Incapacity to Pay or Moral Hazard? Public Mortgage Delinquency Rates in Chile

Luis Marcano and Inder J. Ruprah

Office of Evaluation and Oversight

Inter-American Development Bank
Washington, D.C.

Office of Evaluation and Oversight, OVE

Incapacity to Pay or Moral Hazard? Public Mortgage Delinquency Rates in Chile.

Luis Marcano and Inder J. Ruprah*

ABSTRACT

High delinquency rate of publicly provided mortgages in social housing programs are often interpreted to be due to moral hazard. In this paper we show that the typically used parametric approaches give misleading results due to overlooked confounding and selection biases. We show that by using the more appropriate impact or treatment non-parametric approach the problem of high delinquency rate in publicly provided mortgages is due to the incapacity to pay and not due to moral hazard. The results caution against public policies to encourage private mortgage providers to move down market, and suggest eliminating mortgages and correspondingly increasing the grant component of the programs.

Keywords: Moral hazard, mortgages, delinquency rate, social housing programs, confounding bias.

JEL Classification: R31, G21, H43

INTRODUCTION

Moral hazard is often assumed to exist in government lending programs. Thus, it is widely held, almost as a self-evident truth, that government provided mortgages would, by their very nature, have higher delinquency rates relative to private sector provided mortgages due to the moral hazard problem. In this paper we test the moral hazard hypothesis against the alternative that the delinquency differential between public and private providers is due to the incapacity to pay of the borrower independently of the provider.

Which hypothesis is valid has different ramifications for the design of public housing programs. These typically consist of an upfront voucher grant plus a publicly provided mortgage for a household that cannot afford to buy a house of a given quality. If the moral hazard hypothesis is correct, then the essential design should be maintained but the provision of the mortgage component moved from public to private financial intermediary. This redesign of the program would eliminate the dead weight loss of delinquency.

Alternatively, if the incapacity to pay interpretation is correct than it cautions against transferring the provision of mortgages to private providers or government guarantee schemes to encourage private mortgage providers to move down market. Such a change will not reduce the delinquency rates although may reduce the dead weight loss to the extent that private providers recover their loans through foreclosures. It also implies that, for the same quality housing solution, the mortgage component in social housing programs should be eliminated and the grant component correspondingly increased.

We test the validity of the competing hypothesis by using treatment effect (impact) methodology that has become increasingly the preferred method for evaluating public programs and compare its results with the more frequently used methods in the delinquency-moral hazard literature, namely either a simple descriptive incidence analysis, or a parametric approach that uses a *probit* or *logit* specification. As far as we are aware, treatment effect methodology has not been applied to this issue in developing countries. We apply it to the case of Chile.

Chile's public housing programs essentially follow the voucher plus mortgage design plus an eligibility condition of having a household saving account in a recognized financial intermediary. The different programs have different targeted groups and different quality of the housing solutions hence different quantities of

1

grants and mortgages[1]. Analyst often point out that Chile has one of the highest housing finance provisions in an emerging economy[2]. The Chile's mortgage market has been growing fast, with the number of mortgages doubling between 1998 and 2003. Private providers' mortgages grew in the same period sevenfold, contributing 40% of the total growth, followed by the National Bank (Banco Estado), a public commercial bank, contributing 38%, and finally the public provider, Housing and Urbanization Service (Servicio de Vivienda y Urbanización, SERVIU), that is an operational arm of the ministry of housing, contributing 18%. This success can be attributed to a generally favourable macroeconomic policy and performance context, combined with two specific policy measures namely an inflation indexation (UFs) scheme which facilitated increased maturities, and a pension reform that provided long term source of savings. These general and specific policies created an enabling framework for the growth of the housing finance.

---

[1] For a detailed description of the programs and a meta-impact evaluation of them see Ruprah and Marcano 2007. Publicly provided mortgages in general cannot exceed 75% of the value of the house except for Worker's Housing Program whose limit is 65%. Mortgages are provided in: (i) in Progressive Housing Program directly by the Ministry of Housing (Ministerio de Vivienda y Urbanismo, MINVU) where the mortgage is without interest payments, tenor of eight years, and where the amortization payments cannot exceed 25% of the households income; (ii) in Basic Housing Program, where the mortgage carries a real interest of 8% and a tenor of 20 years. The mortgage is guaranteed by SERVIU but provided by National Bank (although in principle can also be provided by commercial banks); and (iii) mortgage letters of 12 to 20 year tenors for Workers Housing Program, Rural Housing Program, and Unified Subsidy (1st phase) Housing Program at market interest rates.
[2] See Hassler 2002 and 2003 for a description of the actors and instruments in Chile's housing market and in developing countries respectively.

Table 1: Incidence and Change of Incidence by Provider

	Quintil 1	Quintil 2	Quintil 3	Quintil 4	Quintil 5
Incidence (% of stock in 2003)					
SERVIU	12.2	22.9	23.1	25.0	16.9
Banco Estado	3.2	10.1	21.4	32.7	32.6
Private Financial Institution	0.7	2.0	5.2	11.3	80.9
Other	4.0	7.1	10.3	21.2	57.3
Total	5.7	12.4	17.9	24.9	39.1
Change in incidence)					
(% change in stock, 2003-1998					
SERVIU	-6.7	-0.9	-2.1	3.3	6.3
Banco Estado	-1.9	-5.8	-1.1	2.5	6.3
Private Financial Institution	-1.1	-3.2	-5.0	-17.9	27.2
Other	-6.9	-6.2	-4.5	-10.5	28.1
Total	-6.1	-6.6	-5.0	-1.1	18.8

Source: Own calculations from the National Survey of Socioeconomic Characteristics (CASEN for its Spanish abbreviation)

However, these positive aggregate figures hide a differing incidence of mortgages by household income, with incidence of public mortgages prevalent in lower income levels and private provided mortgages more prevalent at the higher income levels, but do not operate in a completely segmented market. In addition, there is a *growing* problem: the withdrawal of *all* providers from lower income household (quintiles 1 to 3) to the higher income end of the market (see Table 1). As the market's depth has increased, private and public providers have increasingly concentrated in the top two income quintiles. This fact suggests a problem in the "enabling framework" that dominates housing finance policy discussions regarding the ability of market forces to reach lower income households. A possible policy solution, sometimes advocated, is a guarantee system to encourage private providers to reverse the private sector's withdrawal from lower income part of the market, a solution that the capacity to pay argument cautions against.

EMPIRICAL EVIDENCE

In this section we consider three types of evidence offered to substantiate the moral hazard interpretation: incidence, parametric and, treatment effect calculations. A priori confidence, as we argue below, of the evidence increases from the first to the last evidence type.

3

a. Incidence

"*Only fools service their housing debts with the government*" (Pardo 2000).

The typical evidence in favour of the moral hazard argument is shown in Table 2 that shows the delinquency incidence by provider. SERVIU's clients have higher delinquency rates relative to private providers as revealed by the delinquency ratio. Further, the higher delinquency rate for SERVIU to private holds over the business cycle; the ratio varied from 8 to 12. This information, plus the fact that SERVIU does not engage in foreclosure has been taken as prima facie evidence in favour of the moral hazard hypothesis[3].

Table 2: Mortgages' Delinquency Rates by Provider

	SERVIU	Private	SERVIU to Private	Per capita GDP
	%	%	Ratio	Growth (%)
1998	67.0	5.5	12.3	5.9
1999	57.0	6.1	9.3	2.5
2000	69.0	6.7	10.3	-2.4
2001	71.0	7.4	9.6	3.1
2002	66.0	7.8	8.4	1.5

Source: Central Bank of Chile (BCC) and Superintendency of Banks and Financial Institutions of Chile (SBIF)

Obviously this is not evidence in favour of the moral hazard hypothesis but merely points to a problem and its size. What is missing from the analysis is the recipients of the mortgages and the determination of any systematic differences between those that receive private or public mortgages. The data in Table 1 had suggested that SERVIU clients have on average a lower income than private sector clients. This advises that private and public clients may be systematically different, consequently invalidating the naive approach.

b. Parametric Approach

"*This lack of payment corresponds more to the result of moral hazard than the incapacity to pay of the debtors.*" (Morandé and García 2004).

The second approach is estimating the parameters of a *probit* or *logit* equation specification that includes the provider and the profile of the clients. The *probit* and *logit* models specify the provider of the mortgage by the inclusion of a

---

[3] See Pardo 2000

4

dummy and control for socio-economic characteristics of the household in addition to the household's income and geographical location. The estimations are summarized in Table 3[4].

Table 3: Delinquency Incidence (Probit and Logit Regressions)

	Probit Regression		Logit Regression	
	Coeff.	dy/dx	Coeff.	Odds Ratio
Respect to other providers				
SERVIU	0.507***	0.143***	0.786***	2.195***
	[0.12]	[0.033]	[0.21]	[0.47]
Banco Estado	0.143	0.0407	0.26	1.297
	[0.12]	[0.034]	[0.22]	[0.28]
Private	0.131	0.0377	0.142	1.153
	[0.13]	[0.040]	[0.25]	[0.28]

Source: Own calculations from the National Survey of Socioeconomic Characteristics (CASEN for its Spanish abbreviation)

Where *** p<0.01 and standard errors in brackets

In column headed by dy/dx in the table is revealed a statistically significant marginal effect of the provider: a 14.3% increased probability of delinquency of a SERVIU client relative to a private entity's client from the *probit* specification and twice the odds from the *logit* specification. Thus, the evidence is in favour of the moral hazard interpretation.

However, there is a priori doubt on the validity of the interpretation using this approach. The key problems are selection bias, misclassification bias, and confounding bias that cast doubt on the estimated parameter of interest[5]. The

---

[4] The full list of control variables includes: age, age squared, gender (dummy), years of schooling, years of schooling squared, income of household head, household head with labour contract (dummy); household beneficiary of public housing program, head in public employment, self-employed as an entrepreneur, household poor (dummy); household income, household income decile, residential area urban or rural (dummy); location in which region with respect to the capital, the number of household members. The coefficient is statistically significant with different set of control variables ranging from a maximum of 0.51 and a minimum of 0.46. The results are available from the authors on request.

[5] Let's assume that t is treatment (private versus public), d the outcome indicator (delinquency rate) and, y the confounding variable (income). If t is independent of y, then only, it could contribute to a non-systematic variation of d. The impact of source of the loan on the delinquency rate would be $p(d/t) = \int p(d/t,y)p(y/t)dy$. If the source of the loan were independent from income, $p(d/t)$ would be zero and it would be easy to estimate the impact of the source of

regression assumes that the assignment of both types of loans was random. However, this is not the case. The public loan beneficiaries generally do not have access to private loans because of the lack of income and/or collateral. On the other hand, high-income households are generally excluded by eligibility conditions of the programs from participating in public programs or simply choose to not participate. So, income and type of benefits are closely associated and the effects confound the impact of each other on the outcome, in this case the delinquency rate. Further, re-estimating the *probit* equation but correcting for selection bias a la Heckman gives that there is perfect co-linearity between household income and the probability to obtain a private loan. This implies that it is impossible, with this approach, to determine if the problem is the provider or the household's income.

c. Treatment: A Non-parametric Approach

The third approach is a treatment effect methodology. In principle this approach avoids the problems associated with the previous parametric approach, thus is a more suitable method to answer the question at hand[6].

This approach is conceptually simple and intuitive. It computes the difference in average values of delinquency between those that received a private mortgage (the treated) compared to those that received a public mortgage (comparison group) but where the two groups are similar in all relevant characteristics other than the type of mortgage. Ideally, these two groups should be constructed from random assignment of mortgages[7]. However, the data available is not based on random assignment; hence we take the second best option of a quasi-experimental approach to determine the two groups. Note, the set of low-income households contain households with mortgages from both private and public providers. This reflects that Chile's housing programs do not have a strictly enforced upper income bound means test for eligibility and that private provided mortgages can be found at the lower income levels.

To obtain the support group composed of two the groups treated and non-treated we need to determine whom amongst the beneficiaries of public and private mortgage holders have the same probability to obtain a SERVIU or a Private mortgage. These households are determined through a propensity score matching

---

the loan on the delinquency rate. However, because $p(d/t)$ is not zero it would necessary to separate the impact of each other. This involves the problem of knowing or identifying the real structural form of the relationship. In such a case, it would be necessary, for example, use instrumental variables.

[6]See Blundell and Costa (2002) for a comprehensive review of this approach.

[7]See Dulflo et al (2003) for the argument in favour of randomization.

approach using a *logit* regression. The preferred participation regression is summarized in Table 4[8].

In this application a number of choices have to be made. First, to be confident that the groups are similar in all relevant observable characteristics other than treatment requires defining the statistical equivalent to the concept of "similar". We use "t" test[9], the *Hotelling* joint significance test[10] and the *Kolmogorov-Smirnov* "*D*" statistic to determine acceptable level of similarity[11]. Also, the definition of the two groups is sensitive to decisions on whether to use Kernel (and within this approach the size of the bandwidth) or nearest neighbor (and within this approach the size of the caliper, the number of matching pairs, and if with replacement or not).

---

[8] CASEN (2003) reported that the number of households with open loans was 4903 of which 3633 were SERVIU and 1270 Private. After dropping households with missing information, the sample was reduced to 3261 consisting of 2514 SERVIU and 747 Private. Using the 3261 households the propensity of having a private loan was estimated using 28 explicative variables. The list of variables includes: imputed rent as a percentage of household income, age of head, gender of head, years of schooling of head, income of head, head in public employment, household is poor, household income decile, total household income, region located and distance from regional capital. Depending of the balancing process the support group depends on the parameters and methodology used and possibly changes every time the iteration of creating a support group and balancing is performed. The preferred estimations reported in the text consisted of a support group formed with 312 SERVIU and 310 private mortgage holders.

[9] The *T-Test* assesses whether the means of two groups are statistically different from each other. This analysis is appropriate whenever you want to compare the means of two groups.

[10] *Hotelling's Test* checks of whether a set of (jointly) means is equal between two groups

[11] The *Kolmogorov-Smirnov two-sample "D" test* assesses whether two independent samples have been drawn from the same population (or from populations with the same distribution). The statistic test uses the maximal difference between cumulative frequency distributions of two samples.

Table 4: Participation equation for SERVIU
and Private Beneficiaries only

	Logit regression
	Coeff.
Private beneficiaries =1 / SERVIU beneficiaries =0	
Age in years	0.0134**
	[0.0067]
Years of schooling	0.248***
	[0.021]
Working Contract (Yes =1 / No =0)	0.365**
	[0.17]
Head in public employment	-0.346*
	[0.19]
Head working as self-employed	-0.413**
	[0.20]
Total household income (Logs)	1.919***
	[0.11]
Total working members in the household (Logs)	-1.035***
	[0.23]
Region number VII	-1.238***
	[0.37]
Residence area (Urban =1 / Rural =0)	-0.716***
	[0.24]
Constant	-29.71***
	[1.46]
Observations	3280
Chi- square	1789
Pseudo R-squared	0.507

Source: Own calculations from the National Survey of Socioeconomic Characteristics
(CASEN for its Spanish abbreviation)

Where *** $p<0.01$, ** $p<0.05$, * $p<0.1$, and standard errors in brackets

Using the propensity scores the new treated and non treated groups' distributions of the propensity scores (based on nearest neighborhood, without replacement, and a caliper of 0.01) becomes almost identical (see Chart 1.B) relative to the distribution of the original set of Private and SERVIU clients (Chart 1.A). The latter is based on the data used in the *probit* and *logit* equations presented in Table 3 previously.
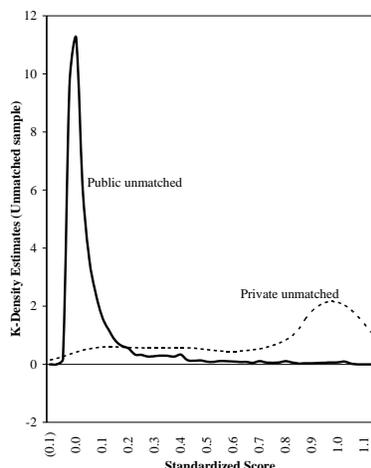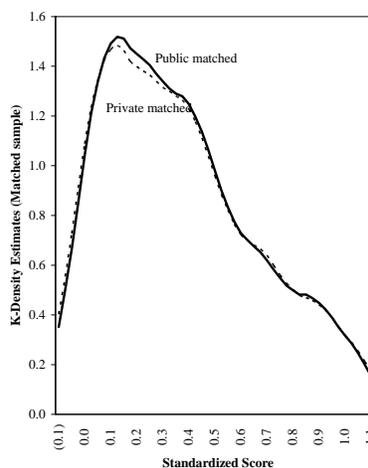
Chart 1.A: K-density Before Matching

Chart 1.B: K-density After Matching

The preferred impact calculations are given in Table 5 in the row titled "preferred" It is the preferred calculation as it has the highest number of household characteristics that are balanced using the "t" statistic (column T-Test), passes the *Hotelling* joint significance test (column Hot. Test) and the *Kolmogorov-Smirnov "*D*"* statistic (column K-S test).

Table 5: Delinquency Incidence Differential between Private and SERVIU Beneficiaries.

	ATT	[95% Confidence Interval] Bias Corrected (bounds)		T-Tests 28 variables individually		Hot. Test F (Value)	K-S test D (Value)
		Lower	Upper	(#)	(%)		
Preferred (W/O replacement: Caliper	-0.02	-0.06	0.03	24	85.7	0.3	0.04
Nearest Neighborhood							
Without replacement: Caliper 0.06	-0.01	-0.04	0.04	24	85.7	0.5	0.10
Without replacement: Caliper 0.04	-0.02	-0.05	0.02	24	85.7	0.4	0.08
1 Neighbor: Caliper 0.06	-0.07	-0.15	-0.01	5	17.9	113.5	0.73
1 Neighbor: Caliper 0.04	-0.07	-0.15	-0.01	5	17.9	113.5	0.73
1 Neighbor: Caliper 0.01	-0.07	-0.14	-0.01	5	17.9	112.7	0.73
2 Neighbors: Caliper 0.06	-0.06	-0.15	0.00	3	10.7	113.5	0.73
2 Neighbors: Caliper 0.04	-0.06	-0.14	0.00	3	10.7	113.5	0.73
2 Neighbors: Caliper 0.01	-0.06	-0.14	0.00	3	10.7	112.7	0.73
Kernel Epanechnikov							
Bandwidth 0.06	-0.08	-0.17	-0.02	6	21.4	113.5	0.73
Bandwidth 0.04	-0.06	-0.18	-0.02	5	17.9	113.5	0.73
Bandwidth 0.01	-0.02	-0.12	0.02	4	14.3	112.7	0.73

Source: Own calculations from the National Survey of Socioeconomic Characteristics (CASEN for its Spanish abbreviation)

Where:

ATT: Average Treatment Effect on the Treated

Bias Corrected Bounds: significant at 10% using Bootstrapping Bias Corrected after 500 Repetitions

T-Test: Difference of the means of treated and untreated populations. Evaluated at 10% of significance.

Hot. Test is Hotelling Test

K-S. test is the Kolmogorov-Smirnov test

Unmatched - Naïve Estimation was -0.12

9

The impact coefficient of the provider is zero. The coefficient is shown in the column denominated as ATT, i.e. (Average Treatment Effect on the Treated), and is -0.01. However, using the bootstrap method with 500 reiterations and the biased corrected procedure, statistically, at the 10% level; the coefficient is not statistically different from zero. To check for robustness of the findings the table also shows the various alternatives for calculating the impact effect; they all show a statistical insignificance difference of delinquency rates between public and private providers.

Note the naïve impact calculation obtained from the difference of the averages of non-matched public and private clients is 12%. This is equivalent to the 14% marginal effect obtained in the *probit* equation reported in Table 3. However, repeating the *probit* equation, using the same set of controls used previously (see footnote 5), but this time using only the support group, shows that the provider does not matter but household income per capita does (see Table 6).

Table 6: Regression using the Support Group only

	Probit Regression	
	Coeff.	dy/dx
Mortgage provider - SERVIU / Other Providers	0.196	0.0215
	[0.20]	[0.022]
Total Households income (logs)	*-0.405***	*-0.0443***
	[0.17]	[0.019]
Number of members in the households (logs)	*0.903****	*0.0986****
	[0.30]	[0.033]

Source: Own calculations from the National Survey of Socioeconomic Characteristics
(CASEN for its Spanish abbreviation)
Where *** $p<0.01$, ** $p<0.05$, and standard errors in brackets

Thus, there is no credible evidence that the provider (public or private) has an influence on the delinquency rate. Evidence suggests that delinquency is due to the incapacity to pay of the clients. These results confirm the analysis carried out by SERVIU in 1996 through a survey of beneficiaries that concluded that the problem was capacity to pay[12].

---

[12]See MINVU 1998.

CONCLUDING REMARKS

Moral hazard is a powerful theoretical construct that combined with inappropriate empirical methodology has led to the commonly held view that moral hazard underlies the high delinquency rates of public provided mortgages relative to private commercial provided mortgages.

This view is wrong at least for the Chilean case. The problem is incapacity to pay. Whether the findings can be generalized to be independent of time and space will depend upon building up a stock of empirical evidence. Credible empirical evidence should not rely on incidence and parametric techniques but on impact techniques preferably using random assignment or if not possible then quasi-experimental techniques. The task is not just an intellectual curiosity regarding different techniques but using the appropriate method for the question in hand to obtain credible evidence.

Credible evidence, at least for the Chilean case, rejects the moral hazard hypothesis in favour of the incapacity to pay interpretation. The incapacity interpretation cautions against any government guarantee schemes to encourage private mortgage providers to move downstream towards low-income borrowers. It would only encourage sub-prime loans; hence increase foreclosures, thus negating the very objective of public housing programs, increase housing ownership amongst lower income groups. To increase occupancy rates, of a given quality house, through public housing programs the mortgage component should be eliminated and the grant component correspondingly increased.

REFERENCES

Blundell, R. & Costa, M. 2002. *Alternative Approaches to Evaluation in Empirical Microeconomics*. University College of London. London: CEMMAP.

Duflo, E. & Kremer, M., 2003. *Use of Randomization in the Evaluation of Development Effectiveness*. Washington DC: Operations Evaluation Department (OED), World Bank.

Hassler, O., 2003. *Housing Finance in Developing Countries. Financial Sector Issues and Analysis Seminar*. Washington DC: World Bank.

Hassler, O., 2002. *Housing Finance Session Case Study-Chile. Financial Sector Forum in Chantilly, Virginia*. Washington DC: World Bank.

Ministerio de Vivienda y Urbanismo, 1998. *Compartimiento de pago y determinantes de morosidad de los deudores hipotecarios SERVIU en las Regiones Metropolitana, V y VIII*. Chile, Santiago: s.n.

Morandé, F. & Garcia C., 2004. *Financiamiento De La Vivienda En Chile*. Documento de Trabajo, No. 502. Washington, DC: Departamento de Investigación, IADB.

Pardo, C., 2000. *Housing Finance In Chile: The Experience in Primary and Secondary Mortgage Financing*. Washington, DC: Sustainable Development Department, IADB.

Ruprah, I. & Marcano L., 2007. *A Meta-Impact Evaluation of Social Housing Programs: The Chilean Case*. Washington, DC: Office of Evaluation and Oversight. IADB.