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The Mexico Mortgage Market Boom, Bust and Bail Out: Determinants of Borrower Default and Loan Restructure After the 1995 Currency Crisis

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Natalie Pickering is an Associate at Goldman Sachs. She received a summer dissertation fellowship from the Joint Center for Housing Studies for her work on the Mexican mortgage market, while a Ph.D. candidate at Harvard University.

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Abstract

The Mexican government has struggled to curtail growth of bad bank loans since the currency devaluation of December 1994. This paper examines borrower choice to default or restructure mortgage loans under the initial phase of the government relief program called “The Accord for the Assistance of the Banking System” or ADE. It uses microdata from a commercial bank to test whether it was borrowers net equity or ability-to-pay that primarily drove them to default or restructure.

Under the assumption that it was primarily an ability-to-pay problem that drove default, the ADE provided borrowers with an interest rate subsidy, and later a monthly payment subsidy, if they restructured their loans. However, the results here show that it was borrowers’ net home equity that primarily influenced the decision to default or restructure and that lower income borrower’s were both less likely to default or restructure, choosing instead to continue paying under their original loan contracts. The ADE program was an inappropriate policy response to borrower default. Data available even at the time the program was designed suggested that other measures should have been taken.

The Mexico Mortgage Market Boom, Bust and Bail Out: Determinants of Borrower Default and Loan Restructure After the 1995 Currency Crisis

by
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Introduction

The Mexican government has struggled to curtail growth of bad bank loans since the currency devaluation of December 1994. The downturn in the economy precipitated a banking crisis in which the share of non-performing assets grew to over 40 percent. Individual residential mortgages comprise a large portion of the delinquent portfolio, and have been a major focus of government intervention. In 1995 when the government began aiding banks to restructure loans, half of the total funds available--an amount over US\$7 billion--were directed to restructuring mortgage credits (Comision Nacional Bancaria y De Valores [CNBV] 1996:2).¹ Government aid to the mortgage sector grew to nearly US\$18 billion by the end of 1996.²

This paper examines borrower choice to restructure mortgage loans under the initial phase of the government relief program called "The Accord for the Assistance of the Banking System" (*Acuerdo de Apoyo a los Deudores de la Banca [ADE]*). The ADE program was the first in a series of government and individual bank relief programs aimed to stem payment delinquency and default. Substantial controversy surrounded the ADE program. The program was voluntary, but it offered borrowers an interest rate subsidy if they signed new loan contracts and switched from peso denominated loans to loans denominated in an inflation-adjusted accounting unit called "Units of Investment" (*Unidades de Inversion*) or UDIs. UDIs were created as an alternative currency for accounting purposes to allow financial products such as mortgage to maintain a constant purchasing power (real value) in the face of inflation. The value of the UDI is published daily and grows in tandem with inflation.

¹ In 1995, 57,700 million pesos were allocated to restructure mortgage credits. The exchange rate in December 1995 was 7.57 pesos/US\$ (Banco de Mexico, Informe Annual 1995).

² By the end of 1996, an additional 77,821 million pesos were allocated to the mortgage sector bringing the total to 135,521 million pesos (Banco de Mexico, Informe Annual 1996). The peso/US\$ exchange rate was then 7.88.

The new UDIs mortgages offered under the ADE program were fixed-rate level-payment loans similar to the common US mortgage in real terms. However, because the UDI is indexed to inflation, both the loan balance and monthly payments can rise in nominal terms each month. In contrast, the original peso loans were a special kind of contract called a Dual Indexed Mortgage (DIM). These are variable rate mortgages in which the loan accrues interest at a spread over a market interest rate, but monthly payments are determined by a separate payment rate that grows over the life of the loan. Payments were kept low initially by a contractual provision that allowed capitalization of part of the monthly interest due on the loan for the first several years of the mortgage until the payment rate grows sufficiently to begin amortizing the loan.

By the end of the first phase of the ADE program about one-third of the borrowers eligible to restructure credits had done so and roughly an equal number had fallen into default. At the time of the ADE, most borrowers were faced with restructuring into higher balance loans because their original loan balances had grown, some times in excess of the value of their homes, due to the DIM provision which allowed interest to be capitalized. Yet borrower reluctance to restructure was blamed on increased payment burden: under the restructured UDIs mortgages, loan payments increase monthly in nominal terms. In response, the government initiated a second phase of the ADE program that offered monthly payment discounts starting at 30 percent for borrowers who restructured and remained current on their payments.

This study presents evidence that payment discounts were an inappropriate policy response to the increasing rates of default and the initial low level of borrower participation in the ADE program. It uses a nationwide sample of loans from a commercial bank portfolio to estimate the influences on a borrower's decision to (1) continue paying their existing loan, (2) restructure into a new UDIs subsidized loan, (3) default, or (4) terminate their existing loan by prepaying it in full. The results suggest that while borrowers' choice to restructure or default did vary by income level, net equity position--in particular whether a borrower had negative home equity--was a more important determinant. Higher relative wealth and income were actually associated with higher default rates as well as higher restructure rates. Low-income borrowers were more apt to continue paying on their original loans.

The results provide new evidence in the long-standing debate on the causes of mortgage default. Over the years this debate has centered on the question of whether the borrower's net equity position in the house or ability to pay drives default. Cunningham and Capone (1990) were among the first to synthesize the evidence in the United States, and they concluded that for both fixed and adjustable rate mortgages, equity was of greater importance than ability to pay in predicting default. Subsequent research has conceptualized default as a financial put option and focused on the so-called "ruthlessness" with which borrowers exercise this option.

The current study differs from previous ones and represents a new contribution to the literature on borrower behavior in mortgage markets for several reasons. First, it is the only study of mortgage default in a developing country based on microdata. Unlike the U.S. mortgage market, which is well developed and has been thoroughly studied, the Mexican mortgage market is of recent origin. Little work has been done to date on borrower behavior in developing countries. Second, it is a study of borrower default and restructure in response to a system-wide financial crisis. U.S. studies have dealt with borrower response to interest rate movements, but not to severe macroeconomic shocks like that of Mexico in 1995 (which nearly lead to the collapse of the financial system) and not to large-scale government programs to provide relief to the sector. Third, the study deals with the type of mortgage instrument used in Mexico, which differs from the fixed and adjustable rate mortgage usually issued in the United States. And, because the Mexican mortgage negatively amortizes creating greater risk of reducing borrower home equity, it allows one to better examine the trade-off between maintaining low payment rates and risking negative equity. And finally, the study highlights the importance of understanding the determinants of borrower behavior for formulating public policy.

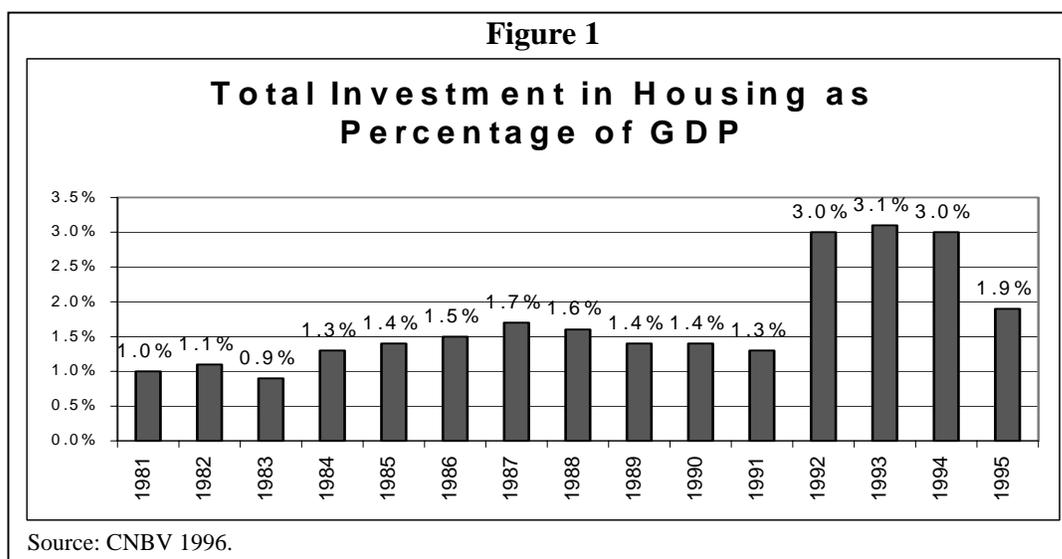
The results presented here reveal that discounts directly off the loan balance—not payment discounts--were needed from the onset of the crisis to encourage restructure and stem default. In fact, such balance discounts were ultimately granted in a much later borrower relief program called *El Punto Final* (January 1999). This study points out that it was possible to predict, based on data available as early as May 1996, that balance rather than payment discounts would be a more effective policy measure. It also shows that payment discounts had a regressive distributional effect.

The Boom

The relationship between residential real estate booms and banking crises is a topic that in recent years has begun to receive more attention in developed and developing countries alike (Guerra de Luna 1997). In Latin America, exchange rate based macroeconomic stabilization programs and privatization of the financial sector have been linked to boom and bust cycles in housing markets and failure of domestic banks. Uruguay and Chile were among the first in the 1980s to experience difficulties in their mortgage markets due to stabilization programs. Mexico, which underwent banking crises in both the 1980s and in 1994, can trace the origins of many of the current problems in the mortgage market to previous bank regulation and privatization, increases in capital inflows, and the design of mortgage contracts.

The 1980s were a period of limited availability of bank credit for housing in Mexico. Shortly before leaving office in 1982, President Lopez Portillo nationalized the banking system and initiated a system of restrictive quotas for lending. Commercial banks were required to maintain a fixed percentage, ranging from 3 to 6 percent, of their outstanding mortgage portfolio in so-called “social interest loans,” loans to households earning under US\$7,200 (six times the minimum wage) on housing valued under US\$18,000 (in current dollars). The government also required banks to maintain 70 percent of their assets in government securities discouraging growth in other assets such as market rate residential mortgages (Barry, Casteneda, and Lipscomb 1994).

As a result of these restrictive lending policies, demand for housing credit mounted. After commercial banks were liberalized in 1991 mortgage lending represented one of the fast growing segments of the portfolio. Total investment in housing as a percentage of GDP nearly tripled between 1991 and 1992 and remained above the previous average through 1995 (see Figure 1). Housing finance also increased in terms of its relative share of total credit to the private sector. Commercial banks’ mortgage portfolios nearly doubled, increasing from roughly 10 percent of total assets in December 1989 to 19 percent on the eve of devaluation in November 1994 (Banco de Mexico).



Foreign capital inflows accounted for much of this expansion. Alfonso Guerra de Luna (1998) showed that in Mexico, as in several other emerging markets, an increase in the net foreign liabilities of banks coincided with an expansion in mortgage credit and a real estate boom. Net foreign assets of Mexican banks more than doubled, increasing from 25.8 billion pesos to 52.4 billion pesos between 1991 and 1993; mortgage credits represented roughly one-third of the net resource transfers to the country over this period (Guerra de Luna 1998:11).

Banks actively intermediated capital inflows generated through macroeconomic stabilization by expanding domestic credit to the real estate sector. Three reasons are commonly given for why banks disproportionately increase credit to the real estate sector during periods of capital inflows: (1) mortgages are easy to originate and do not require a detailed project appraisal, (2) mortgages as collateralized loans are less risky than unsecured debt, and (3) the real estate market is large and can quickly absorb new investment (Guerra de Luna 1998:9).

Although it is easier for domestic credit to expand into the real estate market than into commercial or industrial ventures, mortgage lending also presents unique challenges particularly when an economy is prone to inflationary bouts, good indexes of house prices do not exist, and the legal procedures for foreclosure are cumbersome. Some of these challenges became apparent in Mexico even before the currency devaluation. As early as the end of 1993, some Mexican banks began to witness a rise in delinquency in their mortgage portfolio.

The Bust

Loan contract design, in part, drove the increase in delinquency. Nearly all mortgages originated in Mexico before the devaluation were dual-indexed mortgages (DIM). The DIM is a variation on an instrument called the Inflation-Proof Mortgage (IPM) designed in 1975 by a team of researchers under the guidance of Franco Modigliani at the Massachusetts Institute of Technology (MIT). The DIM has also been called the Dual-Rate Mortgage (DRM) and the Dual-Rate VRM (Variable Rate Mortgage). Several studies have described and analyzed the DIM both in the U.S. and Mexican context. Modigliani and Lessard (1975) and Modigliani (1989), saw it as a superior mortgage design for the rising and variable inflation environment of the United States in the late 1970s because it overcame the tilt problem of fixed-rate-level paying mortgages. Payment tilt arises because, in an inflationary environment, a fixed-rate, level-paying mortgage must have higher initial payments to make up for the fact that these same payments will be worth less in real terms in the later years of the mortgage. Agudo-Roldan and Campos-Spoor (1992), Castaneda (1995) and Bernstein (1998) highlighted the fact that DIMs in the Mexican mortgage market have allowed lenders to earn a variable market interest rate on loans while also keeping payments affordable for borrowers.

The novel feature of the DIM is that the monthly payment is not determined by the “effective” or “debiting” rate but instead by a separately calculated “payment” rate. The debiting rate determines the interest accrued on the outstanding debt at any time, and is the interest owed by the borrower over the life of the loan. The payment rate, on the other hand, specifies the amount paid by the borrower in any given month. DIM payment rates grow over time. Payments are adjusted periodically, usually at longer intervals than the debit rate, and determine the rate of amortization of the loan at any given time. Payment adjustments in Mexico have typically followed minimum wage adjustments. Initial payment rates are set such that the mortgage will amortize in a fixed term given the projected payment growth rate. The Mexican DIM contract often contained a provision that allowed the loan term to extend should payment growth be insufficient to fully amortize the loan under the original term.

Note that the DIM, unlike most mortgages, places all interest rate risk on the borrowers. The borrower does not face the true cost of funds each month, but is charged the full (adjustable) interest rate with no cap over the entire life of the loan. In more stable

macroeconomic environments, lenders and borrowers have usually shared interest rate risk in the form of either a fixed interest rate, or adjustable rate mortgage with caps.

In Mexico, commercial banks used a variable interest rate--usually the monthly rate on treasury bills plus a spread of 10 percentage points--as the debiting rate. The initial payment rates set on these DIMs ranged from 11 to 18 pesos per thousand of initial loan principal and were adjusted every six months to reflect changes in the minimum wage index (and later inflation). These mortgages were designed to negatively amortize over the early period of the loan's life. This practice allowed banks to keep payments affordable. The degree of negative amortization on Mexican DIMs varied according to the payment rate. Table 1 shows the negative amortization as a percentage of the total initial loan balance based on the simulation of a mortgage originated during the period from 1991 to 1994 with different initial payment rates, but assuming that all loans accrued interest at a market rate plus 10-percentage-point spread. The difference between the payment rate and the interest accrual rate determines the loan's negative amortization as well as the age of the loan, since even under normal macroeconomic conditions the loans are designed to build up negative amortization over approximately the first five years of the contract. On the wake of the currency devaluation, older loans had built-up more negative amortization than more recently originated loans, as did loans with lower initial payment rates.

Year of Origination (January)	Average Annual Interest (Debiting) rate	Initial Payment Rate						
		11	12	13	14	15	16	18
1991	26.46%	75%	65%	55%	45%	35%	25%	5%
1992	25.33%	47%	41%	35%	29%	24%	18%	6%
1993	25.06%	29%	25%	22%	19%	16%	13%	6%
1994	24.62%	12%	11%	10%	8%	7%	6%	3%

In an inflationary economy where the real price of housing remains constant, negative amortization of this magnitude should not present a serious problem; the value of the house will rise in tandem with the loan balance. Note that capitalizing only the portion of interest

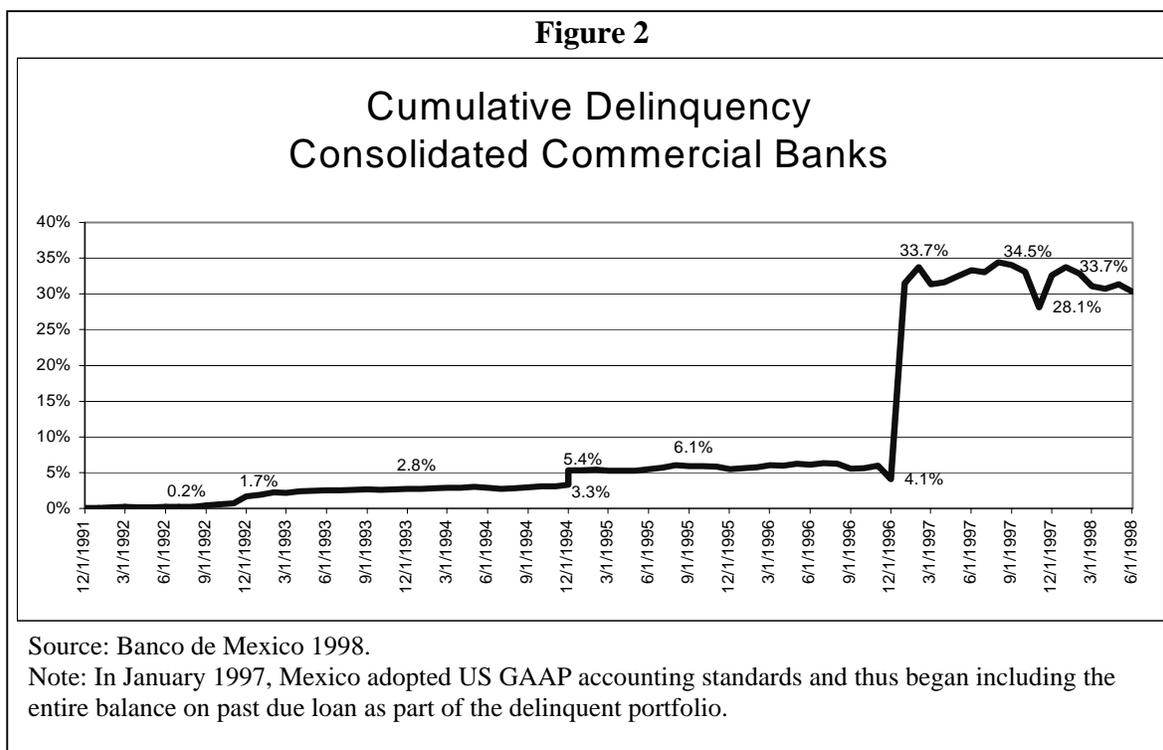
that reflects inflation into the loan balance is equivalent to indexing the loan to inflation, and as long as property prices keep pace with inflation, the original loan-to-value ratio is not exceeded, and the borrower maintains positive equity. Furthermore, in the early stages of the lending boom in Mexico, banks charged initial payment rates of around 18 pesos per thousand in loan balance (equivalent to an annual rate of 21.6 percent), limiting the amount of negative amortization. As interest rates dropped, however, banks started to compete for customers by offering lower payment rates. Initial payment rates declined to as little as 10 pesos per thousand and negative amortization became excessive. Some of the larger banks were concerned about the buildup of negative amortization in their mortgage portfolios and began to alter their original contract design, indexing payments to inflation rather than the minimum wage, which tended to lag inflation.

A cycle in property prices exacerbated matters. From 1991 to 1993 capital inflows generated an asset price bubble in the real estate market. For instance, in Mexico City the urban land price index rose from 2,423 in 1988 to 31,934 in the first trimester of 1993, representing roughly a 150 percent real appreciation of land prices over this 4-year period (Villar, Backal, and Trevino 1997). However, by the end of 1993 the bubble showed signs of bursting. Housing in Mexico is typically categorized into four price categories: residential (>US\$115,000), medium (US\$45,000 to US\$115,000), economic (US\$10,000 to US\$45,000) and social-interest (<US\$10,000) (Comision Nacional Bancaria y De Valores [CNBV] 1996:14). The available data suggest that urban land prices decreased about 10 percent in real terms between 1993 and 1995 and that social-interest housing prices declined similarly. Residential, medium, and economic housing--the three categories on which commercial banks concentrate their lending--suffered a much deeper price decline, estimated at 30 percent in real terms.³

Under these circumstances, many mortgage holders found themselves in a negative equity position and mortgage delinquency rates began to rise. Figure 2 shows the mortgage delinquency rate of the consolidated commercial banks as a percentage of the total outstanding mortgage portfolio. As noted, the rates are not strictly comparable over the entire time period as banks switched to U.S. Generally Accepted Accounting Principles (GAAP)

³ See Guerra de Luna (1997, 1998) for further discussion of the evolution of land and housing prices in Mexico over the period.

accounting standards in 1997 and only then began to report the entire outstanding balance on loans with six or more payments outstanding as delinquent. Before this, only outstanding payments were reported as delinquent. Even measured by outstanding payments alone, a steady increase in delinquency is evident from the beginning of 1993. Delinquent payments rose from 0.2 percent at the end of 1992 to 3.3 percent on the eve of the devaluation.⁴



Some banks curtailed new loan origination toward the end of 1993 because of the rise in delinquency. The speculative attack on the peso, which led to its devaluation against the dollar of 23 percent on December 21, 1994, brought all lending to a halt. By March of 1995 the peso's decline against the dollar reached 46 percent and interest rates spiked. Government paper carried a coupon of 80 percent. Many recently originated mortgages were capitalizing as much as 35% of the interest due on their loans into the balance making it impossible to pay off the loans without increasing the payment rate.⁵

⁴ The Mexican Banking Commission (CNBV) estimates that the percentage of delinquent loans as compared to current loans was as high as 13.9 percent by the end of 1993.

⁵ In fact, a case was brought in court to show that it was mathematically impossible for some mortgages to fully amortize within even the contractually allotted extended loan term without changes in the original payment increases because of the excessive capitalization of interest (*La Jornada* 1998).

The Bail-Out

With banks under severe pressure on both the asset and liability sides of their balance sheets, the government faced a choice of intervening in the market or watching the financial sector collapse. Several measures were taken to provide liquidity to banks and payment support for debt holders. For mortgage holders, the Debtors Support Agreement (*Acuerdo de Apoyo a los Deudores de la Banca [ADE]*) was initiated to allow borrowers to restructure loans into an inflation adjusted accounting unit, the *Unidades de Inversion (UDIs)* at a low (subsidized) fixed real interest rate.

By restructuring their clients' loans into UDIs, banks avoided the problem of accelerated negative amortization in a high inflation environment. The government supported the UDIs restructure by creating a swap with the commercial banks. The swap was designed to eliminate the asset-liability mismatch between UDI denominated mortgages and peso denominated deposits. The government created a trust which swapped the cash flows of the restructured mortgages from the banks with a bond equal to 96 percent of the face value of the mortgage and earned a coupon of the weighted average rate on bank time deposits plus 4 or 5 percent. Approximately 58 billion pesos were initially made available to banks for the ADE program.⁶

Borrowers who restructured their loans under the ADE program received a discount, in the form of a subsidized interest rate, and an extension on the term of their loans. The interest rate on restructured loan contracts was set at 6.5 percent (real) for the first year, and was then raised to 8.75 percent for subsequent years on the first 165,000 UDIs of loan balance (roughly 247,000 pesos in May 1996). A real interest rate of 10 percent was charged on the balance in excess of 165,000 UDIs. Depending on the existing loan balance and interest rate spread, the subsidy ranged from 2.5 to over 15 percentage points against market interest rates for 1995. The term on UDI loans was usually extended to 25 or 30 years from the date of restructure. Even in the case where the loan remained with the original 20-year term, a term extension was given because the new term began at the restructure date rather than the previous origination date. In addition, borrowers who restructured their loans were protected

⁶ This equals about US\$7.5 billion at the December 1995 exchange rate of 7.64 pesos/US\$.

by a legal truce that effectively eliminated a bank's option to foreclose until October 1996. Penalty charges and interest on delinquent accounts were also waived for loans that restructured.

Despite the benefits offered for restructuring mortgages, borrower participation was low and delinquency continued to rise. The government response was to provide an additional incentive to restructure. In May 1996 the government announced that the program would be extended until September 1996 (it was ultimately extended to December 1997). In addition, discounts on monthly payments would be offered to borrowers who restructured into UDIs and remained current on their payments. The discounts were offered over a ten-year period beginning in June 1996 at 30 percent and decreasing each subsequent year by 5 percentage points until they terminated in 2005 at 5 percent. This type of subsidy was offered in the belief that borrowers were reluctant to restructure into UDIs because payments would increase on a monthly basis in nominal terms. Although payments did increase more rapidly under the UDIs contracts, in most cases the extension of the term meant that the initial payments were lower than they were at the time of restructure under the original pesos contracts. Higher loan balances however did deter borrower participation in the ADE restructure program. Because DIM mortgages negatively amortize, at the time of restructure most borrowers were faced with signing new loan contracts for amounts significantly higher than their original loans. Some, in fact, for amounts greater than the value of their homes.

The remainder of this paper analyzes the determinants of borrower behavior over the first phase of the ADE program (August 1995 to May 1996). The results show that home equity was a stronger influence than payment burden on borrower choice to restructure or default. These results accord with previous studies on mortgage default in the United States under non-crisis macroeconomic conditions and support an approach to modeling default as a put option. The results also show that even with limited data on loan characteristics and macroeconomic conditions a straightforward discrete choice model can be estimated. And, more importantly, had this model been used it would have helped inform public policy in the second round of relief programs.

Model and Data

Mortgage default studies in the United States have become increasingly sophisticated in estimating the value and timing of default and prepayment options embedded in mortgage contracts. Deng, Quigley, and Van Order (2000) employed the most advanced estimation technique--a unified, competing risk hazard model--to simultaneously estimate baseline default and prepayment functions. Their model also accounts for unobserved heterogeneity among borrowers, allowing its estimation along with the parameters of the default and prepayment functions.

Continuous time models such as the one just described are useful when examining default timing over the entire life of a mortgage and when accurate longitudinal data are available on house price changes. However, neither is the case in Mexico. Here the central question is how borrowers responded to two particular calendar events: the currency devaluation (December 1994) and the first phase of the ADE program (August 1995-May 1996). The time period under consideration is sixteen months, and although clearly both capital and real estate markets fluctuated over this time, the influence of these fluctuations is secondary to the two events themselves. Furthermore, no house price index exists in Mexico that would allow accurate updating of property values over such a short time interval.

This study uses a discrete choice model of borrower behavior commonly employed by an earlier generation of default studies. It estimates a multinomial logit model where borrowers are viewed as facing four choices: (1) continuing payments under the current contract, (2) restructuring the mortgage into UDIs, (3) defaulting, or (4) prepaying the mortgage and terminating the contract. The model assumes that consumers optimize their utility over these four alternatives. This approach is less rigorous econometrically but better suited here because of the overwhelming importance of a specific calendar event--the currency devaluation--in influencing borrower default, and because of the limited time span during which borrowers could restructure. Several previous studies have estimated similar models for mortgage default and prepayment in the United States. Campbell and Dietrich (1983), Vandell and Thibodeau (1985), Zorn and Lea (1989), Cunningham and Capone (1990), and Deng and Calhoun (1997) all used some variant of a multinomial logit model in

which the fitted coefficients are interpreted as indirect utility weights that maximize borrower choice.⁷

The probability of a borrower choosing alternative i is given by the multinomial logit model:

$$P_n(i | X_n) = \frac{e^{\beta_i X_n}}{\sum_i e^{\beta_i X_n}}$$

Where

i = the outcome: either current, restructure, default, or prepay

β_i = the vector of utility weights for choice i

n = the borrower index.

Before this model can be estimated, the indeterminacy must be removed by measuring three of the four outcomes relative to the fourth. In this case, continuing payment under the current contract was selected as the reference outcome.

This leads to

$$\text{Prob}(y = j) = \frac{e^{\beta_j^1 X_j}}{1 + \sum_{k=1}^3 e^{\beta_k^1 X_k}}$$

Where $k = 1, 2, 3$ represents restructure, default, and prepay.

The outcome is conditional on loan survival until August 1995: borrowers who prepaid their loans before this time were eliminated from the sample. Loans delinquent as of January 1995, however, were included. The sample was not limited to loans that were current

⁷ For a comprehensive review of these studies as well as even earlier work on default and prepayment literature see Quercia and Stegman (1992) and Vandell (1993, 1995).

in their scheduled monthly payments because prior delinquency, or even what could be considered default, did not disqualify a borrower from participation in the program.⁸ In fact, the judicial truce and waiver of penalties encouraged delinquent borrowers to restructure.

Loans were, however, limited to those held by private households, rather than corporations and bank employees. Banks held many so-called “mortgage loans” at the time of the crisis that were actually individualized bridge loans to construction companies who intended to transfer the loan to the home buyer at time of purchase. Including these loans in the sample would have misrepresented household behavior, as default or restructure was linked to corporate and not individual household decisions. Bank employee loans were removed because the underwriting criteria and terms of employees’ loans often differed significantly from ordinary mortgage loans and because employees were frequently offered special discounts or incentives for restructuring.

Outcomes were coded based on the loan’s status at the end of April 1996. This was immediately prior to the government announcing the second phase of the ADE program that included payment discounts. Again, during the first period, government assistance was limited to a subsidized interest rate, extension of the loan’s term, a judicial truce against bank foreclosure, and a waiver of penalty charges or accrued interest if the loan was delinquent at the time of restructure.

The data for the study come from a Mexican commercial bank with branch offices nationwide. The original database consisted of 33,428 DIMs originated between January 1, 1991, and December 31, 1994. After eliminating loans with missing or erroneous information, those that terminated before August 1995 and those held by construction companies or bank employees, 26,448 loans remained in the sample. All loans had a 20-year term, were adjustable interest rate and had an initial payment rate that varied between 11 and 18 pesos per thousand in loan balance. The bank also classified the loans into three categories by house type/price level: residential, medium, and economic. The mean house price (standard deviations in parentheses) for each type in 1995 prices was 988,312 (541,262), 239,298 (134,579) and 92,030 (21,689) pesos, respectively. The distribution of sample loans by type, year of origination, and initial loan-to-value ratio is given in Appendix A.

⁸ Foreclosure in Mexico requires 3 to 5 years so banks prefer to try to collect or settle outside of court loans that would be formally classified as defaulted.

The database contains information on the borrowers and properties at the time of loan origination and detailed payment histories from the onset of the ADE program to January 1999.⁹ The database has no direct information on borrower characteristics such as income, age, employment, or education. While it is preferable to include such borrower characteristics, most recent studies (Deng, Quigley, and Van Order 2000, Deng and Calhoun 1997) have omitted them. Early work concluded that borrower-related factors had only a second order effect on defaults that were primarily motivated by negative equity: an “in-the-money” (default) put option.¹⁰ Thus, later studies have focused on better estimating borrowers’ option position and have de-emphasized other characteristics.¹¹ It is difficult to obtain up-to-date, accurate information on borrowers. When such information is available it usually dates from the time of origination rather than the time at which borrowers default or prepay.

The lack of up-to-date information on borrowers’ income is a problematic aspect of this study; however, several proxies have been constructed and are discussed below. Again, even when income has been included directly in studies, it is income at the time of loan origination rather than borrowers’ resolution choice. Income at origination should be highly correlated with later income and wealth levels. The measures used here are based on loan amount and house values, however, and are equally good correlates of income and wealth.

The focus here is on the question of whether negative equity (positive value put option) or ability to pay principally motivated borrowers to default or restructure. To test the

⁹ The early part of most loan payment histories is missing because the bank switched to new servicing software in 1996. Loans were migrated over to the new system in batches between 1995 and 1996 and the paid portions of payment histories on loans that were current at that time were not transferred. In these cases, the missing payments were presumably made before the migration, but it is unknown whether they were made punctually or after a period of delinquency. Payment histories extending back more than three months prior to the devaluation exist for less than 20 percent (4549) of the loans. These loans represent a biased sample of delinquent loans: those that were delinquent at the time of the migration to the new system. For all but 839 loans the entire history exists from the start of the ADE program (8/1/95). Lack of complete prior payment histories provides another rationale for using all loans, not only those which were current at the beginning of crisis. Some of the loans that were current by the beginning of the ADE may have been delinquent at the time of the devaluation and only became current in response to the relief program.

¹⁰ An exception is Elmer (1997), who questioned the validity of option-based models of default in legal jurisdictions where lenders can seek recourse for default losses. Deng, Quigley, and Van Order (1999) did not include specific borrower characteristics but estimated unobserved borrower heterogeneity. They concluded that unobserved borrower heterogeneity is important in estimating prepayment but insignificant for default.

¹¹ See Cunningham and Capone (1990) for a list of the variables that were determined to be significant in earlier default studies and Quercia and Stegman (1992) for a discussion of the role of borrower characteristics in default studies.

negative equity hypothesis two variables were used. First, a dummy variable was constructed to indicate which loans were in a negative equity position in January 1995. Then, a second continuous variable was used to measure positive home equity. This second variable takes a value of zero if home equity is negative.

Home equity was calculated by inflating the original property value to January 1995 prices using the national consumer price index and subtracting the loan's market value as of that month. For delinquent loans, the balance as of when the borrower stopped payment was used because the ADE waived interest on loans in default. Since DIMs are adjustable rate mortgages with no caps, the balance reflects the loan's market value. Property values were determined only by inflating them to constant 1995 prices; no adjustments were made for the real increases or declines in property values that occurred over the course of the real estate cycle. The devaluation led to overall decline in house prices but there are no available regional house price indices that span the period before and after the devaluation, so it is difficult to determine how prices varied across the nation. Home equity is undoubtedly measured with some error, and should be consistently upwardly biased as, in general, house prices did not keep pace with inflation over the period. Thus both the indicator variable for negative equity (NEGEQU₉₅) and the continuous variable for positive equity (EQUPOS₉₅) are biased downward.

Ability to pay was measured by four variables: house type (ECONHOUSE and RESIDHOUSE), income proxy (INCPROX), cosigner (COSIGN), and municipal unemployment (UNEMPLOY). The relative wealth level of the household is the strongest indicator of ability to pay, and this is measured by the categorical variables for house type: residential, medium, and economic.¹² The difference between the three income levels measured by housing type is marked. There is an order of magnitude difference between the lowest income housing (economic), which mean value is roughly US\$10,000, and the highest income housing (residential), which on average is valued at US\$100,000. Medium-type housing has an average value of US\$25,000. House type alone thus divides the borrowers into distinct wealth levels. Income, of course, can vary depending on the individual circumstance of the borrower. However, in countries like Mexico where the division of

¹² Only the dummies for residential housing and economic housing types are included in the equation. Medium type housing is treated as the base category.

income is immense and labor and capital markets are underdeveloped so that poorer households have less access to other sources of income, housing type alone proxies well for ability to pay.

In addition, a measure of relative household income was constructed following Deng and Calhoun (1997) by dividing the original loan amount by the regional average loan amount for a particular house type. This variable provides a good measure of relative income for a family in a particular geographic region and house type. For the ability-to-pay hypothesis to hold, borrowers with lower wealth and lower relative income should be more likely to default and less likely to restructure.

The variable indicating whether or not the loan was cosigned was also included. On the one hand, the presence of a cosigner should decrease the probability of default because cosigning the loan extends the legal liability to third party; that is why banks demand a cosigner. However, the fact that the bank demanded a cosigner also indicates that the borrower did not qualify for the loan based on their own financial resources and therefore could have ability-to-pay problems. If the presence of a cosigner on the loan signaled ability-to-pay problems and borrowers were reluctant to restructure due to payment increases, then COSIGN should actually be negatively related to restructure. Even without ability-to-pay problems, the presence of a cosigner decreases the probability of restructure since it requires a cosigners to participate in the restructure and extends their liability through the extended loan term.

Finally, the municipal unemployment rate for 1995 was included as a measure of income variability. Municipalities with higher unemployment rates should have a higher number of defaults and a lower number of restructures under the ability-to-pay hypothesis. However, municipal unemployment should also be highly correlated with unobserved house price declines. Thus high unemployment could increase the probability of negative home equity. The first-order effect on income is considered more important here. Unemployment's second-order impact on real estate markets would lead to the same predictions for the variables sign: negative for restructure and positive for default. High unemployment's effect is unambiguous, but the mechanism through which it impacts borrowers' decisions remains somewhat unclear since unemployment should reflect regional variations in the real price of a constant quality bundle of housing as well as income variations.

Table 2 presents the correlation matrix between the two equity-related variables and the four measures of borrowers' ability to pay. The correlation is low in every case except between residential housing and the continuous positive equity variable. The correlation between these two variables is 0.49, indicating that borrowers with mortgages for residential housing more often had greater positive equity in their homes. This is not surprising given that these homes are also higher priced.

Table 2: Correlation Matrix

	NEGEQU ₉₅	EQUPOS ₉₅	RESIDHOUSE	ECONHOUSE	INCPROX	COSIGN	UNEMPLOY
NEGEQU ₉₅	1.00						
EQUPOS ₉₅	-0.17	1.00					
RESIDHOUSE	-0.04	0.49	1.00				
ECONHOUSE	0.23	-0.25	-0.12	1.00			
INCPROX	0.01	0.25	0.00	0.00	1.00		
COSIGN	-0.02	-0.03	-0.04	0.03	-0.01	1.00	
UNEMPLOY	-0.08	0.04	0.02	-0.00	-0.04	-0.18	1.00

The summary statistics for the equity and ability-to-pay variables discussed above are listed in Table 3 along with the remaining independent variables used in estimation. The variables are categorized as equity-related, ability-to-pay-related, other loan and borrower characteristics, and local and regional macroeconomic conditions.

A brief description of some of the remaining variables will help clarify why they were included. SUBSPREAD is a measure of the subsidy that the loan would qualify for if the borrower restructured; it is the annualized interest rate subsidy that the borrower would have received for the remainder of 1995. SUBSPREAD was calculated by taking the difference between the fixed real interest rate that a restructured UDIs loan would receive in the first year (6.5 percent on the first 165,000 UDIs in loan balance and 10 percent on the remaining balance) plus inflation and the market rate interest rate plus the loan's spread in the original contract. The municipal DIVORCE rate was included, as in previous studies, to measure the

Table 3: Description of Independent Variables Used in Estimation

Variable	Definition	Maximum (Minimum)	Mean (SD)	Unit of Measure	Expected Sign Restructure (Default)
Equity Related Variables					
NEGEQU ₉₅	Negative equity in home January 1995	1.00 (0.00)	0.11 (0.31)	Yes=1, No=0	- (+)
EQUPOS ₉₅	Positive equity in home January 1995	4,870.2 (0.00)	48.69 (99.27)	Thousands of Pesos	+ (-)
Ability-to-Pay Related Variables					
RESIDHOUSE	House type: residential	1.0 (0.00)	0.04 (0.186)	Yes=1, No=0	+ (-)
ECONHOUSE	House type: economical	1.0 (0.00)	0.29 (0.452)	Yes=1, No=0	- (+)
INCPROX	Income proxy (original loan amount divided by regional average loan amount for its housing type: residential, medium, or economic)	6.77 (0.01)	0.99 (0.44)	Ratio of loan amounts in pesos	+ (-)
COSIGN	Co-signer on loan	1.0 (0.0)	0.44 (0.50)	Yes=1, No=0	- (-)
UNEMPLOY	Municipal unemployment rate	0.084 (0.018)	0.057 (0.016)	Percent	+ (+)
Other Loan and Borrower Characteristics					
SUBSPREAD	Potential interest rate subsidy if restructure	0.154 (0.026)	0.125 (0.020)	Difference in percentage points	+ (-)
GENDER	Gender	1.0 (0.0)	0.26 (0.44)	Female=1, Male=0	- (+)
DL6Jan	Delinquent 6 months or more as of January 1995	1.0 (0.00)	0.14 (0.352)	Yes=1, No=0	+ (+)
Local and Regional Macroeconomic Conditions					
DIVORCE	Municipal divorce rate	0.0019 (0.00004)	0.0008 (0.0003)	Percent	- (+)
LOANDENS	Number of Loans per Thousand Population (1995) by Municipality	5.91 (0.0039)	1.59 (1.04)	Loans per Thousand Pop.	- (+)
CITIES3	Districto Federal, Guadalajara, Monterrey	1.0 (0.0)	0.32 (0.468)	Yes=1, No=0	+ (+)
SMCIT250	Cities with populations less than 250,000 in 1995.	1.0 (0.0)	0.05 (0.225)	Yes=1, No=0	- (-)

effect of extraneous trigger events. LOANDENS, the number of loans held by the bank per thousand in population by municipality, was included to control for variance in loan servicing and informational differences. Banks presumably place more effort in servicing their loans in areas of high loan density (where costs are lower). Borrowers are also likely to have better information about the restructuring program in these cities. Dummy variables for the three major metropolitan areas--Mexico City, Guadalajara, and Monterrey--and for cities with populations of less than a quarter million were also included to capture differences in labor and real estate markets by city size.

Finally, a dummy variable for loan delinquency of six months or more as of January 1995 (DL6Jan) was also constructed. This variable, however, must be used with some caution. The bank from which the data originated switched to a new servicing system in 1995-96 and in the course of this transition erased the completed payments of many current loans. Thus the dummy variable for delinquency only captures those loans that remained delinquent through the migration to the new servicing system. It does not capture the delinquent status of loans that “self-cured” immediately preceding the migration.¹³ The delinquencies captured by the dummy are better viewed as chronic or prior defaults, which, if the equity hypothesis holds true, should be driven by negative equity and high negative amortization. DL6Jan should therefore also be highly correlated with NEGEQU₉₅ and NEGAM₉₅. The correlations are 0.4089 and 0.4639, respectively.

Estimation Results

Two models were estimated using the entire loan sample of 26,448 loans. Separate equations were then run with a more limited set of variables for the Federal District, Guadalajara, and Monterrey. Tables 4 and 5 present the results for all the models. The coefficient estimates are interpreted as utility weights for each choice normalized relative to continuing to pay under the original peso DIM contract.

The results consistently support the equity hypothesis over the ability-to-pay hypothesis. In Models 1 and 2 the coefficients on NEGEQU₉₅, and EQUPOS₉₅ both have the expected signs and although EQUPOS₉₅ is statistically insignificant for restructure, which is reasonable, it is significant and negative for default. The relative risk ratios based on Model 1

¹³ See footnote 9 for a more complete description of the payment history data.

and shown in Table 6 indicate that a loan in a negative equity position in January 1995 was 60 percent less likely to restructure, 58 percent more likely to default, and 70 percent less likely to prepay than to continue paying under the old contract.

In Model 2, DL6Jan is added and is highly significant and negative in the restructure equation and positive in the default equation. Note, however, the coefficient on NEGEQU₉₅ becomes negative for default. The problems with using the indicator variable for delinquency are discussed above. Yet this result is worth noting. It lends credence to banks' claim that default was rising even before the currency devaluation and that default was due to problems associated with excessive negative amortization and declining property values. It also suggests that a seasoning effect was present. Borrowers with negative equity in January 1995 who had not defaulted were less likely to default, but also less likely to restructure, choosing instead to continue payment under their original contracts.

The coefficient estimates for housing type, RESIDHOUSE and ECONHOUSE, clearly contradict the ability-to-pay hypothesis. Borrowers whose homes were classified as residential were 3.76 times as likely to default than medium type homes and borrowers with economic type homes were 57 percent less likely to default (see relative risk ratios in Table 6). Economic homeowners showed a lower propensity to restructure, lending some credence to the ability-to-pay hypothesis; however, the coefficient on the indicator variable for residential homeowners was insignificant.

The continuous variable INCPROX takes opposite signs from those predicted by the ability-to-pay hypothesis, further strengthening the equity hypothesis. The coefficient for INCPROX is positive and significant for restructure, default, and prepay, suggesting that borrowers with higher initial loan balances relative to the average in their region were more likely to opt for one of these three courses of action than to continue paying on their original contracts. The coefficient on INCPROX is highest in the default equation, over three times that of restructure, so while higher relative income contributes to the probability of restructuring over continuing to pay on the original contract, it contributes even more to default. The coefficient on COSIGN is positive for all three choices. In terms of the relative risk ratios, a cosigned loan was 61 percent more likely to restructure, 26 percent more likely to prepay, and surprisingly, 14 percent more likely to default than to continue paying.

Table 6: Relative Risk Ratios for Categorical Variables

Variable	Restructure	Default	Prepay
NEGEQU ₉₅	0.40	1.58	0.29
RESIDHOUSE	1.05	3.76	1.52
ECONHOUSE	0.77	0.43	0.68
COSIGN	1.61	1.14	1.26
GENDER	0.93	0.98	1.07
CITIES3	1.60	1.01	1.60
SMCIT250	1.48	0.53	1.08

Note: Numbers printed in boldface are significant at the 10-percent level or lower.

Counter to the ability-to-pay hypothesis as well as the equity hypothesis, a higher municipal unemployment rate was actually associated with a lower rate of default and restructure. The lower rate of restructure was expected; however, default was predicted to be higher. A possible explanation for this is that high unemployment in Mexico is actually found in the largest metropolitan areas, such as the District Federal and Monterrey, and reflects the situation of the informal sectors that form a counterpart to the industrial and service economies. The rural and semi-rural areas, where income and house prices are lower and less varying, actually also have lower unemployment rates. The population in these areas is employed in agriculture. Borrowers may have chosen to keep paying their original loans because house price declines were not so severe and the old loan structure remained affordable.

Note also that because economic type homeowners are less likely to restructure or default the opportunity to receive a greater interest rate subsidy (SUBSPREAD) is actually associated with higher default and lower restructure and prepayment rates. This is an artifact of borrowers with lower balance loans choosing to continue paying rather than restructure their loans. The positive sign in the default equation on SUBSPREAD reflects the fact that borrowers who would have been given a fully subsidized interest rate chose to default rather than to continue paying their loans or restructure.

Finally, the coefficients on LOANDENS indicate that default is more probable in cities with a greater number of loans per thousand in population than is restructure. While banks may have more servicing infrastructure in high density lending areas, this infrastructure is also placed under greater strain during a financial crisis. In addition, borrower anonymity is greater, which can increase “moral hazard” defaults. In regions where banks have fewer loans, bank-borrower contact is likely to be higher.

The coefficients on CITIES3 and SMCIT250 suggest that after controlling for density--which should be highly correlated with loan servicing capabilities--borrowers in the three major metropolitan areas and in smaller cities were more likely to restructure and less likely to default. Prepayment was also significantly higher in the metropolitan areas.

A separate equation without the local and regional variables (DIVORCE, LOANDENS, CITIES3, and SMCIT250) and UNEMPLOY (which is also derived from a regional-based statistic) was estimated on the entire sample so it could then be compared to equations run on the three largest cities in Mexico: the Federal District (DF), Guadalajara, and Monterrey. This was done in order to both isolate the individual loan and borrower characteristics from regional economic effects and to see if the estimates remained consistent on a smaller sample. Table 5 shows the coefficient estimates for these equations. These estimates still support the equity hypothesis over the ability-to-pay hypothesis; the results however are less robust.

The negative equity variables indicate that option value is still of primary importance for restructure and default but becomes insignificant for prepayment. NEGEQU₉₅, was statistically significant, took the expected sign, and had a higher coefficient in the whole sample and in Guadalajara; however, in Monterrey and the DF the coefficients are lower.

The results on the ability-to-pay variables also remain consistent with the first model. Borrowers in residential-type housing are more likely to restructure and default and those in economic-type housing less likely. The sign on the INCPROX variable remains positive and significant for all the equations except for prepayment in the DF and Guadalajara, where it is insignificant and negative.

Simulation Results

In an effort to better assess the impact of individual variables on borrowers' decision to restructure or default, the estimated equations from Model 1 were simulated at their mean values and then marginal changes were made on each variable to see its effect on these probabilities. Table 7 presents these results. The mean probabilities for restructure or default over the first phase of the ADE program are practically equal (39 and 37 percent, respectively) while prepayment is significantly less probable at 1.2 percent, and continuing to pay represents a probability of roughly 23 percent. If a borrower's home equity is negative, the borrower is 19, 23 and 33 percentage points less likely to restructure depending upon their respective income levels ranging from economic, medium, and residential, respectively, and 11, 29 and 50 percentage points more likely they will default than the average. It is notable that even with positive equity high income borrowers were on average less likely to restructure and more likely to default. Medium income borrowers are only slightly more likely to restructure (1.8 percent) and are only slightly more likely to default (0.7 percent) than the average. Positive equity, however, has a marked influence on low-income borrowers, making them about 7 percent more likely to restructure and 13 percent less likely to default than the average. Cosigners on loans make restructure about 5 percent more probable and default about 2 percent less probable.

Overall, borrowers in the three largest cities--Mexico City, Guadalajara, and Monterrey--are 6 percent more likely to restructure and 4 percent less likely to default. However, the 5 percent of loans held by borrowers in cities of less than a quarter of a million inhabitants are even more willing to restructure (13 percent over the mean) and less liable to default by 15 percent.

Table 7: Simulated Choice Probabilities

Outcomes		Restructure	Default	Prepay	Continue Paying
Baseline Probabilities with Variables at Mean		38.59%	37.41%	1.21%	22.78%
Negative Equity Scenarios					
Residential		-33.08%	50.34%	-1.03%	-16.23%
Medium type house		-23.74%	28.81%	-0.87%	-4.21%
Economic		-19.08%	11.07%	-0.81%	8.82%
Positive Equity Scenarios					
Residential		-18.12%	31.47%	-0.23%	-13.12%
Medium type house		1.83%	0.71%	0.13%	-2.68%
Economic		6.87%	-13.51%	0.13%	6.51%
Increasing Home Equity of 10,000 pesos		0.58%	-0.88%	0.03%	0.27%
Income Proxy	1.5	-4.55%	10.19%	-0.13%	-5.51%
	0.5	3.25%	-9.29%	0.09%	5.95%
Cosigner	Yes	5.19%	-2.23%	-0.01%	-2.94%
	No	-4.01%	1.56%	0.00%	2.46%
Unemployment	+ 1.0%	1.00%	-2.46%	0.04%	1.42%
	- 1.0%	-1.08%	2.52%	-0.04%	-1.40%
ADE Interest Rate Subsidy	3.0%	-12.07%	13.61%	-0.47%	-1.07%
	-3.0%	12.70%	-12.35%	0.60%	-0.95%
Gender	Female	-1.01%	0.41%	0.10%	0.51%
	Male	0.36%	-0.15%	-0.03%	-0.18%
Divorce	0.03%	-1.11%	3.88%	-0.21%	-2.57%
	-0.03%	0.84%	-3.78%	0.24%	2.70%
Loan Density	1	-2.08%	4.62%	-0.21%	-2.34%
	-1	1.82%	-4.42%	0.24%	2.37%
Is in D.F., Guadalajara, or Monterrey		6.48%	-3.63%	0.23%	-3.08%
Is City Larger than 250K but Not Top 3		-4.37%	3.22%	-0.12%	1.27%
Is in City of Less than 250K		13.40%	-15.16%	-0.01%	1.77%

Summary and Conclusions

The currency devaluation that Mexico suffered at the end of 1994 set off a recession and banking crisis from which the country has still not fully recovered. The housing market has been one of the sectors most seriously affected. Despite attempts by the government to aid banks and borrowers with mortgage loans, default rates have remained high.

The results of this study provide insight into why the ADE government aid program failed between 1995 and 1996. Loan contracts that permitted excessive negative amortization coupled with a decline in property values left many borrowers with negative equity in their homes. With negative home equity, borrowers default to maximize wealth. Nearly two decades of research on mortgage pricing have shown that default should be viewed as a contingent claim attached to the mortgage contract. Lenders sell a put option when they originate a mortgage that explicitly allows the borrower to relinquish the home at the price of the mortgage. When the value of the outstanding loan exceeds the value of the house, the put is in the money and a rational, wealth-maximizing borrower will default. Mexican mortgage holders have largely responded, as financial theory would predict, by exercising the put option to default on their loans.

The ADE program, by giving payment discounts, did not affect borrowers' negative equity and did not address the root cause of default. In fact, the results presented here show that this policy decision was also regressive in that lower income borrowers were less likely to participate in the program choosing instead to continue paying on their current mortgages. High and medium income borrowers were more likely to default or to restructure and thus receive the benefits of these discounts.

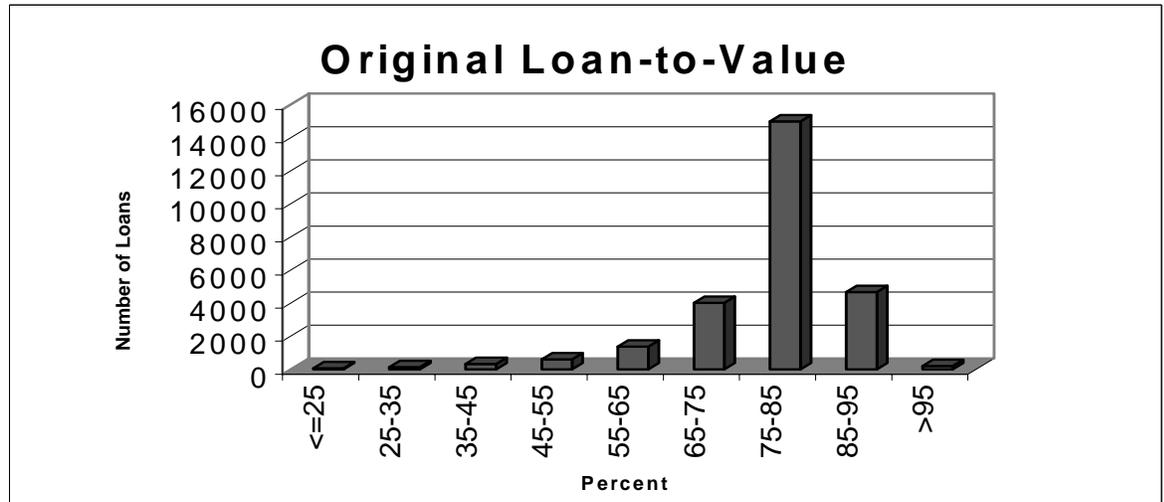
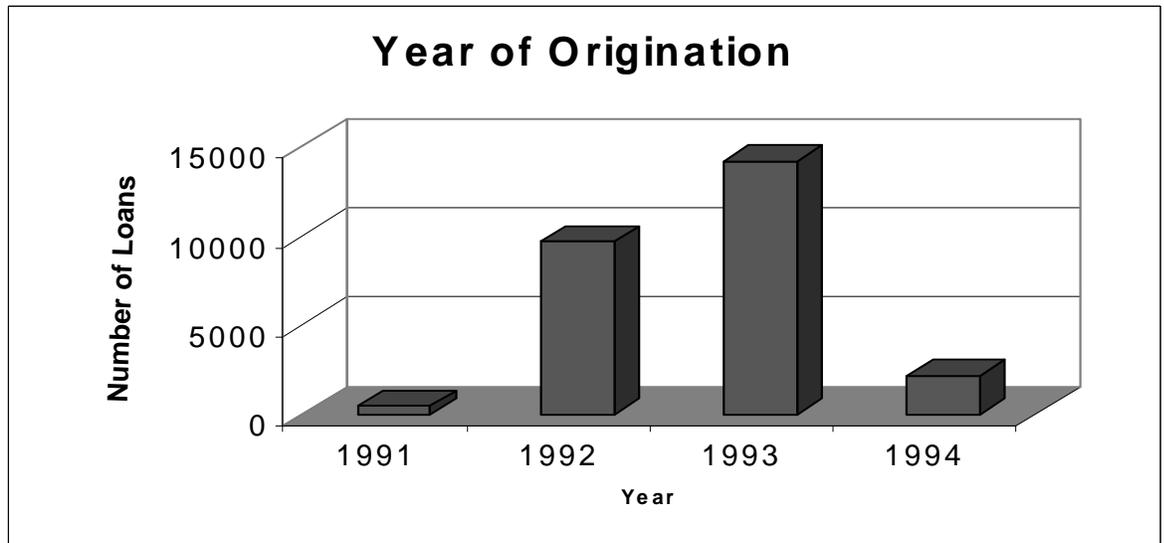
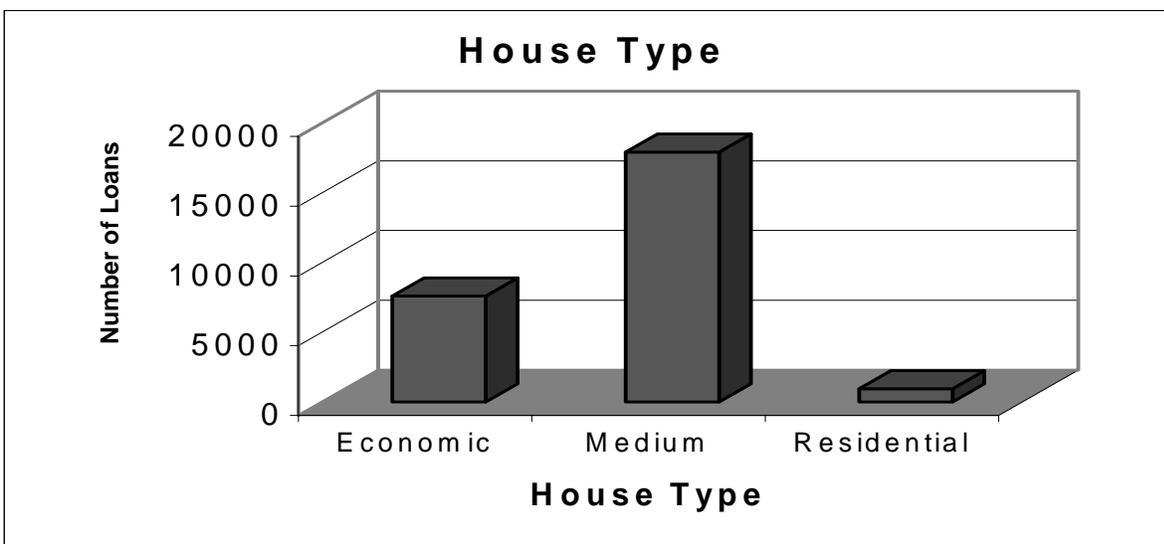
Many loans fell into delinquency subsequent to restructuring. Some claim that because payments rose with inflation under the restructured contracts, borrowers became delinquent again when they were unable to keep up with payment increases. Others point out that the ADE program only provided borrowers with an opportunity to defer foreclosure, but borrowers' participation in the program did not represent a greater willingness to pay. Later evidence suggests that many borrowers did restructure only to fall into delinquency again. Foreclosure deferral was a plausible motivation for this behavior, but payment increases were not. A more likely reason is that since many borrowers were still in a negative equity position

following restructure, they were rationally exercising the option to default even subsequent to the ADE.

This is not to say that default was only brought on by negative equity. Borrowers have suffered payment problems due to a decline in income under the old and new contracts alike. In addition, the systemic rise in default has made foreclosure even more difficult for banks. Moral hazard has plagued the mortgage market, creating excessive administrative burdens for banks and courts alike. Many borrowers, recognizing that banks are unable to possess their properties without an extended and costly court case, have chosen non-payment as a means to obtain a discounted settlement with the bank. The results of this study would suggest that higher income borrowers, who here show a propensity to default even when holding positive equity in their homes, are more adept at receiving these discounts. Again this leads to a regressive outcome for resolving the delinquency problem.

The results of this study point out that basic research on the causes of borrower behavior in the mortgage market would have aided the government in designing a relief program that better addressed the causes of default and benefited lower-income borrowers. Direct discounts off the balance of the loan would have been a more effective policy for stemming default and encouraging restructure. Eventually, nearly three years later, the government did decide to support banks in granting such discounts through a program called *Punto Final*. By this time, however, borrowers had grown to expect a new relief program each time delinquency rose. Strategic default was well cultivated in the market making it ever harder to attain positive results even from a well-designed program. Successive policy failures, such as that of the ADE program, helped nurture a culture of non-payment. Only better-designed policy initiatives that take into consideration the causes of borrower choice can reverse this trend.

Appendix A
Distribution of Loans by House Type, Year of Origination, and Original Loan-to-Value



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