively related to the offer acceptance probability, the opposite to the results found for the Premium group. And finally, no evidence is found on the importance of the revolving credit balance on the offer acceptance decision, in both margins.

The next section is concerned on the empirical analysis of the effects of the Adverse Selection on observables.

c. Results: Adverse Selection on Observables

The starting point of the analysis of the Adverse Selection on Observables is a test for difference in means to check is the customers who accept the credit offer have worse observed characteristics than those who did not accept and also if, among those who accepted, those who contracted under worse terms are worse credit risks than those who contracted under better terms.

The test is carried out in a regression framework, and the relevant variances computed in the heteroskedasticity-robust version, because the groups were of unequal sizes and the assumption of equal variances could not be maintained[7].

Table 6 – Test for Difference of Means

	Premium		Inter	
	Difference	p-value	Difference	p-value
Amount Due Credit Card	-12.97667	0.78728	138.28914	0.15852
Credit Card Limit	-1388.25780	0.00000	-269.88950	0.28318
Limit ATM (t=0)	5.08272	0.03199	14.53498	0.01522
Behavior Score Acct.	-4.95691	0.00000	-4.74515	0.00579
Days Late (t=0)	-0.04165	0.31295	-0.06093	0.27598
Amount Late (t=0)	3.79386	0.11579	-0.27154	0.46096
Other B.S. Cust. (t=0)	-3.52377	0.00000	-3.54786	0.00189
Worst B. S. Cust. (t=0)	-16.46025	0.00003	-17.56272	0.01555
Income	-23168.05300	0.32182	254.44545	0.99583

Null Hypothesis: Equality of group means.

In the table above is presented the difference of means between the customers who accepted the offer and those who did not, as well as the p-value for the null hypothesis of equal means between groups. The results indicate the customers who accepted the offer were worse credit risks for the bank (lower behavior scores), in both groups, in accordance to the Adverse Selection in Observables hypothesis of Ausubel (1999). This result holds for both groups.

Still according to Ausubel (1999), the second part of the test is concerning the differences in interest rates. In the same paper, it is advanced the higher the interest rate, the worse is the customer pool who accepts the offer. In the following table is presented the tests for difference of means between groups exposed to different interest rates offered, among those who accepted. The following table does not provide evidence for worse credit risks for worse terms offered.

Table 7 – Difference of Means – Groups of Offers (p-values)

	Premium	Inter
Amount Due Credit Card	0.32437	0.75659
Revolving Credit Limit	0.35173	0.72168

[7] In other words, the problem was rewritten as a regression model, and the difference of means was tested as an hypothesis for a coefficient (for which a robust standard error was computed).

ATM Limit (t=0)	0.54179	0.31353
Behavior Score Account	0.30284	0.08241
Days Late (t=0)	0.70862	0.11452
Amount Late (t=0)	0.59421	0.03659
Other B. S. Cust. (t=0)	0.80323	0.10897
Worst B. S. Cust. (t=0)	0.44871	0.14090
Income	0.15347	0.39586
Share of Defaulters	0.17111	0.92932

P-Value (H0=Equal Means Between Groups)

The results on the observed credit quality of borrowers between offers indicate those are similar in this respect, among those who accepted the offer, at odds to the hypotheses of Adverse Selection on Observables by Ausubel (1999). These conclusions are also consistent with the results at tables 4 and 5. In table 4, the estimates indicate a worse (lower) credit rating to be associated with a larger probability of offer acceptance in both groups. In table 5, concerned with the intensive margin, evidence is found only for the higher income group, Premium.

And finally, with regards to the unobserved characteristics of borrowers, as well as the moral hazard effects, the next section develops the results.

d. Moral Hazard

In this section is investigated the role of the other major informational problem in borrowing decisions: moral hazard. More specifically, the moral hazard problem appears when the borrowed voluntarily decides not to repay the amount borrowed. In order to identify such effects is required some measure of cost associated with the non-repayment decision. In the experimental database, considering the offer characteristics, data is available on the credit card usage at the time of the offer and until twelve months after that time.

If the borrower does not honor his commitment, the associated credit card becomes inactive – that is, the customer is not able to make additional purchases. In that sense, the revolving credit limit is part of the opportunity cost of the non-repayment decision. In the absence of moral hazard effects, the credit card limit would not have any effect on the default decision.

The next table presents the estimates from a PROBIT model for the default decision, among those who accepted the offer, for the same two groups of customers.

Table 8 – Default Decision

	Premium				Inter			
	Coef		Elasticities		Coef.		Elasticities	
Offer Rate	3.859	*	4.109	*	5.031		6.493	
	(2.09)		(2.06)		(1.33)		(1.27)	
Installment amount	-0.00239	***	-3.636	***	-0.00439	*	-4.371	
	(-4.05)		(-3.49)		(-2.00)		(-1.75)	
Amount Borrowed	0.000171	**	3.484	**	0.000543	**	7.711	*
	(3.13)		(2.89)		(2.91)		(2.34)	
Days late (t=0)	0.00174		0.000484		-0.0546		-0.0369	
	(0.04)		(0.04)		(-0.53)		(-0.52)	
Amount Late (t=0)	-0.0131		-0.148		0.0540		0.137	
	(-0.80)		(-0.78)		(1.62)		(1.51)	
Number of Accounts Cust. (t=0)	0.384		1.276		-0.202		-0.711	
	(1.79)		(1.76)		(-0.49)		(-0.48)	
Other Behavior Scores Cust. (t=0)	0.0109		7.769		-0.0262	*	-19.93	*
	(1.54)		(1.53)		(-2.25)		(-2.09)	
Worst B. S. Cust. (t=0)	0.00189	*	2.498	*	-0.00125		-1.748	
	(2.52)		(2.47)		(-1.01)		(-0.98)	
Oldest account of Customer (t+12)	0.000192		0.0461		-0.00204		-0.410	
	(0.14)		(0.14)		(-0.51)		(-0.50)	
Bounced Check (t+12)	2.010	***	0.159	***	2.183	**	0.105	**
	(5.74)		(4.97)		(3.08)		(2.59)	
Other B. S. Customer (t+12)	-0.0128	***	-8.799	***	-0.00335		-2.415	
	(-4.94)		(-4.32)		(-1.80)		(-1.70)	
Amount due Credit Card as % of limit (Before Default)	0.966		0.288		2.082	*	0.817	*
	(1.83)		(1.81)		(2.45)		(2.41)	
Amount Due of Credit Card/Limit (t+12)	3.388	***	6.420	***	3.643	*	7.064	
	(4.68)		(3.87)		(2.18)		(1.90)	
Credit Card Limit	-0.0000106		-0.286		-0.000132	**	-2.271	*
	(-0.39)		(-0.39)		(-2.58)		(-2.33)	
Constant	-7.121	**			1.173			
	(-2.82)				(0.26)			
Demographics	Yes		Yes		Yes		Yes	
Revolving Credit	Yes		Yes		Yes		Yes	
N	577		577		213		213	
Pseudo-R2	.3697		.3697		.4319		.4319	
Revolving Credit=0 (p-val)	.03102		.03102		.03118		.03118	

T Stats in Parentheses. Demographics = Gender, Marital Status, Owns Home and Income
* p<0.05, ** p<0.01, *** p<0.001

The results in table 9 are directly relevant to the study of Moral Hazard effects on the credit demand. The revolving credit amount in the quarter immediately before the default (or until the twelfth month after the offer, in case of non-default) is significant for the default decision in the International Group. This is indicative of moral hazard effects for this sub-sample.

All these results point to remarkably different behaviors between groups of customers. The larger income group, Premium, presents a interest sensitivity for credit demand quite similar to the one found by Gross and Souseles (2004) for developed countries; an extensive margin interest elastic and an intensive margin interest inelastic. For the lower income group, both intensive and extensive margin were insensitive to interest rates, consistent with the results observed for microcredit in developing countries.

As for the second hypothesis, the Adverse Selection in observables, we have mixed evidence of its effects in the examined sample; there is evidence for a statistically significant difference in credit quality between customers who accepted the offer and those who did not. Furthermore, lower credit scores were also associated with higher probabilities of offer acceptance. However, there is no evidence worse offers attracted worse credit risks.

The results also point out to the effects of Moral Hazard in this market, more specifically in the lower income group (inter). The higher the revolving credit limit, the lesser the default probability for this group.

To a large extent, besides being in line with the results of similar studies in other countries and income levels, the results here shed some light to the customer credit markets in Brazil. As in Karlan and Zinman (2006), the interest sensitivity of credit demand is also related to income levels in this study – the higher the higher the income of the borrower.

The Premium group, with larger incomes and lower credit risk, has access to alternative credit sources and a decrease in interest rates in credit will attract more demand from these alternative credit offers, consistent with an interest elastic demand in the extensive margin for this group.

These characteristics do not apply for the lower income group. Given the lower number of alternatives available, a decrease in interest rates does not attract more credit from

alternatives. For this group, the moral hazard effects are also relevant. For neither group a decrease in interest rates elicit an improvement in behavior scores.

5. Concluding Remarks

This paper tries to investigate some important questions on personal credit demand for a group that is little studied in this literature: the middle class in a large emerging market. In order to do so, a database from an experiment carried out by one of the largest credit card issuers was used, in which randomized interest rates were sent to customers of two different groups.

The first one – called Premium – has a median income similar to developed countries, around USD 20,000/year, and the second one, Inter, has a lower median income at about USD 8,000/annum.

From this database, three hypotheses were investigated. The first one is concerned with the interest sensitivity of credit demand, both in the extensive margin (offer acceptance or not) and in the intensive margin (amount borrowed). The second one is concerned with the Adverse Selection on observables problem in this market, with the customers who accept the offer being worse credit risks than those who do not. And finally, the third group of hypotheses is focused on the effects of moral hazard on the default decision on the borrowed amount.

The results indicate for the Premium group, with higher incomes, an interest elastic demand in the extensive margin. For the intensive margin, this group had an inelastic demand. For the lower income group, International, the demand did not seem to be elastic in any margin, and no interest elasticity was significant.

As for the Adverse Selection in Observables, as in Ausubel (1999), the customers who accept the credit offer seem to be worse credit risks than those who did not accept. Furthermore, the worse the customer's behavior score, the larger the probability he will accept the offer. However, it was not found any difference between those who accepted worse credit offers and those who accepted better credit offers.

As for the moral hazard problem, it was found lower income group had a negative correlation between the credit card limit in the quarter immediately before default and the default

decision. This result supports the importance of moral hazard considerations for lower income groups in default decisions.

All these results point to a quite different behavior between these groups. The lower income, called middle class according to emerging market standards, still have some characteristics of poorer income groups of emerging markets, and the higher income group already seems to look like the middle class of developed countries.

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