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BORROWING CONSTRAINTS AND CREDIT DEMAND

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Resumen

Este artículo analiza los determinantes de la demanda por crédito en presencia de restricciones crediticias para la economía chilena utilizando una reciente e innovativa fuente de información: la Encuesta Financiera de Hogares. El procedimiento de estimación implementado permite que la deuda observada sea una función de múltiples reglas de selección e incorpora endogeneidad de ingreso y activos en la ecuación de deuda. El artículo provee evidencia contundente acerca de la relación altamente no lineal entre el ingreso de los hogares y su deuda, tanto asegurada como no asegurada. Este resultado tiene claras implicancias para el nivel de endeudamiento de los hogares en presencia de desregulación financiera.

Abstract

This paper investigates the determinants of credit demand in the presence of borrowing constraints for the Chilean economy using a recently collected detailed and innovative data set, the Households Financial Survey. The estimation procedure employed allows for the observed debt to be a function of multiple selection rules and incorporates the endogeneity of income and assets into the debt equation. The paper provides compelling evidence that the relationship between household income and debt, both secured and non secured, is highly non linear. This result has clear implications for the level of household debt in the face of financial deregulation.

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1 Introduction

The last decade has seen a steady growth in the level of the borrowing debt carried by Chilean households (see Banco Central de Chile, 2009). Moreover, this increased borrowing does not simply reflect higher household incomes since debt, as measured as a fraction of total household income, has also increased dramatically over this period. In fact, the growth rate of debt has now consistently surpassed that of real GDP for several decades. This increasing level of debt has raised concerns among commentators regarding the Chilean economy's capacity to sustain more household sector debt and the potential implications of the burden of excessive household debt for the state of the economy.

While Fuenzalida and Ruiz-Tagle (2009) have studied the vulnerability of Chilean households financial stability, and its implications for the financial system to aggregate unemployment shocks, the relationship between the Chilean financial sector and household indebtedness is relatively unexplored. As financial systems further develop it is likely that the Chilean economy will experience a relaxation of borrowing constraints, potentially inducing higher levels of household indebtedness. Accordingly, it is extremely important that we obtain a greater understanding of what determines the level of debt for Chilean households.

This objective of this paper is to examine the determinants of debt held by Chilean households. We do so by estimating a model of household debt which incorporates the presence and potential endogeneity of borrowing constraints. We also account for the potential endogeneity of key regressors. Demand for consumption loans and mortgages are treated in separated models to allow different processes for each. We estimate the model via a semi-parametric approach using a recent survey of Chilean households which provides detailed household information at a greater level than was previously available. The next two sections of the paper describe the level of household debt at the macro level and focus on the evidence regarding borrowing constraints. Section 4 of the paper provides a detailed description of the Encuesta Financiera de Hogares (EFH) data which we analyze here. The remaining sections then describe the results from estimating a model of the determinants of credit demand.

2 Household Indebtedness and Credit Constraints

Real banking debt held by household represents more than 70% of total household debt (see Figure 1) and has grown almost 15% in average real annual terms between the

years 2003 and 2008. As a result, real banking debt has almost doubled during this period while real GDP increased by only 30% for the corresponding period.

The last several years have also seen the growth in total household debt surpass the growth in the disposable household thereby significantly increasing the ratio of debt to disposable income. From the fourth quarter in 2003 to the corresponding quarter in 2008 this aggregate indicator increased has reached almost 69% from 44%. Furthermore, over the same period the financial service burden to disposable income ratio increased from 14% to 20% (see Figure 1).

Since banking debt is the most important component of household debt, this increased exposure of the banking system to household sector is a matter of concern from a financial stability perspective. Banking exposure, measured as the sum of total mortgage and consumer loans as a percentage of total banking loans, has increased from 15% at the beginning of the 1990s to over 33% in 2008.

Even though Chilean households are increasing their debts, there are no clear signs that Chile is following a trend significantly different from other countries. In fact, the relationship between households' debt to GDP and per capita GDP suggests that household debt is not a significant share of GDP. Nevertheless, the financial service burden to disposable income ratio is not particularly low compared to its economic development –measured as the per capita GDP (see Figure 2). This last observation is related to the length of the loans and the high interest rates, when compared to developed economies.[1]

While a macroeconomic analysis of the data provides an interesting perspective a corresponding investigation of household debt at the microeconomic level reveals a remarkable degree of heterogeneity across Chilean households. The most noticeable feature of the data when examined at the household level is the distribution of debt across households. More explicitly, the vast majority of debt is held by high income groups. This is particularly important in Chile due to its relatively high levels of income inequality suggesting that a large proportion of the debt is borne by a relatively small proportion of households. In fact, the distribution of debt appears to follow a similar pattern to that of income.[2] This is a feature of the data which is uncovered by

[1] There are some caveats about the financial service burden since in some countries, debt service refers only to interest payments while in others it includes required loan payments which include both interest and principal repayments (including Chile).

[2] See Cox, Parrado and Ruiz-Tagle (2007).

different various microeconomic surveys, although the evidence suggests it may be slightly changing over time, suggesting a financial deepening process. Moreover, a household's ability to pay back debts may vary considerably depending on its debt and income levels. This is an important reason to consider households heterogeneity when analyzing households financial vulnerability.

3 Debt Levels and Borrowing Constraints

Markets do not offer credit irrespective of the individual, so that there is no supply of credit that is the same for everybody. Each person is offered credit in a different manner, with different restrictions, and in different amounts. Examples of this are department store credit cards and bank credit cards, where each individual has different quotas and pays different (implicit) interest rates. These particular features of the financial markets tend to be accentuated in developing countries where markets are less mature and where the authority has less power to control the behavior of loan issuers.

Zeldes (1989) defined credit constraints on the basis of the level of assets. Jappelli (1990) and Bertaut and Haliassos (2004) prefer to define as credit constrained those who have a demand for credit which is higher than the supply of credit they face, although they do not distinguish explicitly an individual supply of credit. On the other hand, Gross and Souleles (2002) define as credit constrained those who cannot access low-cost credit and hence end up using high-cost credit (credit cards).

In the Chilean case, following Gross and Souleless and using a lower bound measure of credit constraint, Ruiz-Tagle (2009) finds that at least 29% of Chilean households were credit constrained in 1988, 21% in 1997, and 41% in 2004. Empirical evidence for developing countries to assess the extension of liquidity constraints is scarce. A reasonable comparison is the estimations by Grant (2007) for the US between 1988 and 1993, who finds that between 26% and 31% of the population were credit constrained. In addition, Crook and Hochguertel (2007) estimated similar figures for the US, but much lower levels for Netherlands, Italy and Spain, as will be shown in the following section.

4 The Chilean Survey of Households Finances

To assess the households' demand for credit it is necessary to employ detailed financial data at the household level. While data of this type have, until very recently, been unavailable in Chile, the Chilean Survey of Household Finances (Encuesta Financiera de Hogares - EFH) provides the type of household information which enables such an analysis.

The EFH was first conducted by the Central Bank of Chile in 2007. This initiative, a pioneer in the region, elicits detailed information regarding labor market status, real estates ownership, financial assets, debts, perceptions about debt service, access to credit, pensions, insurances and savings. The EFH 2007 included 4,021 households which were considered to be representative of the population at the national urban level. Furthermore, since there are many assets held by only a small fraction of the population, the survey also has an oversample of the wealthier households. Through the collaboration of the Tax Office (Servicio de Impuestos Internos) it was possible to obtain a sample with a significant oversampling of the high wealth households.[3] Therefore, the EFH 2007 constitutes the only statistical source in Chile that provides complete information about the balance sheets of the households as well as their ability to service financial commitments.[4]

To begin our analysis we describe some of the primary features of the data. As stated above, the EFH collects not only data on debts and income, but also on perceptions related to the household financial situation. Households are asked to report whether they had been rejected in a loan application, and also if they did not apply because they thought they would be rejected.

Following the literature for the US and Europe,[5] we take these two cases as reflecting credit constrained households.

Table 1 supports our earlier statement that the distribution of household debt mirrors that of household income. This table reports the level of debt when broken down by quintiles of the income distribution. Also note that 63% of households hold some debt while 16% of households report being credit constrained. However while the holding

[3] The EFH follows the sample design of the SCF.

[4] Description, methodology and results of the Chilean Survey of Household Finances 2007 are explained in Banco Central de Chile (2009).

[5] See Jappelli (1990) and Cox and Jappelli (1993) for seminal studies, and Crook and Hochguertel (2007) and Grant (2007) for recent developments.

of debt appears to be invariant to location in the income distribution, the probability that the household is credit constrained is not. In fact, the proportion of households with credit constraints reaches 25% in the bottom quintile, while only 5% in the top quintile report being credit constrained.

Overall levels of credit constraints must be read with care. Although the figure of 16% may appear low compared to US figures around 30%, it is much larger than estimations for European countries. In fact, Crook and Hochguertel estimated credit constraints in the 1990s and 2000s at 2.4-3.7% for Netherlands, 3.3-2.7% for Italy, and 3.4% for Spain (2004 only in this case). However, it must be considered that questionnaires refer to previous two years preceding the surveys in Netherlands and Spain, one year in Italy, and five years in the US. In the Chilean case, the questionnaire refers to last two years. The inclusion of "discouraged borrowers" as credit constrained households implies another source of complexity for international comparisons. For example, in the US and in the Netherlands it is possible for a household to have applied for a credit and to have been discouraged, whereas in Italy, Spain, and in Chile the questionnaire does not allow for this: a household may only be discouraged if it did not apply for a loan.

Coming back to debt in Chile, Table 2 reports the distribution of debt by age of household head. An examination of this table reveals that the proportion of households with positive debt is fairly similar across age cohorts, except for those aged 65 and more. However, the amount of debt held by households is concentrated in those whose head is aged between 35 and 54. This reflects a life-cycle pattern in which the primary component of the debt is mortgage debt. Note that the level of debt follows closely the distribution of income by age. The presence of credit constrains is decreasing with age and the very young households are significantly credit constrained.

The geographical distribution shown in Table 3 reports some interesting patterns. On the one hand debt holding is rather similar across geographical areas. However, debt is highly concentrated in the Metropolitan Region (70% of total debt). Actually, the distribution of debt tracks very closely the concentration of income. On the other hand, the presence of borrowing constrains has significant variation across regions. While northern regions have above average levels of constrains (almost 24%), center regions and Metropolitan Regions have below average levels of constrains (14% and 15.4% respectively). The geographical dispersion of northern regions, where supply of credit is more concentrated in main cities may explain part of the story. In parallel, the fact that the majority of debt is held in the Metropolitan Region, where credit constrains are below average may indicate a relevant role for supply of credit.

Table 4 presents the distribution of debt by educational level of the household head. It is noteworthy that households with tertiary education hold the vast majority of debt. More explicitly, these households hold 86% of total household debt. A similar concentration occurs with income, where 78% of income is held by households with tertiary education, reinforcing the linkage between income and debt holding. While 52% of the households which report that the head has a maximum of primary education report having a positive level of debt, 68% of households with tertiary education do so. Of the households which report the maximum level of education attained by the head is primary education, 23% respond that they are credit constrained. Of those reporting a maximum of secondary education 20% indicate they are constrained. In contrast, of those reporting having tertiary education only 11.5% credit constraints respond that they face credit constraints.

Thus, despite the geographical peculiarities, the distribution of debt and the presence of credit constraints appear to be highly related to the distribution of income and educational levels (which are also highly correlated among them). However, access to some credit (positive debt), seems to be widely distributed across households.

Finally, we focus on debt holding and credit constraints. Table 5 shows that 52% of households are unconstrained debt holders. Only 4.7% of households are constrained non debt holders, and 11.1% of households are constrained debt holders. This means that relaxing borrowing constrains would affect a relatively small number of households. These characteristics of the credit situation among households indicate that a more profound financial deepening process could play a limited role in increasing borrowing levels. What seems to be the most important component in driving borrowing is income, where larger income shares are associatd to the larger debt shares. Table 6 shows the number of observations available for estimation purposes.

5 Which Chilean Households Hold Debt?

An important feature of the data described is that a large proportion of the households report not having debt. The absence of debt is the reflection of demand and supply issues so it is valuable to explore the determinants of the probability that a household possesses some debt. The previous section described some of the relationships between the probability of, and the level of, debt and the household characteristics. We now explore these potential relationships somewhat more rigorously. To do so we first

estimate a model which explains the probability that an individual household is borrowing constrained. We then estimate a model of whether the household has debt. Each of these models is intrinsically of interest as they each provide insight into the working of the credit market in Chile.

The first model has the following form:

$$N_i = I(X_{Ni}\beta_N + u_{Ni} > 0) \qquad (1)$$

where N_i is an indicator which takes value 1 if the household reports it is borrowing unconstrained and the value 0 otherwise; the X_{Ni}'s are exogenous variables, β_N is an unknown parameter vector and the u_{iN} are zero mean error terms. The results from estimating this model are reported in column 1 of Table 8. Note that the models are estimated via least squares but where we allow for non linearities between the continuous explanatory variables and the dependent variable. Thus while the estimator is based on a least squares principle it shares some features of semi-parametric estimation as the number of non linear terms is chosen by a cross validation procedure.

Before we focus on the estimates of this model it is useful to consider the variables which we include in the X_N vector. In addition to the household characteristics mentioned above (age, education and income[6]) we included real estate assets, gender (1 if Male), spouse (1 if spouse present in household), total number of people in household, and total number of employed individuals in household. We also included average area income (at the municipality level), to proxy for geographical income segregation, and regional controls. In addition to the household variables, we included variables which capture some essence of supply controls at the municipality and at the regional level. We employ a ratio of number inhabitant per number of banks present in each municipality and in each region as proxies for financial lack of financial deepness. These variables are related to the facility to access the banking system by the people in each area. Table 7 summarizes these variables.[7]

Before turning to the estimates it is interesting to note a few features of the data. First, there is a significant part of the indebted households whose debt is relatively low (25% of households have debt below monthly income average). Non real estate assets

[6] We used annual total household income.

[7] Income variables are in Ch\$ millions.

account for only a fifth of real estate assets. On the other hand, households head are relative mature, being on average 50 years old.[8] It is also interesting to note that 45% of households indicate that they do not need a credit. The proportion of households that report being paying financial services already too high reaches 29%.

There is also significant variation in area average income (at the municipality level) and substantial variation in the supply variables related to the bank system availability, both at the regional level and at the municipality level. While the minimum is 17 branches in a region, in the metropolitan regions there are as many as 930. Even at the municipality level there is a lot of variation. In this dimension the number of banks ranges from 1 to 23, and the number of branches ranges from 1 to 222.

Borrowing constrains probability estimations are presented in column 1 of Table 8.[9] The results show that education, real estate assets, area income, and having signed a job contract, significantly increase the probability of being unconstrained. These are all variables related to permanent income, indicating that borrowing constrains decrease with it. Also, self perception of being paying high financial services reduces significantly the probability of being unconstrained, showing that the credit scoring process may capture well self perception of indebtedness. Age exhibits a concave profile, although the coefficients are not statistically significant.

The lack of financial deepness, measured as the number of inhabitants per number of banks, decreases the probability of being unconstrained. This is a particularly interesting result the financial deepening may play a significant role in reducing credit constrains among the population. Regional effects do not show any significant affect, indicating that probably regional heterogeneity is already captured in the financial deepness variables and in area income. In parallel, the credit scoring process is also reflected in that some arrears variables exhibit positive statistically significant coefficients.

On the other hand, the presence of a spouse and being a male have no statistically significant effect. The number of persons in household significantly reduces the probability of being unconstrained; indicating that per capital income may play a

[8] Recall there is oversampling of the rich, so that wealthier households tend to be relatively older.

[9] Regressions were run without using weights, so statistical significance of coefficients may be reduced. The use of sample weights should give results more representative of the Chilean population. However, preliminary results using weights gave similar results.

relevant role. However, the number of employed persons in household does not show a significant effect, revealing no intra-household risk sharing effect.

While the results in column 1 of Table 8 are interesting in that they capture the determinants of the household's propensity to be borrowing constrained, they only partially reflect the process by which we observe whether or not the household has debt. More importantly, if we wish to estimate the demand for debt it is clear that we need to observe positive values of debt for unconstrained households. Accordingly, in addition to estimating whether a household faces borrowing constraints we estimate the following equation:

$$B_i = I(X_{Bi}\beta_B + u_{Bi} > 0) \qquad (2)$$

where B_i is an indicator which takes the value 1 if the household reports that it holds some debt and the value 0 otherwise; the X_{Bi}'s are exogenous variables, β_B is an unknown parameter vector and the u_{iB} are zero mean error terms. The model is estimated in a similar manner to the equation explaining whether the household is borrowing constrained and the results are reported in column 2 of Table 8. Once again the specification of the X_B's reflects that many of the characteristics of the household head are likely to influence the probability that the household hold debt. In addition we included a dummy variable equal to 1 if household feels it is paying too much in debt service (including interests and principal).

An examination of the estimation results for this model reveals that the coefficients generally display the expected signs, where many of the coefficients are statistically significant. The effect of years of education of household head exhibits the expected positive and significant coefficient. Real assets however, does not seem to play a relevant role as collateral.

The presence of the spouse in the household has a positive incidence in debt holding, so does a male household head, although the latter has no statistically significant coefficient. Age has a concave profile as expected. The number of persons in household increases the probability of holding debt. Area income shows a negative sign with a significant value, supporting the idea of some geographical income segregation. Regional effects are positive only for northern regions, which may be linked to the high wages of mining sector.

The perception that the household is over paying in debt services has a positive and statistically significant value, which was expected from a demand point of view. In fact, it is expected that debt holders consider that consumer loans make them struggle to some extent in their balance sheets.

6 Estimating the Determinants of Household Debt

While the estimates of the models discussed in the previous section are interesting, as they provide insight into the availability and use of debt and how it varies across by household characteristics, the primary focus of our investigation is what factors determine the level of household debt. Accordingly we now focus on this question.

It was noted above that only 63% percent of the household report positive debt (56% hold consumption loans). Thus if we were to estimate a model of debt level over these households there is the possibility that a sample selection bias arises. That is, while estimating the equation over the sample of households reporting positive debt enables us to make inferences about that sample, it may not be true that these inferences are true for the larger population. This is because the unobservable factors which determine whether or not a household acquire debt may be correlated with the unobservable factors determining household debt thereby producing a bias in the estimates. This is particularly important in this case as we expect that the development of the financial sector is likely to increase the number, and type, of households which are likely to be taking on debt. Thus it is necessary to account for this potential selection by incorporating the factors which determine whether a household takes on debt.

To illustrate how a selection bias might arise, consider the estimation of the following equation:

$$D_i = X_{Di}\beta_D + u_{Di} \tag{3}$$

where the X_{Di}'s are exogenous variables, β_D is an unknown parameter vector and the u_{iD} are zero mean error terms. Recall that in this particular instance we only observe positive values of debt for household i if N_i = 1. Moreover, we only observe unconstrained levels of debt if N_i = 1 and B_i = 1. Estimation of equation (3) over the subsample for N_i = 1 and B_i = 1 would not cause a selection problem where this sample

is randomly chosen from the population, but in the case where the u_{iD}'s are correlated with the u_{iN} and u_{iB} a bias arises. This is because after conditioning on the probability of being observed, the error has a non zero mean which is correlated with the explanatory variables. More explicitly:

$$E\left[D_i \mid N_i = 1 \,\&\, B_i = 1\right] = X_{Di}\beta_D + E\left[u_{Di} \mid N_i = 1 \,\&\, B_i = 1\right] \qquad (4)$$

To obtain consistent estimates of the β_D from the above equation it is necessary to account for the misspecification of the conditional mean captured by $E\left[u_{Di} \mid N_i = 1 \,\&\, B_i = 1\right]$. In the case where the error terms are assumed to be jointly normal, it is relatively straightforward to account for this misspecification. If the u_{iN}'s are uncorrelated with the u_{iB}'s this simply involves estimating each of equations (1) and (2) by probit and computing the inverse mills ratio from each to be added as additional regressors in (3). This is slightly more complicated if the u_{iN}'s are correlated with the u_{iB}'s as this correlation needs to be accounted for when computing the component of the conditional mean which is misspecified. This requires the estimation of the correlation and thus the two equations must be estimated jointly rather than two univariate probits.

Here we allow for the correlation between the u_{iN}'s and the u_{iB}'s in addition to relaxing normality by employing the procedure of Das et al (2003). That procedure approximates $E\left[u_{Di} \mid N_i = 1 \,\&\, B_i = 1\right]$ as $f\left(\Pr(B_i = 1 \mid X_{Bi}), \Pr(N_i = 1 \mid X_{Ni})\right)$ where $f(\cdot)$ is an unknown function and the $\Pr(\cdot)$ denote probabilities which are estimated semi-parametrically. These $\Pr(\cdot)$'s are estimated as the predicted value from the models in the previous section and the $f(\cdot)$ is approximated as a series polynomial which is determined by cross validation.

Estimation of the debt equation is further complicated by the inclusion of two key explanatory variables capturing the level of household income and the household's level of assets. First, it is possible that each of these variables is endogenous to the level of household debt. Second, it is seems unnecessarily restrictive to assume that these variables enter the debt equation linearly. To account for this endogeneity and potential non linearity we follow Das et al (2003) and include the residuals, from the reduced form equations for these variables as additional explanatory variables. To

capture the non linearity we add use higher powers of the assets and income variables as regressors in the debt equation and also employ higher powers of the residuals. To determine the "appropriate" number of higher order terms for each of these variables, and their residuals, we employ a cross validation procedure.

Columns 3 and 4 of Table 8 show the results of these two variables that are considered endogenous in the model. For identification purposes, besides household characteristics linked to permanent income, we also include a set of variables that are correlated with income and non-real estate assets and that should not be correlated with the amount of borrowing. This set includes the number of insurances held by the household, the amount of the pension fund of the household head (that cannot be used as collateral for borrowing), a dummy variable if the pension fund is larger than zero, a dummy variable for the ownership of bank current account, and a dummy variable for the use of telebanking by the household. Most of these variables are significant and with the expected signs, revealing them to be useful for identification.

Continuing this discussion related to identification it is valuable to highlight what is contained in the vector X_D. More explicitly, we focus on the explanatory variables which appear in the (1) and (2) equations which do not appear in X_D as these variables, in their capacity as exclusion restrictions along with the additional variables employed in the income and non real estate equations, are the basis of identification for the model.

As mentioned above, variables related to household composition and job characteristics were used in the equation explaining whether the household reports positive debt as they are considered proxies of whether the household would be willing to borrow or not. On the other hand, supply proxies linked to borrowing constraints the lack of financial deepness in the area, and the arrears situation of the household, play the role of identifying supply and demand factors.

Let us now focus on the estimates of the debt equation. In the first column of Table 9 we report the OLS estimates from estimating equation (3) while ignoring the potential presence of selection bias or endogeneity. We provide these results for the sake of comparison. In the second column we provide the parametric selection bias adjustment based on the procedure of Heckman (1979), and employed by Cox and Jappelli (1993) in the credit setting, in which equations (1) and (2) are each estimated by probit and their respective inverse mills ratios are included as additional regressors. These

additional regressors are denoted IMR_B and IMR_N in this Table. Finally in column 3 of the table we report the semi parametric estimates based on the Das et. al (2003).

The estimates in the Table seem to suggest the presence of selection bias. The cross validation process determined that the preferred model for accounting for selection only includes the constrained equation correction and not that from the borrowing selection. This indicates that there is selection from only one source of censoring. Interestingly, the corrections in column 3 suggest that one of the assumptions employed by the parametric correction is inappropriate. Namely, the statistical significance of the higher order selection term suggests the normality assumption is inappropriate. However, the inclusion of the cross product of the propensity scores was not supported by cross validation, suggesting that the zero correlation assumption for the errors in the two censoring equations was supported by the data. The endogeneity of the income and non-real estate assets is also supported by the cross validation procedure which determined a role for residuals from their equations. Accordingly in discussing the adjusted estimates we restrict our attention to the semi-parametric estimates.

A number of the features of column 3 are interesting. First, as expected the level of annual income of the household is an important determinant of household. The coefficients of the higher orders of the variable are also highly significant. Note that the cross validation also supported the inclusion of these higher order terms. Second, an important and non linear relationship exists between age of household head and the level of household debt. Third, as also discussed earlier, the level of education is also an important determinant of household debt in terms of magnitude, although statistical significance is questionable. Fourth, the average income of the area has no significant relationship with the level of household debt. Fifth, while they are largely hidden in the unadjusted estimates in column 1, the adjusted estimates in column 3 reveal some differences on the basis of regional areas. The relevance of the unobservables, captured by the residuals of income and non-real estate assets, supports the idea that there is substantial unobserved heterogeneity in the demand for borrowing.

It is also interesting to note how education, gender, number of employed persons in household and area income, each of these is statistically significant in the unadjusted estimation but lose this statistical significance in the presence of the adjustments. This reflects the importance of accounting for the selection bias in this particular setting.

From the previous estimations it is possible to obtain elasticities of debt demand to income and age for example. The profiles of the relationship of debt to income and age are shown in Figure 4 and 5 respectively. Those figures also show the profile of the corresponding derivatives. Estimates are also shown for the model with no correction, with parametric correction and with semi parametric correction respectively.

The first remarkable result is the non-linearity of relationships. Both debt to income and debt to age exhibit a clear concave profile. Secondly, the parametric model makes little difference with respect to the model without correction. However, the model with semi parametric correction gives substantially different profiles. In the case of debt to income, the derivative is overestimated by the model without correction and with parametric correction. On the other hand, in the case of debt to age, the derivative is underestimated by the model without correction and with parametric correction.

Non secure debt to income weighted average derivative is estimated at 3.9% with a standard deviation of 1% in the model without correction, whereas in the semi parametric corrected model is estimated at 6.7% with a 0.9% standard deviation. It is worth noting that average income is about CH$28 millions in the sub sample. This substantial difference in the estimated elasticities reinforces the importance of the semi parametric corrected estimations. However, existing evidence in studies for other economies indicates substantial variability even in terms of sign (see Crook, 2006).[10]

Non secure debt to age weighted average derivative is estimated at 3.4% with a standard deviation of 0.6% in the model without correction, whereas in the semi parametric corrected model is estimated at 2.3% with a 0.5% standard deviation. Average age is about 45 years in the sub sample. Again, this substantial difference in the estimated elasticities highlights the relevance of the semi parametric corrected estimations. Evidence from other economies, namely US and Italy, show a decreasing profile (rather than inverted U-shape), indicating the Chilean individuals may face a different life-cycle process for non-secure debt, which peaks at about average age of household head.

The model specifications considered thus far were chosen on the basis of economic intuition. This approach may be questionable from a pure econometric point of view where models are interpreted as reduced forms and, accordingly, the data should be relied upon to indicate what explanatory variables are relevant. We also estimated

[10] It has to be stated that most studies consider all types of debt altogether instead of non-secure debt only.

models where the same reduced forms specification, that in Table 8, was used for both selection equations and the reduced forms for the endogenous regressors. We obtained similar results for the estimated elasticities, indicating the results are somewhat robust to the specification of the models.

So far we have concentrated our attention to non-secure debt. We now turn our attention to secure debt (mortgage). At this point, it is worth to analyze how the Chilean financial works in more detail. There are two clear stylized facts. First, non-mortgage credit is restricted in access through banks, and almost unrestricted for department stores cards. However, the amounts that can be borrowed in the latter are much smaller, and the interest rates much larger.[11] Second, mortgage-credit could be thought as almost unrestricted in access: it is rare that all institutions refuse to give a mortgage credit for a given property. The "only restriction" is that monthly payment cannot be larger than monthly household income that the applicant is able to demonstrate. Income will then determine the horizon of the mortgage (although most mortgage credits are issued at 20 or 30 years). In parallel, it happens to be that 10% of mortgages are obtained through government institutions, with significant subsidies. Also from the rest of the household with mortgages, 30% of them are credits through the State Bank, most of them with some sort of subsidy and/or facilitated access. It is true however that richer households can obtain relatively lower interest rates (about 4-5% real interest rate compared to about 6-7% for lower income people).

Our preliminary estimations of the model for secure debt show non-significant role for selection. This result could be thought as correct in line with the previous argument. In fact, our questions to determine who is credit constrained (and/or discouraged) could be thought as more related to consumption loans rather than mortgages. The no selection finding is a result in itself, although endogeneity of some variables still remains relevant. Our preliminary results show an elasticity of debt to income of 4.0% without correction and 6.5% with the semi-parametric correction. Also, we obtain an elasticity of debt to age of 2.0% in the model without correction, and 5.4% in the model with correction. However, these results must be taken with care as further investigation has to be done in the mortgage models.

Using the previous results for the estimations for consumption debt, we now explore what could be the effect of removing credit constrains in the demand for credit. We follow again Cox and Jappelli by estimating the demand for credit those households who report being credit constrained. The objective is to estimate the difference

[11] See Ruiz-Tagle (2009).

between desired, D^*, debt and actual debt, D^a. For those households who are unconstrained we have that $D^*_{uc} = D^a_{uc}$.

For households who are constrained we have two cases: $N_i = 0$ and $B_i = 0$; and $N_i = 0$ and $B_i = 1$. The former are constrained households who do not hold any debt and the latter are constrained households who do hold some debt. Then, for constrained households who do not hold debt we estimate the demand for credit as:

$$D^*_{c,B=0} = E\left[D_i \mid N_i = 0 \,\&\, B_i = 0\right], \tag{5}$$

and for constrained households who do hold debt we estimate:

$$D^*_{c,B=1} = E\left[D_i \mid N_i = 0 \,\&\, B_i = 1\right]. \tag{6}$$

For obtaining the estimates of the corresponding levels of demand of debt we use estimated parameters from the unconstrained sample and, according to equation (4), we estimate the error terms $E\left[u_{Di} \mid N_i = 0 \,\&\, B_i = 0,1\right]$ as $f\left(\Pr(B_i = 0,1 \mid X_{Bi}), \Pr(N_i = 0 \mid X_{Ni})\right)$, using the propensity scores both in the parametric model and in the semiparametric model, using the corresponding specification of $f(\cdot)$.[12]

We then average over the sub samples to obtain the overall "debt gap" as:

$$Gap = \left(\overline{D}^*_c \tfrac{I_c}{I} + \overline{D}^*_{uc} \tfrac{I_{uc}}{I}\right) - \overline{D}^a, \tag{7}$$

Where I_c and I_{uc} are the number of constrained and unconstrained households respectively, so that $I = I_c + I_{uc}$.

Our estimations indicate that the "debt gap" would be 8.1% in the parametric model and 1.2% in semi parametric model. This gap could be seen as small, but it has to be recalled that only a small fraction of the population is credit constrained. In parallel, it should no be surprising that the semi parametric model gives a significantly smaller gap. This is due to the fact that the semi parametric model estimated a larger elasticity

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[12] In the parametric model, $f(\hat{b},\hat{n}) = \hat{\sigma}_b\hat{\rho}_b \dfrac{\phi(-\hat{b})}{1-\Phi(\hat{b})} + \hat{\sigma}_n\hat{\rho}_n \dfrac{\phi(-\hat{n})}{1-\Phi(\hat{n})}$ for the sub sample $N_i = 0$ and $B_i = 0$, and $f(\hat{b},\hat{n}) = \hat{\sigma}_b\hat{\rho}_b \dfrac{\phi(\hat{b})}{\Phi(\hat{b})} + \hat{\sigma}_n\hat{\rho}_n \dfrac{\phi(-\hat{n})}{1-\Phi(\hat{n})}$ for the sub sample $N_i = 0$ and $B_i = 1$, where $\phi(\cdot)$ and $\Phi(\cdot)$ are the pdf and the cdf of the normal distribution respectively.

of debt to income, while very few high income households are credit constrained. Then, constrained households could increase their demand of debt, but they may not account for a significant part of overall debt.

7 Conclusions

Borrowing constraints have been study in few developed countries. To our knowledge, this paper is the first attempt to investigate in the demand for credit in a developing economy. Borrowing constraints play an important role when there is scarcity of liquidity in the economy, which boosts under financial crisis. The development of the financial deepness process in a developing economy enhances the role of borrowing constraints as they may relax through time. The availability of estimations of the credit demand may help the design of financial policies and the monitoring of financial stability.

Obtaining robust estimations of demand for credit requires considering borrowing constraints and endogeneity of some key variables such as income and assets. This paper has made use of a novel Chilean data to explore the relationship of borrowing constraints using a semi-parametric framework which allows high levels of flexibility of the models. Two types of selection and and endogeneity of income and assets is used to obtain unbiased estimations of credit demand. The semi-parametric framework allows for multiple correlations of the selection process and a flexible form for the role of unobservables through the endogenous variables without making distributional assumptions.

Credit demand for consumption loans and mortgages are treated in separated models as the evidence shows that selection follows different mechanisms for the two types of debt. In fact, as strong evidence for selection is found in the non-secure debt models, in the mortgage models this is less robust. However, endogeneity of income and assets appears to be relevant for both cases.

We find strong evidence of non-linear relationships of debt to its determinants. This supports a semi-parametric framework that allows for high levels of flexibility in the estimated models. As robust results are found for the non-secure debt models, further research is required for mortgage debt demand.

We obtain estimations for the elasticity of non-secure debt to income as weighted average derivative at 6.7%, which is 50% larger than the estimations obtained without

corrections. Then, relaxing borrowing constraints is likely to increase borrowing of low income households. As low income households take on debt, the nature of the debt to income debt will change.

We also obtain estimations for the elasticity of non-secure debt to age as weighted average derivative at 2.3%, 30% lower than estimations obtained without corrections. This result indicates than the ageing process of the Chilean population will have a moderated effect on the demand of debt, and that it actually will decrease on average in the coming years as the top of the hump of the inverted U-shape age profile has already been reached.

Finally, our preliminary results for the estimation of a "debt gap" indicate that accounting for semi parametric corrections may produce figures much smaller than parametric estimations.

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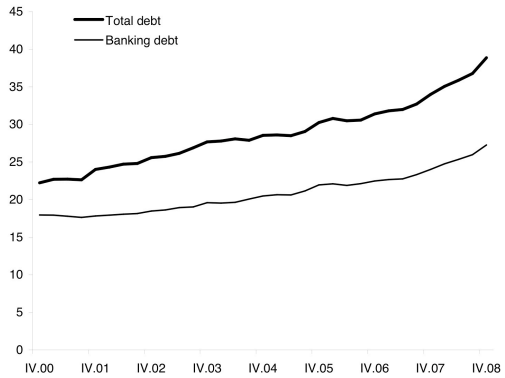
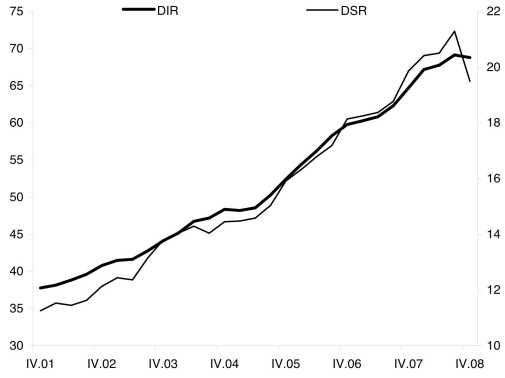
Figure 1: Chilean Households indebtedness at the macro level

(a) Households debt as percentage of GDP



Source: Central Bank of Chile.

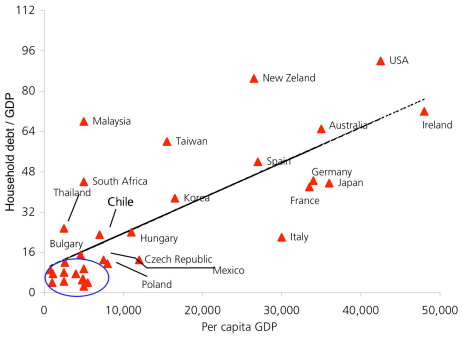
(b) Debt to income ratio (DIR) and debt service to income ratio (DSR)



Source: Central Bank of Chile.

Figure 2: Household debt: International comparison

(a) Households debt and economic development (percentage, US dollars)



(*) Countries inside the circle: Venezuela, Philippines, Russia, Colombia, Indonesia, Peru, Brazil, Romania, Argentina, India, China y Turkey.

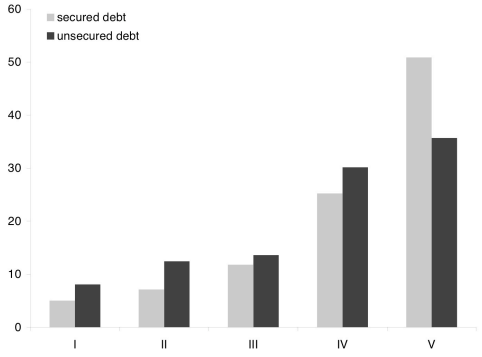
Source: IMF, Global Financial Stability Report 2006.

(b) DSR and household debt (percentage)

Source: IMF, Global Financial Stability Report 2006.

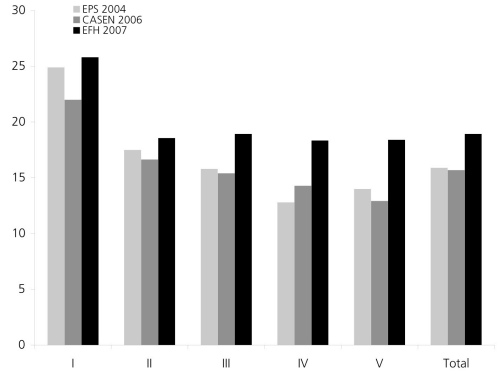
Figure 3: Chilean Households indebtedness at the micro level

(a) Distribution of debt by income quintiles: EFH 2007
(by total household income quintile as percentage)



Source: Fuenzalida and Ruiz-Tagle (2009).

(b) DSR by income quintiles
(percentage)



Source: Fuenzalida and Ruiz-Tagle (2009).

Table 1: Debt by Income Quintiles

Income Quintiles	% of Debt	% of Hh w/Debt	% of Constrained Hhs	% of Income
I	4.6	53.2	25.0	2.4
II	7.5	65.3	19.7	5.3
III	14.5	65.5	17.6	9.4
IV	26.3	68.0	12.0	18.7
V	47.2	64.8	4.8	64.2
Total	100.0	63.4	15.8	100.0

Source: EFH 2007.

Table 2: Debt by Age of Household Head

Age of Household Head	% of Debt	% of Hh w/Debt	% of Constrained Hhs	% of Income
18-24	0.7	64.8	27.4	1.5
25-34	13.4	67.1	18.5	9.5
35-44	28.7	75.2	15.0	21.1
45-54	37.9	71.9	16.3	30.2
55-64	15.9	57.1	17.0	24.5
65 +	3.7	37.6	10.8	13.2
Total	100.0	63.4	15.8	100.0

Source: EFH 2007.

Table 3: Debt by Geographical Regions

Region	% of Debt	% of Hh w/Debt	% of Constrained Hhs	% of Income
North	6.2	72.9	23.8	5.2
Center	14.1	53.8	14.0	16.4
South	9.0	73.8	16.9	8.1
Metropolitan	70.7	64.4	15.4	70.4
Total	100.0	63.5	15.9	100.0

Source: EFH 2007.

Table 4: Debt by Education of Household Head

Education of Household Head	% of Debt	% of Hh w/Debt	% of Constrained Hhs	% of Income
Primary	3.0	51.6	23.2	6.7
Secondary	11.7	60.3	20.0	15.0
Tertiary	85.6	68.2	11.5	78.1
Total	100.0	63.4	15.8	100.0

Source: EFH 2007.

Table 5: Borrowing and Credit Constrains

	Constrained (N=0)	Unconstrained (N=1)	Total
Consumption Loans			
Non Debt Holder (B=0)	5.3	38.6	43.8
Debt Holder (B=1)	10.6	45.6	56.2
Mortgage			
Non Debt Holder (B=0)	12.0	63.0	75.0
Debt Holder (B=1)	3.9	21.2	25.0
Consumption Loans + Mortgage			
Non Debt Holder (B=0)	4.7	31.8	36.5
Debt Holder (B=1)	11.2	52.3	63.5
Total	15.9	84.1	100.0

Source: EFH 2007.

Table 6: Borrowing and Credit Constrains (Number of Observations)

	Constrained (N=0)	Unconstrained (N=1)	Total
Consumption Loans			
Non Debt Holder (B=0)	215	1367	1582
Debt Holder (B=1)	409	1631	2040
Mortgage			
Non Debt Holder (B=0)	498	2364	2862
Debt Holder (B=1)	126	634	760
Consumption Loans + Mortgage			
Non Debt Holder (B=0)	198	1149	1347
Debt Holder (B=1)	426	1849	2275
Total	624	2998	3622

Source: EFH 2007.

Table 7: Summary Statistics of Variables (means)

Variables	All	Debt Holders			Non-Debt Holders	Unconstrained	Constrained
		All	Non-Secure Debt Holders	Secure Debt Holders			
Obs	3622	2275	2040	760	1347	2998	624
Non-Secure Debt Holder = 1	0.56	0.90	1	0.69	0	0.54	0.66
Secure Debt Holder = 1	0.21	0.33	0.26	1	0	0.21	0.20
Unconstrained = 1	0.83	0.81	0.80	0.83	0.85	1	0
Non-Secure Debt	1.92	3.05	3.40	3.85	0.00	1.74	2.78
Secure Debt	3.60	5.73	4.30	17.15	0.00	3.72	3.03
Years of Education	12.7	13.2	13.0	15.0	11.9	12.8	12.0
Annual Income	16.2	17.0	15.9	27.6	14.9	17.1	12.1
Real Estate Assets	43.0	44.9	39.8	76.3	39.9	47.1	23.3
Non-Real Estate Assets	8.00	7.43	6.08	13.00	8.98	8.83	4.05
Spouse Present = 1	0.65	0.70	0.70	0.77	0.56	0.65	0.66
Male = 1	0.62	0.65	0.65	0.66	0.57	0.62	0.61
Age	49.9	47.3	47.4	45.5	54.4	50.3	48.0
# of Persons in Household	3.53	3.74	3.74	3.83	3.16	3.48	3.76
# of Employed Persons in Household	1.56	1.69	1.69	1.76	1.35	1.55	1.62
Area Income	18.1	18.1	17.5	22.1	18.0	18.5	15.7
North (1)	0.07	0.09	0.09	0.07	0.05	0.07	0.10
Center (1)	0.22	0.21	0.21	0.19	0.24	0.22	0.19
South (1)	0.08	0.09	0.09	0.08	0.08	0.08	0.09
Self Perception: Financial Service High	0.29	0.29	0.31	0.22	0.28	0.26	0.44
Signed job Contract	0.47	0.54	0.54	0.62	0.36	0.48	0.45
Wage Earner	0.50	0.58	0.58	0.61	0.38	0.50	0.52
Employer	0.08	0.09	0.09	0.12	0.08	0.08	0.08
Self-Employed	0.18	0.17	0.17	0.16	0.20	0.18	0.20
Formal Worker	0.59	0.66	0.65	0.75	0.48	0.60	0.57
Inhabitants over # of Banks by Region	2017	1992	1986	2028	2058	2007	2064
Inhabitants over # of Banks by Municipality	3610	3698	3725	3695	3461	3603	3643
Had delayed payments in past 12 months	0.18	0.24	0.26	0.19	0.07	0.15	0.32
# of arrears in past 12 months	0.53	0.77	0.84	0.57	0.14	0.39	1.22
# of formal arrears in past 12 months	0.45	0.66	0.70	0.60	0.12	0.29	1.24
# of checks rejected to pay in past 12 month	0.13	0.19	0.22	0.17	0.03	0.09	0.34
# of Insurances held by Household	0.75	0.90	0.87	1.41	0.49	0.77	0.65
Amount of Pension Fund of Household Heac	7.91	9.94	9.64	13.96	4.49	8.10	7.01
Current Account Owner = 1	0.36	0.40	0.38	0.63	0.29	0.38	0.25
Uses Telebanking = 1	0.27	0.33	0.32	0.51	0.18	0.28	0.22
Dummy Pension Fund (> 0 = 1)	0.56	0.66	0.67	0.72	0.38	0.55	0.60

(1) Excluded category is Metropolitan Region

Table 8: Estimates for Selection and Endogenous Variables Models

Variables	(1) Unconstrained = 1	(2) Non-Secure Debt Holder =	(3) Annual Total Income	(4) Non-Real Estate Assets
Years of Education	0.00398**	0.00439**	0.779***	0.179
	(0.00170)	(0.00222)	(0.128)	(0.186)
Real Estate Assets	0.000166***	-0.000121		
	(5.80e-05)	(7.59e-05)		
Spouse Present = 1	-0.00185	0.0498**	1.211	0.907
	(0.0155)	(0.0203)	(1.043)	(1.522)
Male = 1	0.00348	0.0163	2.261**	2.617*
	(0.0147)	(0.0192)	(0.962)	(1.404)
Age	0.00215	0.00694**	0.336**	-0.0677
	(0.00250)	(0.00327)	(0.168)	(0.245)
Age^2	-1.19e-05	-0.000106***	-0.00202	0.00113
	(2.43e-05)	(3.18e-05)	(0.00160)	(0.00234)
# of Persons in Household	-0.00995**	0.0149**	0.820***	-0.406
	(0.00469)	(0.00612)	(0.306)	(0.446)
# of Employed Persons in Household	0.00602	0.0197*	2.061***	0.116
	(0.00826)	(0.0108)	(0.503)	(0.733)
Area Income	0.00172***	-0.00194**	0.375***	0.223***
	(0.000597)	(0.000768)	(0.0399)	(0.0582)
North (1)	-0.0353	0.111***	-1.580	-1.557
	(0.0258)	(0.0317)	(1.625)	(2.370)
Center (1)	0.0103	-0.0306	-0.962	3.219**
	(0.0186)	(0.0202)	(1.040)	(1.517)
South (1)	-0.0257	0.0464	1.807	-0.316
	(0.0246)	(0.0299)	(1.532)	(2.236)
Self Perception: Financial Service High	-0.0872***	0.0540***	1.074	4.179***
	(0.0140)	(0.0178)	(0.917)	(1.338)
Signed job Contract	0.0465**	-0.0175		
	(0.0225)	(0.0294)		
Wage Earner	-0.0622**	0.0591*		
	(0.0269)	(0.0351)		
Employer	-0.0545*	0.0270		
	(0.0290)	(0.0379)		
Self-Employed	-0.0316	-0.0238		
	(0.0229)	(0.0299)		
Formal Worker	0.00429	0.0406*		
	(0.0170)	(0.0222)		
Inhabitants over # of Banks by Region	-5.52e-05***			
	(1.65e-05)			
Inhabitants over # of Banks by Municipality	1.05e-06			
	(2.06e-06)			
Had delayed payments in past 12 months	-0.0727***			
	(0.0209)			
# of arrears in past 12 months	-0.00965*			
	(0.00505)			
# of formal arrears in past 12 months	-0.0104***			
	(0.00323)			
# of checks rejected to pay in past 12 months	-0.00541			
	(0.00716)			
# of Insurances held by Household			3.253***	2.960***
			(0.392)	(0.572)
Amount of Pension Fund of Household Head			0.0758**	0.192***
			(0.0345)	(0.0504)
Dummy Pension Fund (> 0 = 1)			-2.166**	-2.962**
			(0.997)	(1.454)
Current Account Owner = 1			8.287***	8.524***
			(1.154)	(1.683)
Uses Telebanking = 1			4.876***	0.175
			(1.200)	(1.751)
Constant	0.865***	0.299***	-26.31***	-5.902
	(0.0753)	(0.0850)	(4.572)	(6.671)
Observations	3622	3622	3622	3622
R-squared	0.072	0.077	0.249	0.068

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
(1) Excluded category is Metropolitan Region

Table 9: Estimation Results of Borrowing Demand

Variables	(1) No Correction	(2) Parametric Correction	(5) Semi-Parametric Correction
Annual Income	0.0503***	0.0514***	0.0761***
	(0.00669)	(0.00673)	(0.0177)
Annual Income^2	-0.000478***	-0.000483***	-0.000364***
	(7.50e-05)	(7.51e-05)	(9.86e-05)
Annual Income^3	1.13e-06***	1.14e-06***	6.82e-07***
	(2.02e-07)	(2.03e-07)	(2.14e-07)
Non-Real Estate Assets	-0.00102	-0.000898	0.000778
	(0.00169)	(0.00169)	(0.0184)
Age	0.0601***	0.0610***	0.0440**
	(0.0171)	(0.0191)	(0.0173)
Age^2	-0.000589***	-0.000588***	-0.000458***
	(0.000170)	(0.000215)	(0.000170)
Years of Education	0.0820***	0.0860***	0.0315*
	(0.0123)	(0.0135)	(0.0177)
Spouse Present = 1	0.124	0.125	0.0532
	(0.0993)	(0.113)	(0.0982)
Male = 1	0.231**	0.236**	0.119
	(0.0911)	(0.0942)	(0.0933)
# of Persons in Household	0.0403	0.0310	-0.00734
	(0.0288)	(0.0319)	(0.0352)
# of Employed Persons in Household	0.136***	0.137**	0.0648
	(0.0482)	(0.0552)	(0.0588)
Area Income	0.00934**	0.0104**	-0.00545
	(0.00375)	(0.00430)	(0.00509)
North (1)	0.123	0.120	0.165
	(0.141)	(0.185)	(0.140)
Center (1)	-0.0313	0.00742	0.146
	(0.0984)	(0.105)	(0.131)
South (1)	0.0971	0.106	0.0443
	(0.136)	(0.144)	(0.140)
Self Perception: Financial Service High	0.639***	0.538***	0.385***
	(0.0879)	(0.120)	(0.127)
p-score N			9.259**
			(4.001)
p-score N^2			-7.151***
			(2.692)
Annual Income Residual			-0.0415**
			(0.0169)
Annual Income Residual^2			8.04e-05
			(8.10e-05)
Non-Real Estate Residual			-0.00223
			(0.0184)
IMR_B		0.0944	
		(2.018)	
IMR_N		2.019	
		(1.292)	
Constant	-4.103***	-4.957***	-5.563***
	(0.442)	(1.375)	(1.627)
Observations	1631	1631	1631
R-squared	0.224	0.225	0.251

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

(1) Excluded category is Metropolitan Region

Figure 4: Estimated Profile Debt / Income

(a) (b)

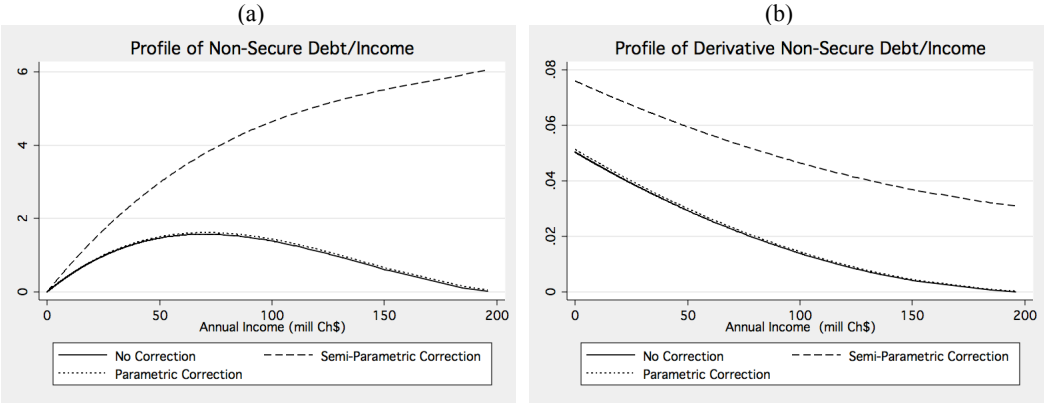
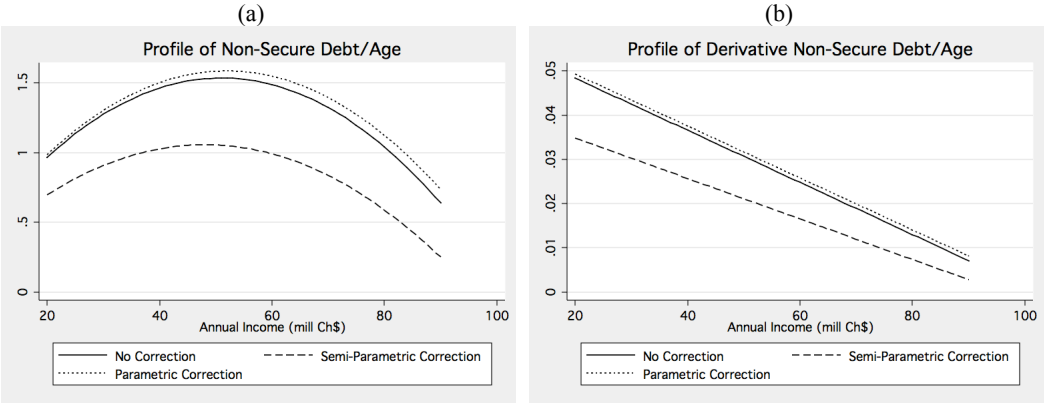


Figure 5: Estimated Profile Debt / Age

(a) (b)



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