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Journal of Housing Economics xxx (2005) xxx–xxx

JOURNAL OF
HOUSING
ECONOMICS

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2 The impact of the 2001 financial
3 crisis and the economic policy responses
4 on the Argentine mortgage market [☆]

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Received 6 July 2005

14 **Abstract**

15 Following the 2001 financial crisis, the government of Argentina instituted economic pol-
16 icies to soften the adverse impact of the crisis on the economy. In this paper, we use loan-level
17 data to empirically assess the impact of the currency devaluation and the economic response

[☆] We are grateful to Fern Silva for her support of this research project and Pedro Llambias and Patricio Limardo for answering numerous questions about mortgage banking and the financial crisis in Argentina. We thank Linda Allen, Brent Ambrose, Maite Bertolini, Leonard Nakamura, Jim Papadonis, Bertrand Renaud, Tony Sanders (editor), Calvin Schnure, Mariano Selvaggi, Nick Souleles, Steve Sumner, two anonymous referees, and seminar participants at the American Real Estate and Urban Economics Association and the Midwest Economics Association meetings for helpful discussions and comments. The views expressed in this research are those of the authors and do not represent the policies or positions of the Office of the Comptroller of the Currency, of any offices, agencies, or instrumentalities of the United States.

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1051-1377/\$ - see front matter © 2005 Published by Elsevier Inc.

doi:10.1016/j.jhe.2005.07.001

18 policies on prepayment and default patterns of residential mortgages in Argentina. On the one
19 hand, our results reveal a significant higher prepayment rate of borrowers who are relatively
20 wealthy or have a US\$-denominated mortgage. On the other hand, we observe a significantly
21 higher default rate of borrowers who are less wealthy or have Peso-denominated mortgage.
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23 *JEL Classification:* C41; F31; G21; R20

24 *Keywords:* Argentine mortgage market; Prepayment and default; Financial crisis; Currency devaluation
25

26 1. Introduction

27 During the 1990's, Argentina experienced an economic boom.¹ Most observers
28 attribute the Argentine success to the currency peg, control of the inflation rate
29 and the broad market-oriented economic reforms (e.g., privatization, economic lib-
30 eralization, and deregulation). The reforms encouraged the development of credit
31 markets that facilitated the allocation of capital to the private sector. Capital flow
32 into the residential housing market was especially significant—the unprecedented
33 16.2% average annual growth rate of mortgage credit subsequently led to the crea-
34 tion of a secondary market in 1996.² By 1998, the Argentine economy showed early
35 signs of contraction, partly afflicted by the economic turmoil and currency devalua-
36 tion of neighboring Brazil. By November 2001, the Argentine economic recession
37 evolved into a full-fledged financial crisis.³ The government defaulted on its debt, re-
38 pealed the convertibility regime of the Peso and devalued its currency to 1.4 Peso per
39 US\$.⁴

40 To soften the impact of the crisis and to spread its burden between a large spec-
41 trum of economic actors, the Argentine government responded in January 2002 with
42 a series of economic policies that significantly affected the financial situation of many
43 households. The government converted US\$-denominated bank loans into Argen-
44 tine Pesos (ARP) at parity. At the same time, in a move designed to limit the loss
45 incurred by savers but that had paradoxical effects, the government converted
46 US\$-denominated deposits into Pesos at the official exchange rate of 1.4 Pesos per

¹ The GDP growth rates increasing by over 50% and inflation rates declined from 23,000 to 0% between 1990 and 1997.

² Between 1991 and 2000 the market grew from \$3.3 billion to \$10.8 billion.

³ De La Torre et al. (2003) document that by November 2001, 47 of the top 50 banks had suffered major withdrawals (\$15 billion was withdrawn between July and November 2001, \$1.3 billion was withdrawn on November 30, 2001 alone).

⁴ Subsequently, inflation surged 46% between 2002 and 2003, house prices in Pesos jumped dramatically, real levels of household income declined by more than 40% between 1999 and 2002, and unemployment peaked at 23% in 2002. The Argentine economy pre- and post-crisis is discussed at length in Section 3.

47 US\$. Furthermore, the government suspended foreclosure proceedings on defaulted
48 mortgage loans. On the other hand, to alleviate the adverse impact of *pesofication* on
49 creditors, the government first (January 2002) indexed all retail loans to the consum-
50 er price index and subsequently (November 2002) to the wage-linked index due to
51 the substantial price surge caused by the currency devaluation and high interest
52 rates.⁵ Finally, the government had to float the Peso in January 2002.

53 In this paper, we use a loan-level dataset to study the prepayment and default
54 behavior of the Argentine mortgage borrowers in response to drastic changes in their
55 household portfolio, triggered by the real life economic and financial stress scenario
56 and the subsequent government policy responses. Specifically, we study the prepay-
57 ment and default decisions of mortgage borrowers in response to the crisis (Novem-
58 ber 2001), the depreciation of the Peso (beginning January 2002), the indexation of
59 the mortgage loans to the CPI (January 2002–September 2002), and to wage-linked
60 index (November 2002–March 2004).

61 The data used in our paper is unique in several respects. Our loan-level dataset is
62 made up of individual mortgage loans that were originated between June 1998 and
63 March 2000, with performance observed until March 2004. In addition to the tradi-
64 tional information captured at loan origination, we also observe if the loan was orig-
65 inated in US dollars (US\$) or Argentine Pesos (ARP). The dataset also contains a
66 very rich set of demographic variables (income, wealth, age, occupation, marital sta-
67 tus, etc.). Using mortgage debt to assess the substitutability between the prepayment
68 and default options is ideal because mortgage debt is much more sensitive to shocks
69 since it has a longer maturity than other consumer debts. Moreover, following the
70 2001 financial crisis the Argentine mortgage borrowers faced wealth maximization
71 incentives that were beyond the call and put options. The surge in Argentine mort-
72 gage prepayments and defaults that occurred during the post-crisis period simply
73 cannot be explained by the factors shaping the traditional prepayment and default
74 model as well as the actual prepayment and default behaviors in the US.

75 We expect that the impact of the currency devaluation and the economic response
76 policies on the prepayment and default decisions of the US\$-denominated mortgage
77 borrowers will differ from those of the Peso-denominated mortgage borrowers. Fur-
78 thermore, the prepayment and default behaviors of the relatively wealthy/high-in-
79 come borrowers will likely differ from those of the less-wealthy/low-income
80 borrowers. In particular, the combination of soaring unemployment, declining in-
81 come and sharp inflation should create a “poverty effect” leading to a surge in mort-
82 gage delinquencies/defaults, especially amongst the less wealthy or Peso-
83 denominated mortgage borrowers. On the other hand, the Peso devaluation along
84 with the *pesofication* as well as the indexation of borrowed capital and the appreci-
85 ation of residential real estate should create a “wealth effect,” and thus lead to a
86 surge in mortgage prepayment, especially amongst wealthy borrowers or US\$-de-
87 nominated mortgages.

⁵ The economic and financial crisis and the policy response are discussed at length in Section 2.

88 To preview our findings, once we control for all the traditional risk factors (LTV,
89 interest rates, credit scores, etc.) predicted by the option theory of mortgage prepay-
90 ment and default, we find that US\$-denominated mortgages on average have a sig-
91 nificantly higher prepayment rate and lower default rate in comparison to ARP-
92 denominated mortgages. Moreover, the performance patterns tend to be heteroge-
93 neous among US\$ and ARP mortgage borrowers along wealth and income charac-
94 teristics. We find a 9.1% lower default rate and 15.7% higher prepayment rate
95 amongst the wealthy borrowers (of both US\$- and ARP-denominated mortgage).
96 Similarly, a 10% rise in income lowered default risks by 9.8% and raised prepayment
97 risks by 10.1%.

98 Focusing on the impact of the financial crisis and the economic policy on the pre-
99 payment and default patterns, we find that following the crisis prepayment risks in-
100 creased 17.8% and default risks rose 8.2% on average. For a 10% depreciation of the
101 Peso, prepayment risks increased 5.2% and default risks increased 14.2%. Subse-
102 quent to the crisis, US\$-denominated borrowers with wealth and high income were
103 more likely to prepay but less likely to default. In general, the US\$ mortgage borrow-
104 ers' prepayment rate rose 17.2%, while their default rate declined 3.1%.

105 Next, we find that indexing the mortgage interest rates to the consumer price in-
106 dex (January 2002–October 2002) resulted in a 28.1% rise in the prepayment rate and
107 20.8% rise in default rate, with a significantly higher prepayment rate amongst those
108 borrowers possessing more wealth. Finally, indexing the mortgage interest rates to
109 the wage-related indices (November 2002–January 2004) resulted in a 14.3% higher
110 prepayment rate and 13.6% higher default rate; these increases are uniform across
111 income groups. These results reveal that subsequent to the wage indexation, the in-
112 crease in default and prepayment trends have slowdown significantly, which suggests
113 that higher income households may have engaged in rate-differential arbitrage and
114 were able to maximize their wealth by continuing to make mortgage payments since
115 the rise in their wages were higher than the rise in their interest payments. Thus, the
116 mortgage market experienced a slowdown in the prepayment rates. On the other
117 hand, low-income households—with no wealth and no fear of a foreclosure—contin-
118 ued to default on their loans, while those with wealth prepaid their loans. Another
119 possible reason may be that by the late 2003, wages on average started to rise, caus-
120 ing the mortgage rates to climb and affecting borrowers' ability to make monthly
121 payments.

122 These results highlight the mechanism and the heterogeneity of consumer re-
123 sponse to the financial crisis and policy responses. They also raise serious concerns
124 about the adverse impact of economic policy responses on the less-wealthy house-
125 holds. In particular, we find that instead of alleviating the financial burdens of all
126 consumers, the Argentine government's policy responses (pesofication, indexation,
127 etc.) inadvertently discriminated against the relatively lower-income borrowers. On
128 the one hand, the wealthy mortgage borrowers received a positive wealth windfall,
129 which was in turn used to prepay their mortgage debt. On the other hand, the
130 low-income mortgage borrowers, instead of receiving the same positive wealth ben-
131 efit, endured "poverty effects" and defaulted on their loans. These outcomes reduced
132 the ability and willingness of financial institutions to supply new credit. In turn, the

133 viability and stability of the newly functioning mortgage-backed securities market in
134 Argentina was weakened, which eventually led to a temporary shutdown of the hous-
135 ing market, with a negative multiplier effect for many economic activities and
136 employment.

137 The remainder of the paper is structured as follows. Section 2 provides a discus-
138 sion of the Argentine financial crisis and the economic policy response. Section 3 dis-
139 cusses the performance of the Argentine mortgage market before and after the
140 financial crisis. Section 4 reviews the mortgage prepayment and default literature
141 and the econometric methodology. Section 5 describes the data and presents some
142 descriptive statistics. Section 6 reports the findings for the default and prepayment
143 behavior for US\$- and ARP-denominated mortgages. Section 7 discusses the impli-
144 cations of the results on the MBS market in Argentina and the broader economy.
145 Section 8 offers concluding remarks.

146 2. The Argentine crisis and the economic policy response

147 In the aftermath of the 1998 Tequila crisis in Latin America and in particular the
148 Brazilian currency devaluation, an economic recession began to unfold in Argenti-
149 na.⁶ Its domestic real GDP fell continuously at a cumulative rate of nearly 25% be-
150 tween 1999 and 2001, and unemployment surged, peaking at 23% in 2002. The
151 economic recession turned into a financial crisis, largely triggered by accumulated fis-
152 cal imbalances and a general loss of confidence. First, the Argentine government's
153 creditworthiness deteriorated due to the weakening of the public finance system. Sec-
154 ond, the lack of public confidence in the economy, as evidenced by the high dollar-
155 ization of the Argentine economy put tremendous pressure on the pegged currency.
156 Third, the banking system did not have recourse as a lender of last resort due to the
157 currency board mechanism, causing a sudden surge of borrower delinquencies. The
158 vicious cycle in the loss of public confidence and the weakening of the Peso impeded
159 the government's ability to cover its financing requirements through the markets,
160 which led to a bank deposit run in massive proportions at the end of 2001 and
161 put unsustainable pressures on the Peso.

162 Following the peak of the crisis in 2001, the government pursued extreme emer-
163 gency measures.⁷ In December of 2001, the Argentine government froze all bank
164 deposits and then announced the country's default on external debt. By early Janu-

⁶ Mussa (2002), Eichengreen et al. (2003), and De La Torre et al. (2003) emphasize the failure of the fiscal policy, currency mismatch, and the banking sector being the root cause of the crisis. Dominquez and Tesar (2004) argue that subsequent to the Brazilian currency devaluation, the short-term lending and portfolio equity flows to Argentina fell sharply. Calvo et al. (2003) and Calvo et al. (2004) suggest that the drop in capital flow was a potential trigger for the Argentine economic crisis.

⁷ We restrict our attention of government response policies to those directly relevant to consumer credit markets, and in particular, mortgage lending. For a broader prospective, see Dominquez and Tesar (2004).

165 ary 2002, a National Emergency Law repealed the “convertibility” regime of the
166 Peso and devalued the national currency to 1.4 Peso/US\$—this official rate applied
167 to fundamental transactions was quickly replaced by a decreed single floating rate
168 regime in February. As a result, the pesofication was applied asymmetrically at par-
169 ity for loans to the private sector, but at the official exchange rate—although already
170 out of touch with the market rate- for the other contracts, in particular for deposits.
171 Furthermore, outstanding bonds of public or private Argentinean entities issued under
172 Argentine law were also pesofied.⁸

173 To alleviate the impact of the pesofication on the financial assets of creditors,
174 indexation was introduced. Initially, the “Coeficiente de Estabilización Financiera”
175 (CER) index used was based on the Consumer Price Index, and in the case of con-
176 sumer loans (including mortgages) included a 3.5% per annum (in real terms) cap on
177 the interest rate to be applied. This index severely impaired debtors because of the
178 price surge following the devaluation of the Peso. Subsequently, it was replaced in
179 October 2002, for mortgages below \$250,000 (at origination), by a wage-linked in-
180 dex, known as the “Coeficiente de Variación Salarial” (CVS), also with a cap on
181 interest rates. A sunset clause was however set for the suspension of the indexation
182 prohibition, which was subsequently reinstated in April 2004.

183 Another response measure targeting outstanding mortgages was the suspension of
184 foreclosure proceedings. Through legislative intervention, the enforcement of securi-
185 ty rights was suspended twice for 3 months in the case of liens on residential prop-
186 erties. This intervention was followed by a stay of foreclosure, a voluntary decision
187 made by the banking industry after consenting with the government that nothing
188 could be done to pursue the defaulting borrowers during most of 2002. In 2003, a
189 new mechanism was designed to facilitate the rescheduling of delinquent mortgages
190 of up to \$100,000. The new mechanism consists of transferring past due loans to a
191 trust that would bear the cost of restructuring. In exchange, lenders get government
192 bonds. In reality, many banks, concerned by their already excessive exposure with
193 the government, chose to reschedule mortgages at their own costs.

194 3. The Argentine mortgage market

195 3.1. Pre-crisis period⁹

196 Mortgage lending grew sharply in Argentina during the 1990s. The total loans
197 outstanding tripled from \$3.3 billion at the end of 1991 to \$10.8 billion by the end
198 of 2000. This development was due to several factors. Macroeconomic conditions
199 were favorable, following the stabilization plan of 1991 that pegged the Peso to

⁸ For an excellent timeline of the Argentine economic crisis, see the Appendix in Dominquez and Tesar (2004).

⁹ For an analysis of the development of mortgage lending until the crisis, see Angel (2001) and Cristini and Moya (2004).

200 the US dollar at par through a currency board mechanism and a subdued inflationary
201 ary environment, which was desirable after a lengthy historical period of hyperinfla-
202 tion and macroeconomic instability. Structural reforms in the mortgage market took
203 place, especially in early 1995 when a fairly comprehensive and consistent framework
204 of reform was undertaken to enhance the country's housing finance. The efficiency of
205 mortgage rights was strengthened, securitization was established, and the MBS mar-
206 ket became the most advanced in Latin America, with the first instance of issues par-
207 tially sold abroad.¹⁰ Liberalization spurred lending because the privatization of state
208 banks, e.g., Banco Hipotecario, leveled the competitive field and encouraged the sup-
209 ply of mortgage loans. In addition, the "Federal Housing System" was organized to
210 provide resources to moderate-income groups via a combination of a theoretically
211 guaranteed volume of public assistance channels (through the "Fundo Nacional
212 de Vivienda") with (possible) links to market funding through securitization. Fur-
213 thermore, a credit information system for consumer lending was established.

214 The benefits of this market expansion and the sustainability of the system, how-
215 ever, were uncertain for several reasons. Despite increased access to the capital mar-
216 ket, the maturity of the loans in practice remained relatively short (10–15 years
217 typically) and in turn limited the affordability of borrowing. Most mortgages were
218 denominated in US\$, 70% of the overall residential sector (80% including all mort-
219 gage loans), a reflection of the dollarization of the lenders' funding bases as well as
220 the high premium charge that borrowers must pay to obtain Peso-denominated
221 loans. The interest rates were about 15% for ARP-denominated debts in the year
222 preceding the crisis and about 13% for USD-denominated debts in 1998–2000.
223 The interest rate spreads were further pushed up by wider intermediation spreads
224 that reflected the asset/liability mismatches of the lenders.

225 *3.2. The effects of the economic and financial crisis*

226 At the macroeconomic level, the drastic devaluation of the Peso, which initially
227 dropped to 4 ARP/US\$ in March 2002 before stabilizing at around 3 ARP/US\$,
228 generated an inflationary environment. Inflation surged to 46% in 2002 and 2003.
229 In turn, households' purchasing power fell drastically as the real level of median
230 household income in urban areas declined by more than 40% between 1999 and
231 the end of 2002. Moreover, this trend was unequally distributed, hurting those in
232 the lowest income distribution more than those at the top of the income distribution.

233 The crisis also had a dramatic impact on consumer borrowing behavior. Inflation
234 had a significantly strong effect on the mortgage borrowers whose debt payment
235 appreciated sharply. This impact was aggravated by the successive choices of index-
236 es, with each experiencing a higher increase than the other one during the period
237 when they were applied.¹¹ Although these periods were relatively short, the conse-
238 quences were long lasting because of the re-evaluation of the loan balances. Overall,

¹⁰ See Standard and Poor's (2000).

¹¹ In 2003, the economic situation took a turn for the better and significant wage increases were granted by private and especially public sector companies.

239 the dual economic and financial-crisis triggered shocks that deeply affected the mort-
240 gage borrowers in three ways: the ability to repay, real estate prices, and the net val-
241 ue of financial assets and liabilities. Below we discuss each of the impacts in details.

242 3.2.1. *The surge of delinquencies*

243 With a combination of soaring unemployment, sharp inflation and declining in-
244 comes, many borrowers faced loan repayment arrears and insolvency throughout
245 the banking system. In consumer lending, there are no aggregated data for the
246 sub-sector of residential mortgages. However, the percentage of past due loans in
247 the overall portfolios peaked at 26% in December 2002.¹² In the case of mortgages,
248 one can assume a parallel trend. Moreover, it is likely that the suspension of mort-
249 gage collateral enforcement did not mitigate the surge in non-performing loans.
250 Finally, it remains unclear what impact the rescheduling on impaired accounts
251 had on both the real phenomenon and its translation in the lenders' account
252 statements.

253 3.2.2. *The surge of real estate prices in Pesos*

254 The real estate sector in Argentina was largely dollarized in the urban areas, espe-
255 cially the middle- and high-income segments of the market. The 2001–2002 devalu-
256 ation of the Peso led to a new price equilibrium, although not through a simple
257 homothetic translation, but rather through differences in the market segments. As
258 a result, there was an abrupt widening of the real estate wealth distribution. At
259 the upper end of the market, where investors need not borrow or even when they
260 do they are often holders of significant assets abroad, property prices in US\$ re-
261 mained quite stable or at most experienced a slight decline. For all other properties
262 that were traded on a dollar basis, real estate prices in US\$ dropped, but far less than
263 prices in Pesos. This is likely a reflection of the “safe haven” status of real estate
264 investment as well as a fall in the owners' willingness to sell. Consequently, prices
265 once converted to Pesos skyrocketed. Typically, they were multiplied by 2.5 in Bue-
266 nos-Aires between 1999 and 2004, and the price-to-income ratio for average proper-
267 ties jumped from its pre-crisis levels typically at 3.5–4 to more than 12 following the
268 crisis.

269 Subsequently, housing became unaffordable for most of the urban households.
270 This effect was aggravated by the soaring construction costs, which were sensitive
271 to the 46% rise in external prices in 2002–2003. In turn, homeowners suddenly be-
272 came richer in Pesos, a wealth effect that perhaps eased the rise in defaults in the sec-
273 ond half of the crisis (2001–2003). On the opposite end, aspiring homeowners were
274 unable to afford the high prices—and unable to borrow for that purpose.

275 3.2.3. *The appreciation of net financial worth*

276 The pesofication of most mortgages at parity (while deposits were converted at the
277 official value of 1.4 ARP/US\$) and the market value of the Peso dropping far below

¹² The ratio declined to 15.3% in March 2004. Source: Banco Central de la Republica Argentina.

278 the parity level had a direct impact on mortgage portfolios of banks, as well as a
279 large redistributive effect. Of more significance is the relatively rare phenomenon
280 of individuals having a windfall gain between their US\$-denominated financial assets
281 and their US\$-denominated mortgage debt—a 40% appreciation in net worth over-
282 night. The windfall was much more substantial in the more frequent case of mort-
283 agers holding hard currency assets that were not subject to Argentine law. The US\$-
284 denominated asset value was multiplied by three, while the Peso-denominated liabil-
285 ities remained unchanged in Peso.

286 The introduction of indexing consumer loans based on Consumer Price Index and
287 wage-related indices severely impaired debtors because of the price surge following
288 the devaluation of the Peso. During the CPI indexation regime, Argentina experi-
289 enced a 46% inflation and declining wages, so a high income or wealthy borrower
290 should prepay the mortgage, while a low-income borrower should default on the
291 mortgage. During the wage indexation regime that is based on a median wage, if
292 a borrower's wage is above the median wage, then the borrower can maximize his/
293 her wealth by *not* prepaying the mortgage. However, if a borrower's wage is below
294 the median wage and he/she holds wealth, then the borrower can maximize his/
295 her wealth by prepaying the mortgage. On the other hand, if a borrower's wage is
296 below the median and he/she does not hold wealth, then the borrower should
297 default.

298 The wealth effect, amplified by the fear of the future consequences of the newly
299 decreed indexation of borrowed capital, induced borrowers to massively materialize
300 the large capital gains by prepaying their depreciated debt. Lending institutions, in
301 trying to restore their liquidity situation, sometimes encouraged mortgage borrowers
302 to prepay. This largely explains the reduction in total residential mortgage loans out-
303 standing from Peso 10.8 billion at the end of 2000 to 5.5 billion at the end of 2003.¹³

304 4. Methodology

305 Despite the differences in the global mortgage markets,¹⁴ the theoretical literature
306 on mortgage prepayment and default is based on the option theory first used by
307 Dunn and McConnell (1981), Findley and Capozza (1977), and Buser and Hender-
308 shott (1984).¹⁵ The standard approach in empirical mortgage modeling research rec-

¹³ This fall also includes the impact of contractual repayment and the quasi disappearance of new lending.

¹⁴ Just to name a few: (i) the underwriting guidelines; (ii) legal framework for default and foreclosure, in particular the existence of deficiency payment or not; (iii) social and cultural attitude towards debt; and (iv) the expectations at one given moment on the real estate price evolution.

¹⁵ According to the option theory, a rational borrower should maximize her welfare by prepaying her mortgage when the call option is *in the money* (i.e., the prevailing market rate is below the existing mortgage coupon rate) in the absence of transaction costs. Similarly, a borrower should default on her mortgage if the put option is *in the money* (i.e., the current market value of the house, serving as collateral, drops below the current market value of the remaining mortgage balance). For a detailed review of the option value literature, see Hendershott and Van Order (1987) and Kau and Keenan (1995).

309 ognizes the ability of the borrower to terminate the mortgage through either prepay-
310 ment or default in a competing risks hazard framework.¹⁶ In general, there is agree-
311 ment amongst the empirical studies that the market values of the call and put options
312 have a statistically significant and positive impact on mortgage termination by refi-
313 nance or default. However, many empirical studies also find that borrowers are not
314 solely and completely sensitive to financial incentives—borrower characteristics such
315 as low borrower credit scores, age, income, education, employment and personal
316 wealth are also important in explaining borrower default or prepayment behaviors
317 (see, e.g., Archer et al., 1997; Archer and Ling, 1993; Deng et al., 2004a; Green
318 and LaCour-Little, 1997; Peristiani et al., 1997; Quigley, 1987; Stanton, 1995).¹⁷

319 Moreover, the surge in mortgage prepayments and defaults in Argentina follow-
320 ing the 2001 currency crisis and the subsequent economic policy responses simply
321 cannot be explained by the factors shaping the traditional prepayment and default
322 model as well as the actual prepayment and default behaviors in the US. Following
323 the 2001 financial crisis, the Argentine mortgage borrowers faced wealth maximiza-
324 tion incentives that were beyond the call and put options. On the prepayment side,
325 the Argentine mortgage borrowers were given an unexpected, temporary incentive to
326 repatriate US\$ holdings from abroad or from under the mattress and pay off their
327 mortgage at 66% discount, regardless of whether borrowers have a US\$- or ARP-de-
328 nominated mortgage. On the default side, the 46% rise in the consumer price index,
329 40% decline in the household income, and 23% rise in unemployment hampered the
330 Argentine mortgage borrowers' ability to pay the mortgage debt.¹⁸ Moreover, Car-
331 bacho et al. (2003) find that households in the lower income deciles faced a 41% de-
332 cline in their income, while those in the higher income deciles faced only a 23%
333 decline in their income. Therefore, we expect a disproportionate rise in default for
334 the lower income borrowers.

¹⁶ Competing risks models are well developed in the labor economics literature (Mealli and Pudney, 1996; Burdett et al., 1985; Narendranathan and Steward, 1993; and Flinn and Heckman, 1982). These models are based on techniques of survival analysis, which was originated in biological studies of mortality and have found frequent application in industrial engineering failure-time studies as well as economic studies related to employment and labor issues. Kalbfleisch and Prentice (1980), and Cox and Oakes (1985) provide a classic statistical discussion of the topic; Kiefer (1988) provides a review of the economic literature on duration modeling.

¹⁷ Other empirical studies also suggest that borrowers sub-optimally refinance and prepay despite the fact that the call option is “out-of-money”. Stanton (1995) raises consumption smoothing as a possible reason for this pattern. Hurst (1999) and Hurst and Stafford (2003) argue that households, particularly those who are credit or liquidity-constrained, refinance because they want to withdraw equity from their home to fund current and future consumption. Agarwal et al. (2004c) consider households that are neither credit or liquidity-constrained and argue that consumers can also be distracted due to a binding time-budget constraint.

¹⁸ Sullivan et al. (2000) analyze a survey of 1991 US bankruptcy filings and find that 67.5% of filers attribute loss of job as the main cause of bankruptcy filings. Additionally, Agarwal and Liu (2003) using data from US provide empirical evidence that for every 20% rise in unemployment there is a 32% rise in consumer delinquency.

335 In this study, we follow Agarwal et al. (2004a) to estimate a Cox proportional
 336 hazard model of prepayment and default of Argentine mortgage borrowers.¹⁹ The
 337 model begins with a baseline time profile of the average probability of default or pre-
 338 payment conditional on the loan surviving to time t , $h_0(t)$. The baseline hazard can
 339 be shifted up or down by a factor depending on the impact of the time-varying
 340 covariates, Z_{it} . For mortgage i at time t , the probability of mortgage termination
 341 can be written as follows:

$$342 \quad H(t|Z_{it}) = h_0(t) \exp(Z_{it}\beta). \quad (1)$$

345 Eq. (1) can be generalized to a joint survival function for prepayment (p) and default
 346 (d). Below is the joint survival function, conditional on Z_{it} .

$$348 \quad S(t_p, t_d|Z, \theta) = \exp(-\eta_p \sum_{k=1}^{t_p} \exp(\gamma_{pk} + \beta'_p Z) - \eta_d \sum_{k=1}^{t_d} \exp(\gamma_{dk} + \beta'_d Z)), \quad (2)$$

349 where Z is a vector of covariates that affect the borrowers' prepayment and default
 350 behavior. Z includes both loan and borrower characteristics such as prepayment op-
 351 tion, loan term, LTV, quarterly updated credit scores, age, income, proxies for
 352 wealth, US\$-denominated mortgage dummy, and regional dummies. In addition,
 353 Z also includes the variables of interest—the crisis dummy, exchange rate variations,
 354 both the CPI and wage indexation dummies, and their interaction with the financial
 355 and demographic variables. θ is a vector of parameters of the hazard function. γ_{jk} are
 356 the parameters of the baseline hazard function, where k indexes discrete periods in
 357 the time dimension since loan origination.

358 5. Data

359 Our dataset consists of 4867 owner-occupied, fixed rate, first mortgage loans orig-
 360 inated by a large financial institution between June 1998 and March 2000, with per-
 361 formance window from loan origination to March 2004. In our dataset, there are
 362 4459 (92%) US\$-denominated and 408 (8%) ARP-denominated mortgages. One
 363 main reason for such an overwhelming percentage of US\$-denominated mortgages
 364 reflects the fact that mortgage-backed security buyers, mainly foreign entities who
 365 recognized the exchange rate risk, did not want to hold Peso-denominated mortgag-
 366 es. In other words, the difference mostly reflects the lack of confidence in the ARP
 367 (even pegged to the US\$) and therefore should be seen as a currency risk premium
 368 required by investors on a macro level (Cristini et al., 2001). Despite assurances from
 369 the government that “a peso was as good as a dollar,” consumers continue to hold
 370 US\$-denominated debts (Edwards, 2002).

¹⁹ We also estimated a proportional hazard model with unobserved heterogeneity, but the mass coefficients are statistically insignificant. A potential explanation is the fact that our dataset is fairly rich and includes several previously unobserved borrower characteristics. We also control for geographically correlated mortgages as discussed in Deng et al. (2004a).

371 In our dataset, about one-third of both US\$- and ARP-denominated loans were
372 originated in 1998, half originated in 1999, and the rest in 2000 (see Table 1). It is
373 interesting that about 13.1% of US\$-denominated mortgages, compared to only
374 2.2% of ARP-denominated mortgages, are 20-year term mortgages. On the other
375 hand, only about 6.8% of US\$-denominated, compared to the 8.9% of ARP-denom-
376 inated mortgages, are 5-year term mortgages. To analyze their performance over
377 time, we create a monthly record of each loan denoting whether the mortgage pre-
378 paid, defaulted, or is still current as of March 2004 for both US\$- and ARP-denom-
379 inated mortgages. We define default as 90-days delinquent, while prepayment is the
380 actual payoff of the loan before contract term. During the performance period, about
381 18.9% of US\$-denominated and 24.5% of ARP-denominated mortgages defaulted,
382 while about 24.6% of US\$-denominated and 12.2% of ARP-denominated mortgages
383 prepaid (see Table 2).

384 The dataset contains usual loan level characteristics, such as the original loan
385 amount, the loan-to-value ratio at origination, appraised house values at origination,
386 and the contract interest rate. We also observe many detailed borrower characteristics
387 such as the borrower credit score (Veraz score similar to a FICO score) at origination as
388 well as the quarterly updated score over the sample period. Other borrower character-
389 istics include: income, second income, age, years on the job, debt to income ratio,²⁰ sec-
390 ond house ownership (a wealth indicator), car ownership (another wealth indicator),
391 car value (wealth measure), female ownership, marriage status, employment type²¹
392 and finally whether the homeowner has a checking account relationship with the bank.

393 In addition, we also know the branch where the loan was originated. In total,
394 there are 137 branches. The branches serve as proxy for the geographical location
395 of the mortgage loans. Since there are differences in the cost and enforceability of
396 bankruptcy and foreclosure laws by geography, the branch indicators will also help
397 control for such differences.²² Moreover, since we do not have updated house prices,
398 branch dummies will also serve as a proxy for the house price appreciation (housing
399 neighborhoods are likely to stratify by bank branches).

400 Table 3 provides detailed summary statistics both for the loan and borrower char-
401 acteristics of the US\$- and ARP-denominated mortgages. With respect to the loan
402 characteristics, we learn that US\$-denominated mortgages have on average longer
403 loan term than do the ARP mortgages (132 months vs. 109 months). Furthermore,
404 US\$-denominated mortgages have on average lower contract rate (12.15 vs.
405 15.91%)²³ and higher original LTV (62 vs. 52%) than do ARP-denominated mortgages.

²⁰ Unlike the US, DTI is defined as the monthly mortgage payment as a percentage of monthly income net of taxes. This calculation does not include other debt, such as auto or credit cards.

²¹ There are four possible employment categories: self-employed, professional employment, non-professional employment, and merchants.

²² Though the Argentine legislature protects the rights of the creditor, the enforceability of such rights varies by region. Cristini et al. (2001) note that enforcement of the laws across the 24 provinces in Argentina has resulted in the disparity in credit availability and banks' non-performing loans are higher. Furthermore, they show that the cost of recovery on a bad mortgage loan can vary between 8 and 13 percent across the 24 provinces.

²³ Soon after the financial crisis, the mortgage contract rates jumped up 5 percentage points.

Table 1
Distribution of loan term

	US\$ denominated mortgages		ARP denominated mortgages	
	Frequency	Percent (%)	Frequency	Percent (%)
<i>Loan term</i>				
5 Years	301	6.75	69	16.91
10 Years	2357	52.86	222	54.41
15 Years	1216	27.27	108	26.47
20 Years	585	13.12	9	2.21
<i>Loan origination years</i>				
1998	1449	32.5	141	34.7
1999	2310	51.8	201	49.2
2000	700	15.7	66	16.1

Notes: The table reports the loan term and loan origination year distributions (frequency and percentages) for US\$- and ARP-denominated mortgages.

Table 2
Distribution of default and prepayments

Default/prepay	All loans	US\$	ARP
Defaults	945	845	100
Prepays	1150	1100	50
All loans	4867	4459	408

Notes: The table reports the prepayment and default distribution for US\$- and ARP-denominated mortgages.

406 Moreover, we learn that borrowers of US\$-denominated mortgages are on aver-
 407 age slightly younger and have relatively lower credit quality (682 vs. 725 credit
 408 score²⁴) and higher debt-to-income ratio (23 vs. 21%). Many of the other borrower
 409 characteristics (such as income level, wealth indicators, demographics, and employ-
 410 ment) do not appear to differ significantly between the two types of mortgage bor-
 411 rowers. On average, about 15% of the mortgage borrowers own a second home
 412 and 75% own a car (average value of \$6025). Furthermore, about 32% of the bor-
 413 rowers are female, 73% are married, 20% have a second income and 16% are married
 414 with two incomes. Finally, 15% are self-employed, 53% are professionals, 17% are
 415 non-professionals, and 14% are merchants.

416 These descriptive statistics indicate that both loan and borrower characteristics of
 417 ARP-denominated mortgages are on average *less* risky than those of US\$-denomi-
 418 nated mortgages. Hence, we should expect a priori a lower average default rate
 419 and a higher average prepayment rate for ARP-denominated mortgages relative to
 420 US\$-denominated mortgages. Moreover, it is noteworthy that despite the less risky
 421 borrower characteristics of ARP-denominated mortgagers relative to US\$-denomi-
 422 nated mortgagers, there is 375 basis points higher in the price of ARP-denominated

²⁴ The scores are provided by a local credit bureau that collects financial and non-financial information to determine the scores. The score range is between 400 (worst) to 800 (best).

Table 3
Descriptive statistics at account origination

Variable name	US\$ denominated mortgages		ARP denominated mortgages		T stats
	Mean	SD	Mean	SD	
	<i>Loan characteristics</i>				
Loan term	132	43	109	32	10.47*
APR	12.15%	1.40%	15.91%	2.14%	-49.38*
Loan amount	\$45,594	\$27,303	\$35,065	\$21,899	7.57*
Appraised house value	\$78,509	\$52,372	\$79,316	\$64,361	-0.29
Origination LTV	62.04%	16.01%	51.65%	19.21%	12.33*
<i>Borrower characteristics</i>					
Origination credit score	682	255	725	233	-3.25*
Owner Age	40	10	45	10	-9.41*
Income	\$2616	\$2,079	\$2,706	\$2,342	-0.83
Debt to income	22.98%	11.93%	21.30%	13.98%	2.68*
Years on the job	9.33	7.93	10.56	8.77	-2.97*
Second house	14.35%	15.07%	15.61%	16.41%	-1.60
Car	73.18%	44.31%	76.70%	41.68%	-1.54
Car Value	\$5627	\$24,683	\$6,070	\$13,765	-0.36
Female	30.77%	46.16%	33.09%	47.11%	-0.97
Married	71.00%	45.38%	74.75%	43.50%	-1.60
Second income	20.50%	40.37%	19.85%	39.94%	0.31
Married w/two income	16.73%	37.33%	16.91%	37.53%	-0.09
Self employed	15.54%	36.23%	18.38%	38.78%	-1.51
Professional employment	52.59%	49.94%	54.90%	49.82%	-0.90
Non professional employment	17.78%	38.24%	15.20%	35.94%	1.31
Merchant	14.08%	34.79%	11.52%	31.97%	1.43
Bank relationship	9.98%	29.98%	14.95%	35.70%	-3.15*
Number of accounts	4459	92%	408	8%	

Notes: The table reports descriptive statistics (mean and standard deviations) for the loan and borrower characteristics at loan origination for US\$- and ARP-denominated mortgages. Additionally, the last column provides the *t* test for difference in means between the US\$- and ARP-mortgages. It is evident that both loan and borrower characteristics are statistically different across US\$ and ARP mortgage borrowers.

* Significant at the 5% level.

423 mortgages with 10% lower LTV.²⁵ The mortgage rate differential, however, can partially be attributed to the general difference in the interest rates in each currency, the 424 ARP-denominated mortgage rate being affected by a higher currency risk premium.²⁶ In addition, even though ARP-denominated mortgages have a higher per-

²⁵ Mortgage underwriters in Argentina told us that generally older consumers who have lived through past devaluations were more likely to choose a shorter duration, lower LTV, peso denominated mortgage despite a higher interest rate.

²⁶ As discussed earlier, the Mortgage Backed Securities market in Argentina has since 1996 provided liquidity to banks (by marketing MBS to international investors in US\$) to alleviate concerns of a devaluation risk to the bondholders the MBS were traded in US\$. US\$-denominated mortgage borrowers who were the bearers of the devaluation risk were provided a subsidy in terms of the interest rate on their mortgages.

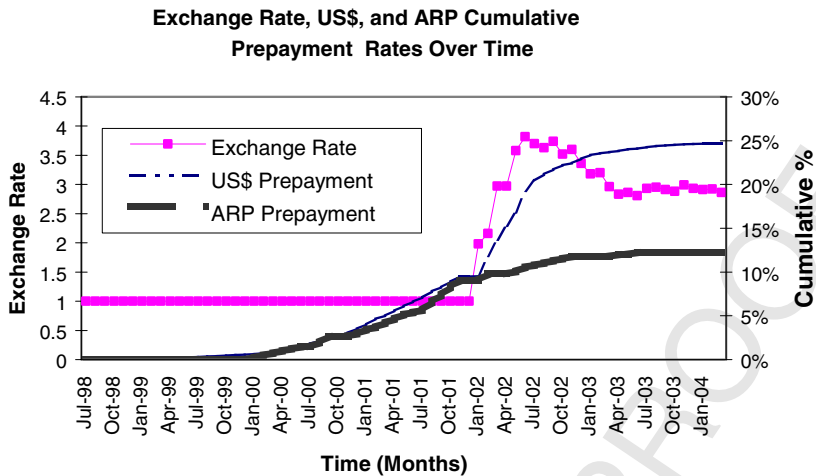


Fig. 1. Exchange rate, US\$, and ARP cumulative prepayment rates over time.

427 centage of short-term mortgage loans, the average portfolio contract rate (APR) is
428 higher.

429 Figs. 1 and 2 provide the pre- and post-crisis cumulative prepayment and default
430 pattern, relative to changes in the exchange rate over the 6-year period (07:1998–
431 03:2004). Fig. 1 shows that the prepayment rate for US\$- and ARP-denominated
432 mortgages are statistically indifferent before the devaluation of the ARP. Following
433 the devaluation, however, there was a dramatic rise in the prepayment of the US\$-
434 denominated mortgages. On the contrary, the prepayment rate of ARP-denominated
435 mortgages slowed down at the onset of the crisis and then rose slowly and steadily
436 thereafter. However, around October 2002, the prepayment rate of both US\$- and
437 ARP-denominated mortgage slowed down. The reasons for the slowdown is possibly
438 due to (1) the change in indexation (from using the CPI index to wage index), which
439 resulted in a dramatic drop in the mortgage interest rates; or (2) the stabilization of
440 the ARP/US\$ exchange rate. A more formal analysis will help sort the two affects.

441 Fig. 2 shows the cumulative default pattern of US\$- and ARP-denominated mort-
442 gages over the same 6-year period. While it is difficult to see in the graph, the average
443 cumulative default rate of US\$-denominated mortgages is statistically higher by
444 1.3% points prior to the devaluation of the Peso. Post devaluation, however, the de-
445 fault rate for ARP-denominated loans extensively out paced that of US\$-denomina-
446 ted mortgages. Once again, the default rates started to stabilize after October 2002. It
447 is possible that the change of the indexation increased the borrowers' ability to pay
448 their mortgage loan, thereby lowered the default rate.

449 We should point out that these figures confound both account seasoning and cal-
450 endar time events (e.g., the 2001 financial crisis). Thus, while we are interested in the
451 effect of the Peso devaluation and indexation, we might be capturing the effect of ac-
452 count seasoning on prepayment and default. A more formal analysis is warranted
453 before we can make any firm conclusions.

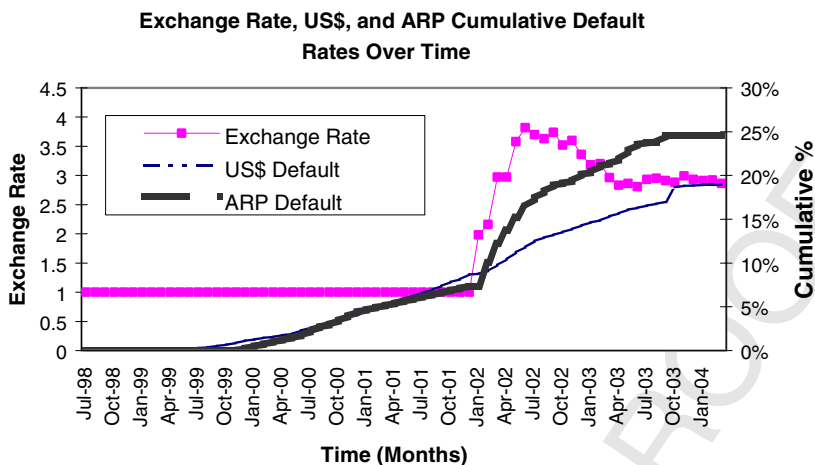


Fig. 2. Exchange rate, US\$, and ARP cumulative default rates over time.

454 5.1. Variables

455 In modeling the probability of prepayment of US\$- and ARP-denominated mort-
 456 gages, we incorporate a set of explanatory variables that capture financial incentives
 457 and consumption smoothing motives to prepay a mortgage debt.²⁷ To approximate
 458 the value of the borrower’s prepayment option, we follow the approach outlined in
 459 Deng et al. (2000) and estimate the prepayment call option as

$$461 \text{OPTION}_{i,t} = \frac{V_{i,t} - V_{i,t}^*}{V_{i,t}}, \tag{3}$$

462 where $V_{i,t}$ is the market value of loan i at time t (i.e., the present value of the remain-
 463 ing mortgage payments at the current market mortgage rate), and $V_{i,t}^*$ is the book-
 464 value of loan i at time t (i.e., the present value of the remaining mortgage payments
 465 at the contract interest rate).²⁸ Since consumers are more likely to prepay and refi-
 466 nance following a decline in the prevailing mortgage rate relative to the original cou-
 467 pon rate, a positive value for OPTION indicates that the prepayment option is “in-
 468 the-money”. To account for any non-linearity in the prepayment option, we also in-
 469 clude the square of OPTION.

470 We do not have access to the current property values, but we do observe the
 471 monthly mortgage payment amounts, so we estimate current LTV holding the
 472 denominator constant. We expect CLTV to be negatively related to prepayment.
 473 We also include the square of CLTV to control for any non-linearity.

²⁷ This section relies on the variable definitions in Agarwal et al. (2005).

²⁸ This is the equivalent to the prepayment option value used by Archer et al. (1996) scaled by the mortgage book-value.

474 In addition, we also capture changes in borrower credit constraints via the time-
475 varying borrower credit score. Borrower credit history is one of the key determinants
476 of mortgage loan approval. Borrowers with good credit history are able to obtain
477 credit with relatively more ease; thus, they are able to take advantage of refinance
478 opportunities. Conversely, borrowers with poor credit scores are credit-constrained
479 since they either face difficulty qualifying for new credit at any price, or if credit is
480 available, the higher interest rate or transaction costs make the new loan prohibitive-
481 ly expensive (see, e.g., Bennet et al., 2000). We include the square of credit score to
482 capture any non-linearity present in borrower credit scores.

483 The US\$/ARP exchange rate for the time period between July 1998 and March
484 2004 capture the impact of depreciation of the Peso on the prepayment and default
485 behavior of the mortgage loans. We include the square of the exchange rate to cap-
486 ture any non-linearity.

487 Furthermore, since our dataset contains borrower characteristics, we are able to
488 control for some of the traditionally unobserved variables. We construct dummy
489 variables to denote monthly income for low, medium, high and very high categories.
490 They are evenly divided into four quartiles. We also create a dummy variable for
491 owners with median age above 40 years, as well as continuous variables to control
492 for debt to income and years on the job.²⁹ In addition, we have dummy variables
493 serving as proxies for wealth, i.e., second home and car. The car value measures
494 the depth of the wealth. Moreover, past studies found variables such as female, mar-
495 ried, second income, married with second income, type of profession (merchant,
496 non-professional, professional, and self employed) as predictors of prepayment
497 and default (see e.g., Deng et al., 2004b), we therefore control for these variables
498 as well. Finally, we have an indicator variable for a checking account relationship
499 with the bank. It has been found that relationship banking to be an important deter-
500 minant of consumer default and prepayment decisions (Agarwal et al., 2004b).

501 Next, we construct several dummy variables to capture the effect of the crisis and
502 its interaction with mortgage denomination, loan and borrower characteristics. First,
503 we construct a dummy variable for the crisis period (November 2001 onwards). We
504 also construct a dummy variable for US\$-denominated loans. We interact these
505 dummies to test whether US\$-denominated loans behaved differently during the cri-
506 sis. Next we construct a set of dummies that interact: (i) the crisis period with LTV,
507 credit scores, prepayment option, income, and wealth; (ii) US\$-denominated mort-
508 gage with LTV, credit scores, and prepayment option, income, and wealth; and,
509 (iii) crisis period with US\$-denominated mortgages with income and wealth. The
510 interaction of LTV, credit scores, and prepayment option with the crisis period dum-
511 my and US\$-denominated mortgage dummy are aimed to test the sensitivity of the
512 prepayment and default behaviors of US\$-denominated mortgages to the traditional
513 option value theory and/or loan characteristics during the pinnacle of the financial
514 crisis. Moreover, the interaction of the income and wealth variable to the crisis dum-

²⁹ Our results are robust across classification of these variables. Alternative models created discrete variable for debt to income, years on the job and continuous variables for income and age. The results are qualitatively the same.

515 my and US\$-denominated mortgage dummy are aimed to test the effect of the crisis
516 and the subsequent policies on the prepayment and default decisions of the various
517 types of borrowers. As discussed in the previous section, we believe that the crisis
518 and the subsequent policies had an asymmetric impact on households with relatively
519 more wealth, higher income, and US\$-denominated mortgages.

520 Next, we construct two dummies for the CPI index (February 2002–October 2002)
521 and the wage index (November 2002–January 2004) regimes. We also interact these
522 dummies with wealth and income variables. Finally, we include a number of vari-
523 ables to control for geography (branch dummies), loan term, quarterly time dum-
524 mies and account seasoning (AGE of account, AGE-square, and AGE-cube).
525 $AGE_{i,t}$ is the number of months since origination at time t , and as Gross and Sou-
526 leles (2002) point out, to allow for loan seasoning. That is, AGE accounts for changes
527 in the prepayment and default propensity as the loans mature. In addition, Gross
528 and Souleles (2002) note that the age variables allow the competing-risks hazard
529 rates to vary with duration. Our cubic specification of AGE allows the prepayment
530 and default hazards to vary non-parametrically.

531 6. Results

532 As a first step in our analysis, we estimate the baseline survival function of the
533 cumulative likelihood of US\$- and ARP-denominated mortgages “surviving” (i.e.,
534 not prepaying or defaulting) over the sample period. Figs. 3 and 4 present the base-
535 line survival curves for prepayment and default, respectively. Fig. 3 shows the base-
536 line prepayment survival curves. The prepayment rates for ARP- and US\$-
537 denominated mortgages are not significantly different. However, it is clear from

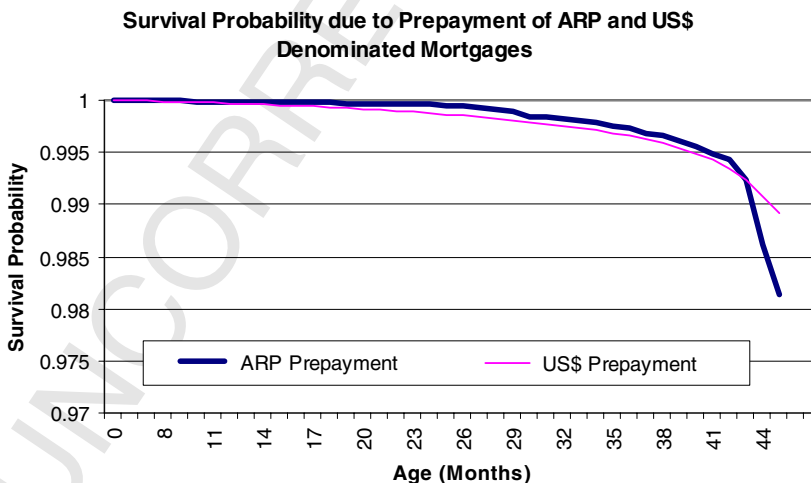


Fig. 3. Survival probability due to prepayment of ARP and US\$ denominated mortgages.

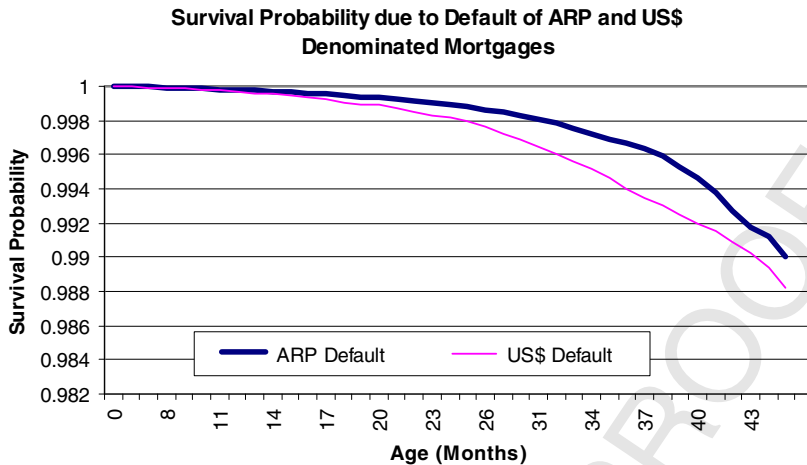


Fig. 4. Survival probability due to default of ARP and US\$ denominated mortgages.

538 Fig. 4 that at any given age, ARP-denominated mortgages have a significantly higher
 539 survival (i.e., lower default) rate than do US\$-denominated mortgages. As discussed
 540 earlier, the overall loan and borrower characteristics of ARP-denominated mortgage
 541 borrowers are on average less risky; thus, the lower default rate is expected.

542 To fully determine the sensitivity of the performance of ARP- and US\$-denomi-
 543 nated mortgages to the financial crisis, government policies and their interaction
 544 with borrower characteristics, Table 4 present the competing risk model parameter
 545 estimates. Below we discuss the general results in Section 6.1 and the impact of
 546 the financial crisis and the economic policies in Section 6.2.

547 6.1. General results

548 Focusing first on the effect of loan characteristics on prepayment and default
 549 risks, we find that loan term dummies for 10, 15 and 20 years are positively related
 550 to prepayment and default, albeit the 20 years dummies in default are statistically
 551 insignificant; these results are consistent with Clapp et al. (2003). Account age is also
 552 statistically significant, which is consistent with much of the mortgage literature.
 553 Next, we look at the CLTV, lagged six months to avoid endogeneity. The higher
 554 the CLTV, the higher the prepayment risk, with no significant differences between
 555 the US\$- and ARP-denominated mortgages. Surprisingly, we find an insignificant in-
 556 crease in the default risks of loans with higher CLTV. Furthermore, the call option is
 557 significantly and positively related to the prepayment and default risks, with higher
 558 prepayment and default risks for US\$-denominated mortgages. These results are
 559 intuitive and consistent with the mortgage literature.

560 We now turn to look at the impact of borrower characteristics on prepayment
 561 and default risks. We find that borrowers with inferior credit quality (credit score
 562 lagged six months to avoid endogeneity) are more likely to default but less likely

Table 4
Regression results for default and prepayment for USS and ARP denominated mortgages

	Default			Prepayment		
	Coeff.	SE	t stat	Coeff.	SE	t stat
<i>Panel A</i>						
Intercept	5.1068000		2.06	-5.6884000	1.9953000	-2.85
Account age	0.1172000		2.16	0.0327000	0.0148000	2.21
Account age (sq)	-0.0031800		-1.51	-0.0007100	0.0004210	-1.69
Account age (cube)	0.0000280		1.12	0.0000077	0.0000270	0.29
Loan term 10 years	0.0128000		3.58	0.0376000	0.0062800	5.99
Loan term 15 years	0.0000450		4.09	0.0001130	0.0000410	2.76
Loan term 20 years	0.0000310		0.31	0.0389289	0.0187320	2.08
Option	0.5360000		2.93	1.4525000	0.4190000	3.47
Option (sq)	0.0141000		3.55	0.0304000	0.0087900	3.46
CLTV	2.5138000		1.77	4.5261000	1.3709000	3.30
CLTV (sq)	1.6533000		1.44	-5.8324000	1.2067000	-4.83
Credit score	-0.0019300		-2.91	0.0017100	0.0008080	2.12
Credit score (sq)	-0.0000033		-7.25	0.0000018	0.0000005	3.40
Monthly income medium	-0.2527000		0.13	-0.0519000	0.5084000	-0.10
Monthly income high	-0.5813000		-0.47	0.3498000	0.4897000	0.71
Monthly income very high	0.0906000		-0.87	0.3922000	0.1147200	3.42
Age > 40 years	0.0666000		1.28	-0.1442000	0.0834000	-1.73
Debt to income	0.0666000		0.25	-2.9162000	1.2768000	-2.28
Years on the job	-0.0084500		-1.89	-0.0034700	0.0046200	-0.75
Second house	-0.2687000		-1.56	0.0660000	0.1570000	0.42
Car	-0.0578000		-0.63	0.2163000	0.1143000	1.89
Car value	-0.0000006		-3.89	0.0000023	0.0000012	1.99
Female	-0.0135000		-0.19	0.0195000	0.0804000	0.24
Married	-0.0189000		-0.24	-0.2251000	0.0937000	-2.40
Second income	-0.0584000		-0.31	0.9615000	0.1995000	4.82
Married w/two income	-0.0507000		-0.25	0.4511000	0.2158000	2.09
Professional employment	-0.0463000		-0.42	0.2398000	0.1035000	2.32
Non professional employment	-0.0954000		-0.97	0.5093000	0.4011000	1.27
Merchant	0.0289000		0.28	0.3857000	0.1053000	3.66

(continued on next page)

Table 4 (continued)

	Default			Prepayment		
	Coeff.	SE	t stat	Coeff.	SE	t stat
Bank relationship	−0.0204000	0.0076500	−2.67	−0.6184000	0.0942000	−6.56
<i>Panel B</i>						
US\$ mortgage dummy	−4.0723000	2.0415000	−1.99	4.0432000	1.3764000	2.94
US\$Dummy*Option	0.2623000	0.1176000	2.23	0.8160000	0.2858000	2.86
US\$Dummy*Credit score	−0.0006380	0.0005330	−1.20	0.0005900	0.0005160	1.14
US\$Dummy*CLTV	0.0715000	0.8398000	0.09	1.0279000	0.7380000	1.39
US\$Dummy*Income medium	0.0799000	0.5824000	0.14	−0.3108000	0.5501000	−0.56
US\$Dummy*Income high	−0.0414000	0.5527000	−0.07	1.0335000	0.5199000	1.99
US\$Dummy*Income very high	−0.6523000	0.5344000	−1.22	1.1872000	0.4421000	2.69
US\$DummyWealth	−0.1695000	0.0532400	−3.18	0.4044000	0.2008000	2.01
<i>Panel C</i>						
Crisis dummy	0.7400000	0.2844000	2.60	7.9019000	1.6192000	4.88
Exchange rate	6.8184000	1.1637000	5.86	6.5611000	1.5127000	4.34
Exchange rate (sq)	1.1969000	0.1832000	6.53	1.0256000	0.2422000	4.23
Crisis*US\$ dummy	−0.2739000	0.0976800	−2.80	0.5117000	0.1382000	3.70
CrisisDummy*Income medium	0.6139000	0.8397000	0.73	−1.9282000	1.1893000	−1.62
CrisisDummy*Income high	−0.6918000	0.3055000	−2.26	0.0445000	0.0220060	2.02
CrisisDummy*Income very high	−0.2276000	0.0563000	−4.04	0.0347000	0.0159650	2.17
CrisisDummy*Wealth	−0.6407000	0.2751000	−2.33	0.1024000	0.0307900	3.33
Crisis*US\$*IncomeMedium	0.5715000	0.8186000	0.70	1.3973000	1.1528000	1.21
Crisis*US\$*IncomeHigh	−0.8094000	0.3877000	−2.09	0.4728000	0.1486000	3.18
Crisis*US\$*IncomeVeryHigh	−0.2095000	0.0521000	−4.02	0.7735000	0.3749000	2.06
Crisis*US\$*Wealth	−1.2884000	0.5360000	−2.40	0.6198000	0.2747000	2.26
CPI Indexation	1.0484000	0.1451000	7.23	0.1781000	0.0202000	8.82
CPI Indexation*Wealth	0.9546560	0.7382900	1.29	0.2578470	0.1283000	2.01
Wage Indexation	0.6158000	0.1714000	3.59	0.3787000	0.1213000	3.12
Wage Indexation*	−0.0159000	0.1794000	−0.09	0.1126000	0.2226000	0.51
AboveAvgIncome						
Loan origination year dummies	Yes					
Quarterly dummies	Yes					

(continued on next page)

Table 4 (continued)

	Default		Prepayment	
	Coeff.	SE	Coeff.	t stat
Bank branch dummies (137 branches)				
Number and % of default/prepays	945	19%	1150	24%
Pseudo R^2	0.49			
Number of accts/observations	4867	186,467		

Notes: This table shows results of a proportional hazard model of prepayment and default using monthly date for Argentine mortgage borrowers from June 1998 to March 2004. Prepayment is defined as actual payment of the loan amount prior to contract terms and default is defined as 90 days past due. Since foreclosure was suspended, the lender was treating 90 DPD as effective default of the loan. The independent variables control for bank branch dummies, loan origination year, account age, calendar time, credit risk, current loan-to-value ratio, interest rates, various demographic variables (age, income, wealth, marital status, etc.), dummy variables for the crisis, exchange rate, CPI and wage index dummies, and interaction of the crisis and policy variables with income and wealth. All time varying variables are lagged by six months to avoid any endogeneity. Additionally, credit scores, exchange rates, call option, and LTV are modeled to capture any non-linearity. The competing risks model is estimated as a multinomial logit via maximum likelihood.

563 to prepay, with no significant differences between US\$- and ARP-denominated
564 mortgages. Moreover, we find that both measures of income are insignificant in
565 explaining mortgage default and prepayment behavior of the Argentine mortgage
566 borrowers; however, borrowers of US\$-denominated mortgages holding wealth
567 (car and second home) are significantly more likely to prepay their mortgage.
568 With respect to income, we find that borrowers in the medium-, high-, or very-
569 high-income quartiles are *not* significantly more likely to default on their mort-
570 gages than borrowers in the low-income bracket, while borrowers in the very-
571 high-income quartiles are significantly more likely to prepay their mortgage.
572 Moreover, US\$-denominated mortgage borrowers in the higher income brackets
573 are significantly more likely to prepay than those in the lower income quartiles.
574 As we noted earlier, at the macro level, household income declined by more than
575 40% between 1999 and 2002. However, as discussed earlier in Section 3.2 and by
576 Carbacho et al. (2003), the crisis had a negatively redistributive impact on the
577 real income decline. Carbacho et. al., find that households in the lower income
578 deciles faced a 41% decline in their income, while those in the higher income dec-
579 iles faced only a 23% decline in their income. While we only observe income at
580 mortgage origination, the above statistics confirm that low-income households
581 experienced a much higher decline in their real income and thus, a higher risk
582 of defaulting on their mortgage loan.

583 Other borrower characteristics such as female, home ownership, marriage, second
584 income, married with second income, and employment type do not have statistically
585 significant affect on the likelihood of default, but have significant impact on the like-
586 lihood of prepayment. For example, while married borrowers are less likely to pre-
587 pay their mortgage, borrowers with second income or married borrowers with two
588 incomes are more likely to prepay their mortgage. Borrowers who are employed
589 as merchants are more likely to prepay. Other interesting results include the follow-
590 ing. Borrowers who have relatively higher debt to income ratio are not significantly
591 more likely to default but are significantly less likely to prepay. The longer the bor-
592 rower (of either US\$- or ARP-denominated mortgage) has been on her job, the less
593 likely she is to default and prepay. While these results are directionally consistent
594 with Corbacho et al. (2003), who find that households with longer job experience
595 have a higher income, our estimated coefficients are insignificant. Finally, it is inter-
596 esting to find the households having some relationship with the bank are significantly
597 less likely to default and to prepay their mortgage. This is also consistent with Agar-
598 wal et al. (2004b) who show that various measures of bank relationship reduce the
599 likelihood of default and prepayment.

600 Overall, these results suggest that default and prepayment decisions are not only
601 driven by the value of the options, but borrower characteristics also help explain the
602 heterogeneous prepayment and default patterns.

603 6.2. *Impact of the financial crisis and economic policy responses*

604 We first look at the patterns and sensitiveness of the Argentine mortgage prepay-
605 ments and defaults following the financial crisis. We find that on average the prepay-

606 ment and default risks are significantly higher following the financial currency, with
607 higher prepayment but lower default amongst the US\$-denominated mortgages. The
608 marginal effects on Table 5 show an 8.2% rise in default and a 17.8% rise in prepay-
609 ment following the crisis. Moreover, the Peso-US\$ exchange rate has a significantly
610 positive effect on both default and prepayment decisions, indicating that households
611 are more likely to default and prepay their mortgage as the Peso depreciates relative
612 to the US\$. In Table 5, our marginal effects results indicate that a 10% rise in the
613 exchange rate (i.e., a 10% depreciation in the Peso) resulted in a 14.2% rise in default
614 and a 5.2% rise prepayment.

615 However, we find that the effects are heterogeneous amongst different types of
616 borrowers. Relative to borrowers of an ARP-denominated mortgage, borrowers of
617 a US\$-denominated mortgage are less likely to default and more likely to prepay fol-
618 lowing the crisis. For borrowers of a US\$-denominated mortgage, the marginal ef-
619 fects on Table 5 shows that there was on average a 3.9% lower default but a
620 17.2% higher prepayment following the currency crisis. With respect to default
621 and prepayment patterns of the different income group post financial crisis, our re-
622 sults show that borrowers in the high- to very-high-income quartiles or have more
623 wealth were significantly less likely to default, but were significantly more likely to
624 prepay. Furthermore, we find a significantly higher prepayment rate and lower de-
625 fault rate amongst the US\$-denominated mortgage borrowers with more wealth or
626 in the high- and very-high-income quartiles. Amongst these borrowers of a US\$-de-
627 nominated mortgage, we find a 4.6% higher default for those in the medium-income
628 bracket, but a 7.1% lower default for those in the high-income bracket and a 12.1%
629 lower default for those in the very-high income bracket. On the prepayment side, the
630 opposite is true. There was a 2.3% decline in the prepayment for those US\$ mortgage
631 borrowers in the medium-income quartile, but a 4.7% rise in the prepayment of those
632 in the high-income quartile and a 12.5% rise in the prepayment of those in the very-
633 high-income quartile. Finally, there was a 12.3% decline in default but a 16.1% in-
634 crease in prepayment of those US\$ mortgage borrowers holding more wealth.

635 One potential explanation for the above results is that the higher-income or
636 wealthy borrowers benefited from the capital gains and hurried to materialize it,
637 while the less well-off incurred unemployment and impoverishment. These results
638 provide evidence that the policy responses to the currency devaluation have an asym-
639 metric impact on consumer finance behavior.

640 Finally, we look at the impact of the CPI and wage indexation regimes and their
641 interaction with income and wealth to determine whether high-income borrowers
642 maximized their wealth by not prepaying their mortgage during the wage indexation
643 regime. The results suggest that prepayment was 28.1% higher on average and de-
644 fault was 20.9% higher during the CPI indexation regime. The interaction of CPI
645 dummy with wealth reveals that wealthy borrowers had a significantly higher prop-
646 ensity to prepay, but not to default. Furthermore, even though we find that during
647 the wage indexation regime default was 13.6% higher and prepayment was 14.3%
648 higher on average—a significant slowdown in both default and prepayment trends
649 compared to the trends during the CPI indexation regime. Moreover, prepayment
650 for high-income borrowers is statistically insignificant. These results imply that

651 high-income borrowers maximized their wealth by continuing to repay the mortgage,
652 while potentially earning higher returns on other investments opportunities.

653 7. Impact of the crisis on the secondary market and financial institutions

654 According to a 1998 study by Argentina's Secretariat of Industry, Trade and Min-
655 ing, the country's mortgage debt grew 92% on a per capita basis from \$137 million in
656 1994 to \$264 million in 1998. Furthermore, Argentina's monthly average mortgage
657 loans by all financial institutions in the country rose from \$166 million per month
658 in 1997 to \$207 million per month in 1998.

659 Given the rapid growth in the mortgage market during these four years, govern-
660 ment officials and market participants felt the need to develop a mortgage-backed
661 securities market in Argentina. They argued that a secondary market would help
662 structure the growing primary market by instituting standards for credit and prop-
663 erty underwriting policies, and enabling lenders to hedge against the financial risks.
664 The secondary market would be composed of mortgage-backed securities (MBS),
665 bringing a higher level of long term liquidity to the banking system. They envisioned
666 that the MBS would stimulate the Argentine mortgage market in the same way that
667 Fannie Mae and Freddie Mac did for the US market. This was facilitated with a
668 US\$1.55 billion investment from the International Finance Corporation (IFC) in a
669 central conduit system set up by Banco Hipotecario.

670 The MBS program included loans ranging from US\$10,000 to US\$80,000 (with
671 terms ranging from 3 to 20 years and fixed interest rates between 10 and 18%). These
672 mortgage loans were denominated in US\$. The mortgage obligation contained pro-
673 visions requiring that the principal and interest on the mortgage loan be payable in
674 US\$. Hence, the exchange rate risk was born entirely by the borrower, accounting
675 for the "discounted" interest rates for mortgages in US\$.

676 With the Argentine government defaulting and devaluating its currency in
677 December 2001 and the subsequent paradoxical economic policy responses ("pesofi-
678 cation" suspension of foreclosures, CPI and wage indexation) designed to cushion
679 the adverse impact of the devaluation on the financial burdens of borrowers and
680 financial institutions, the devastating effects on the mortgage-backed securities mar-
681 ket were enormous. First, as discussed earlier, the 66% subsidy on loan repayment,
682 combined with the 46% rise in consumer price index accelerated the prepayment
683 speed of the underlying mortgages. Second and most severely, the pesofication
684 caused the debt payments made to investors to fall below the dollar amount neces-
685 sary to meet timely payments on the original terms, which then led to a deep depre-
686 ciation of the investors' holdings. Eventually, because of the forced pesofication at a
687 sharply devalued rate, Argentine MBS were deemed in default and downgraded to a
688 rating of 'D'.³⁰

³⁰ See Fitch Ratings (2002).

Table 5

Marginal Effects of Prepayment and default for US\$ and ARP mortgages at the 24th month

Variables	Default	Prepayment (%)
<i>Traditional option variables</i>		
100 basis points increase in APR	6.8%	12.1
10% drop in LTV	-11.2%	9.1
5% Drop in credit score	7.1%	-3.2
<i>Demographic variables</i>		
US\$ mortgage dummy	-4.5%	8.4
Wealth indicator	-9.1	15.7
10% rise in monthly income	-9.8%	10.1
<i>Financial crisis and demographics</i>		
10% rise in the exchange rate	14.2%	5.2
Crisis dummy	8.2%	17.8
Crisis*US\$ Dummy	-3.9%	17.2
Crisis*US\$*IncomeMedium	4.6%	-2.3
Crisis*US\$*IncomeHigh	-7.1%	4.7
Crisis*US\$*IncomeVeryHigh	-12.1%	12.5
Crisis*US\$*Wealth	-12.3%	16.1
<i>Government policies and demographics</i>		
CPI index dummy	20.9%	28.1
Wage index dummy	13.6%	14.3

Notes: The marginal effects of traditional option, demographic, financial crisis and government policy variables on the prepayment and default behavior of Argentine mortgage borrowers. This table reports the impact of a change in the indicated variable on the probabilities of prepayment and default holding all other variables constant that their sample means.

689 The economic and financial crisis also had dramatic impact on the financial system. Of the 116 financial institutions existing in 1999, only 97 existed in March 2004 (a 19% reduction over a five-year period). Similarly, the loan portfolios of these institutions shrunk from 23.5% (private loans as a percentage of GNP) in 1999 to 8.5% in 2004, a 15% point reduction. It is only in 2004 that few of the banks (Banco Rio, Banco Nacion, etc.) started to once again offer mortgage loans. Most of these loans are short maturity of up to 10 years and targeted to relatively more wealthy individuals.

697 Effectively, there are three main factors that still impede the reestablishment of the primary and secondary mortgage markets in Argentina. First, the future uncertainty of the macroeconomic stability affects both the borrowers and the investors. Second, the high level of credit risk affects both lenders and investors. Finally, the loss of confidence in the legal system to protect the lender from credit losses has made lenders apprehensive of offering new credit.

703 8. Conclusions

704 In December 2001, Argentina defaulted on her external debt and devalued her currency. In the subsequent months, the Argentine government pursued economic

706 polices intended to soften the adverse impact of the Peso devaluation on the financial
707 burdens of consumers and financial institutions. Specifically, the government converted
708 all US dollar (US\$) denominated debt into Argentine Pesos (ARP) at the
709 pre-devaluation exchange rate of ARP1.00:US\$1.00 and converted all US\$ denominated
710 deposits into ARP at the post-devaluation exchange rate of ARP
711 P1.40:US\$1.00. Finally, the government announced a New Bankruptcy Law
712 protecting debtors' (over creditors') rights - the law suspended the judicial foreclosure
713 on all consumer or commercial loans. To shield the banks, the government indexed
714 the mortgage interest rates, first to the CPI and then to the wage index.

715 In this paper, we study the impact of both the currency devaluation and the subsequent
716 economic policy responses on the Argentine consumers' decision to prepay or default on
717 their residential mortgage loan. We accomplish this with the help of a
718 loan level dataset of US\$- and ARP-denominated residential mortgages (originated
719 between 1998 and 2000). In the absence of economic policies, we expect the default
720 rates for both US\$- and ARP-denominated mortgages to rise significantly. However,
721 our empirical results show a sharp jump in the prepayment speed of US\$-denominated
722 mortgages and a sharp rise in the default rate for ARP mortgages following the crisis,
723 which cannot be explained by factors shaping the traditional prepayment and default
724 model or the traditional unobserved borrower characteristics. These results
725 can only be explained drastic changes in the household portfolio, triggered by real
726 life financial and economic policies. The "pesofication" and the CPI indexation policies
727 provided a one-time opportunity to wealthy and/or US\$-denominated mortgage
728 borrowers to prepay their loans. The suspension of the foreclosure laws, the
729 23% rise in unemployment, and a 40% drop in income provided an opportunity to
730 the low income and/or ARP mortgages borrowers to default on their loans. Furthermore,
731 the policies had significant impacts on the availability and price of credit and the
732 functioning of the secondary mortgage market. The price of credit jumped by 5%
733 points, while the availability of credit dropped by 50%. Finally, the secondary mortgage
734 market also collapsed.

735 The lessons learnt from the financial crisis and the subsequent economic policy
736 decisions by the Argentine government can be summarized as follows. The policy
737 decisions aimed at spreading the cost of the crisis amongst the whole spectrum of
738 stakeholders, with an emphasis on protecting individual debtors, was in general well
739 intentioned. However, in doing so, some fundamental mechanisms on which mortgage
740 lending relied on were deeply affected: trust in the future value of financial
741 instruments, effectiveness of security rights, creditworthiness of the government,
742 intangibility of contracts, etc. Moreover, the policies resulted in disproportionately
743 benefiting the higher income and wealthy individuals, while disadvantaged the lower
744 income and unskilled consumers.

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