Inflation-Proof Credits and Financial Instruments. Making the Fisher Hypothesis a Reality.

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Inflation-Proof Credits and Financial Instruments: Making the Fisher Hypothesis a Reality

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Abstract

The financial crises of recent years have revealed the sensitivity and vulnerability of nominal interest rates to inflation, which reduces the value of money and affects the returns of financial instruments. The lack of resources to mitigate the impact of inflation has been a limiting factor that has had a marked effect on economies and on the development of mortgage markets in Latin America's unstable economies. This study demonstrates an alternative financial method that compensates losses caused by inflation in nominal fixed-rate mortgages and ensures returns in real terms for banks and investors, while offering families the possibility that their payments may represent an increasingly smaller percentage of their income, even in high-inflation scenarios such as those seen in Latin America during the 1980s and 1990s. The new methodology herein proposed maintains in each period the parity of Fisher's Law with inflation. That is, the real interest rate is kept fixed throughout the life of the mortgage and in any economic conditions that may arise.

Introduction

The economic crises of the 20^{th} Century left a feeling of frustration on academics, practitioners and the general public, since the solutions proposed to the crises were unable to halt the impact of inflation on financial markets, creating

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[✠] I must point out that the creation of the methodology and empirical results described in this study are the work of Juan Orus. I personally am responsible for putting the proposed methodology into formal terms and for mathematical expressions that support the adjustment factor. I would like to thank Omar Maluk (Director of ICHE-ESPOL) for canalizing this study to CIEC-ICHE-ESPOL and Juan Carlos Campuzano for editing this document, also all the people at CIEC for commenting on and contributing to this paper.

the impression that the phenomenon was impossible to control. This perception has had a negative influence on investigations, on the search for a solution and in particular on mortgage models, since they have shown a marked tendency towards this notion instead of looking for a permanent solution that ensures real returns for the investor.

This study develops an alternative model that compensates payments to cover fluctuations in inflation in a nominal fixed rate mortgage and ensures returns in real terms for the financier while, at the same time, offering families the possibility that their payments may represent an increasingly smaller percentage of their income, even in high-inflation scenarios such as those seen in Latin America during the 80s and 90s. Furthermore, the study demonstrates a process that leads to the fulfilment of Fisher's Law in financial processes, and shows how the nominal rate should vary according to changes in inflation, leaving the real interest rate fixed.

The lesson learnt from the crises is an understanding that the volatility of inflation is not in itself the cause of the failure of financial instruments to ensure a fixed real return, since most economic indicators falter and suffer distortions with volatile inflation. The main failure to correspond, from a financial point of view, occurs in nominal rates when inflation exceeds the initially established compensation level and loses parity with the level of prices. This situation affects financial values and returns, nominal rates falter and Fisher's Law becomes a hypothesis unlikely to prove true in economics.

The toughest test for Fisher's Law is time. For this reason, the financial transactions and instruments most vulnerable to inflation are bonds and mortgages since, these being long-term options, depreciation caused by inflation accumulates over time. This phenomenon can be observed even in models that include adjustments for inflation, either because of legal restrictions or because the frequency of adjustments is insufficient. Therefore the initially projected real return becomes very difficult to assure throughout the life of the credit.

Modigliani and DiPasquale (1991), in a presentation for Fannie Mae, show different alternatives for home financing, from fixed-payment mortgages to inflation-proof mortgages, via variable rate mortgages, French and Mexican mortgages, etc. They highlight the various advantages for both the borrower and the lender. Their presentation shows that with all types of mortgage, either the lender or the borrower has to assume the losses caused by unexpected changes in inflation.

There is no doubt that the impact of unforeseen fluctuations in inflation has led to the array of options available to protect mortgage lenders. However, many of these options mean that payments are impossible for borrowers to keep up with, especially in countries with high and volatile inflation. Modigliani (1989) highlights the susceptibility of interest rates to inflation and shows how interest rate adjustments, a result of inflationary variation, lead to a disproportionate increase in monthly dividends: a 5% increase in the interest rate leads to an increase in dividend of around 50%.

This paper is structured as follows: in Chapter 1 a brief description is given of the different mortgage options on offer, together with their advantages and disadvantages; Chapter 2 shows how parity with the CPI is lost (Fisher's Law

losses) when inflation exceeds compensation level, and proposes a new solution and methodology to tackle the problem; Chapter 3 gives simulations of the new methodology for the US and Latin America, whilst Chapter 4 presents some additional considerations regarding this methodology. At the end of the paper the conclusions of the study are presented.

1 Types of Mortgage

The vulnerability of nominal rates to inflation occurs throughout the life of the mortgage and markedly affects fixed-rate credit and investment transactions, creating ever more unpredictable outcomes for the real interest rate of credit and investments. The pressures of inflation affect not only the mortgage lending sector but also the financial standing of banks, as mentioned by Modigliani (1975).

Over the last three decades, this topic has been subject to intensive academic study and research[1] . Perhaps the most interesting development has been the Inflation Proof Mortgage (IPM) [2], which is of particular importance because what is proposed is a type of mortgage that allows inflationary control. It heralds a new direction in this field of research.

Following the inflation crises that have occurred, a wide range of mortgage options and types have been developed to make these sorts of loans more accessible. However, the problem has not yet been solved, because the options proposed have still not managed to protect lenders and borrowers from fluctuations in inflation. This is because these alternatives only offer resources to facilitate transactions, but overlook the fact that the cause of failure in these mortgage types can be found in the very structure of the interest rates. The mortgages available can be classified under two headings: (1) mortgages that operate with adjustments to nominal referential rates, and (2) inflation indexed mortgages. These are described below:

1. FIXED RATE MORTGAGE (FRM) – This mortgage operates with a fixed nominal interest rate and a fixed term. The nominal rate includes a fixed compensation for current inflation and for the risk of future inflation. The model is ideal since it has fixed terms and conditions. The limitation of this type of mortgage is that the bank has no possibility of making adjustments when inflation exceeds the initially established compensation level.

2. ADJUSTABLE RATE MORTGAGE (ARM) – This type of mortgage is very similar to the FRM. The difference is that the nominal interest rate is changed periodically according to referential rates, which have so far been very accurate in predicting inflation, like Treasury Bills in the United

[1] The most important research has been carried out by Franco Modigliani and the team at MIT.

[2] "The Inflation – Proof Mortgage: The Mortgage for the Young." Modigliani, Franco (1984).

States. When interest rates rise, payments are strongly affected. The mortgage is therefore restructured periodically, the remaining capital being divided by "N" remaining periods. This type of mortgage is, however, the most common world-wide. The restructuring takes place annually in the United States, and more often in other countries.

3. GRADUATED PAYMENT MORTGAGE (GPM). – Payments increase at a payment growth rate "g", so the first payment is low and the final payment is higher, with payments gradually increasing in steps directly proportionate to the growth rate, without affecting the nominal rate in operation. There is the risk of negative amortizations if the first payment is very low. If adjustments in the nominal rate are planned, the result could be uncertain and lose its value despite the planned increases. Generally speaking it is an attractive option if the nominal rate is fixed, and if the increments are planned below the rate of wage increases, which takes into account a possible increase in family income.

4. INDEXED MORTGAGE, CMVU (CONSTANT MONETARY VALUE UNITS). – The main objective of this type of mortgage is to keep the real interest rate, or spread, fixed and float the nominal rate at the day's rate of inflation. This maintains a real interest rate at all times. This mortgage type generally works with a "monetary unit tied to inflation", known as CMVU (Constant Monetary Value Units), and in some cases (such as Colombia) with a "monetary unit tied to the construction index", known as UPAC (Constant Purchasing Power Units), which are used to finance house purchases. The disadvantage of this type of mortgage is that it requires non-decreasing salaries, since repayments increase parallel to inflation. In unstable economies such as those of Latin America, where wages lag behind volatile inflation, it has led to serious crises when borrowers were no longer able to keep up with payments.

5. DUAL INDEX MORTGAGE (DIM). – The need for "real wages" in order for indexed mortgages to be a viable option led to the creation of a very attractive mortgage based on the following principle: "repayments increase at the same rate as wages, and capital increases at the rate of inflation". This type of mortgage demonstrates for the first time a recognition that both lenders' and borrower's interests must be given equal importance. This new system was applied over a decade ago in Mexico and is currently used in some countries of Western Europe. The mortgage term is not fixed and the success of this type of loan depends chiefly on the parity between wage increases and the price index of the country in which the system is applied.

6. THE INFLATION - PROOF MORTGAGE (IPM). – The objective of this type of mortgage is to facilitate access to mortgage loans for young home buyers. The first payments are lower since the interest rate is lower, and then these increase for the final payments. As its inventor has explained,

the effect of this mortgage is very similar to that of the graduated payment mortgage, since it uses a certain factor to determine repayments, with adjustments based on referential interest rates like Treasury Bills. It is a good example of financial engineering seeking to balance the interests of both lenders and borrowers.

There are other types of mortgage such as PLAM (Price Level Adjusted Mortgage), Roll-Over Mortgage, Shared Appreciation Mortgage, French Mortgage and Canadian Mortgage, which facilitate access to and recovery of long-term loans. In conclusion, these types of mortgage offer working resources that aid access to loans and allow their recovery in real terms. However, they only allow mortgages to operate smoothly up to certain levels of inflation. If inflation rises above mid and high levels, these mortgage types invariably end up affecting borrowers, whose unchanging wages make it impossible for them to keep up with payments.

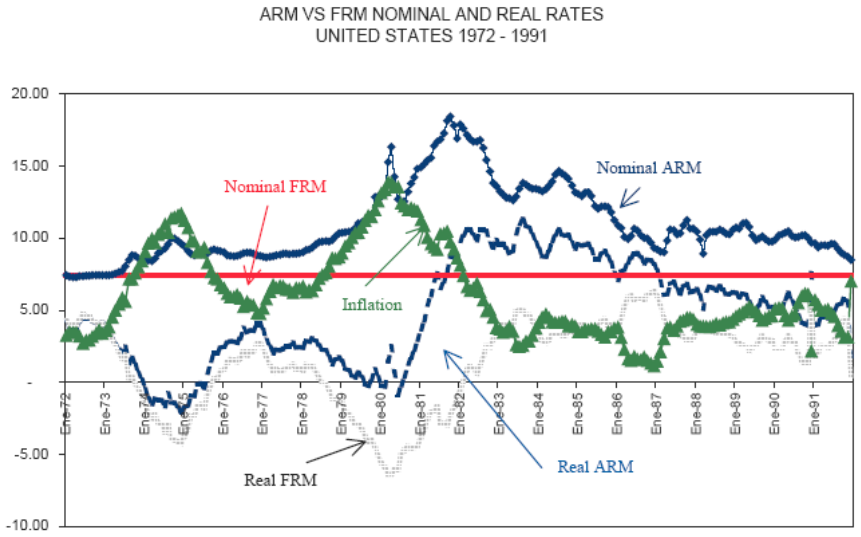
2 Fisher's Law and a New Methodology

The failure of the aforementioned mortgage types lies within the nominal rate, and occurs when inflation surpasses the planned compensation level in any mortgage type that uses nominal rates. The vulnerability of nominal rates structured under Fisher's Law lies in their being established according to expected inflation, and there are no formal procedures in place to keep constant parity with the price index, as the Law stipulates. In this sense, the Law has become a Hypothesis based on the assumption that the expected rate of inflation will cover the depreciation caused by changes in the price index.

Therefore Fisher's Law is only valid under initial conditions, since as from the first period nominal rates lose parity with the price index, even when they change within the compensation limits and are covered by inflation. Furthermore, it is important to bear in mind that most financial transactions are taken out at the present time but culminate in the future (either in the short, medium or long term) and in circumstances where future inflation cannot be known for sure. As a result, the Law's effectiveness is currently limited, and its future application remains a Hypothesis.

Graph 1 shows the real return on investment in mortgages for the United States, during an exceptional period between 1972 and 1991, for the two most common mortgage types: Fixed Rate Mortgage (FRM) and Adjustable Rate Mortgage (ARM).

Graph 1



As can be seen, in both cases (FRM and ARM) return in real terms does not remain at the originally projected level, and this is a result of the uncertainty introduced by changes in the inflation rate. It can therefore be said that inflation will affect any type of mortgage that involves nominal rates, and in particular mortgages that involve fixed rates.

In this respect, the new methodology proposed here offers the possibility of keeping returns in real terms constant throughout the life of a fixed rate mortgage (FRM). The reasoning behind this new methodology lies in the adjustment that must be made to payments, calculated from the beginning of the FRM. The analysis must begin by taking into account the real value of payments made under non-fluctuating inflation and comparing it with the real value of payments under observed fluctuating inflation. Thus the future value of a mortgage with payments including interest is given by:

$$FV = \sum_{t=1}^{N} PYMT_t$$

where $PYMT_t = R \times M \left[\frac{(1+R)^N}{(1+R)^N - 1}\right] = PYMT \quad \forall t \quad$ and $R = (1+r)(1+\pi^e) - 1$

R: Nominal interest rate of the mortgage.

r: Real interest rate of the mortgage.

π^e: Expected inflation rate at the moment the mortgage is taken out[3].

M: Value of the mortgage.

N: Periods of duration of the mortgage.

[3] We suppose that $\pi^e = \pi$, since the nominal interest rate is kept constant throughout the life of the mortgage.

Each payment in real terms can be considered under two scenarios: 1) Inflation constant and equal to inflation at the time of taking out the mortgage (naïve scenario from here on) and, 2) Inflation variable and equal to inflation registered at the end of each period.

Under the first scenario, each payment in real terms is given by the following expression:

$$RP_t^{naive} = \frac{PYMT}{CPI_t^{naive}} = \frac{PYMT}{CPI_0(1+\pi)^t} \tag{1}$$

where:

RP_t^{naive} : Naive real payment in period t.
CPI_t^{naive} : Consumer Price Index in period t calculated using the inflation rate when the mortgage was taken out.
CPI_0 :Consumer Price Index at the moment the mortgage was taken out.

Under the second scenario, each payment in real terms is given by the following expression:

$$RP_t = \frac{PYMT}{CPI_t} = \frac{PYMT}{CPI_0 \prod_{i=1}^{t}(1+\pi_i)} \tag{2}$$

where:
RP_t : Real payment in period t.
CPI_t :Consumer Price Index registered in period t.
π_i : Inflation registered in period i.

Note in equation (1) that under the naïve scenario real payments would maintain their value over time (this does not imply that they would be constant), since the interest rate applied in each period to the remaining capital would always cover the inflation that, supposedly, has stayed constant. However, under the second scenario, in equation (2), the real value of payments would fluctuate above or, and this would be worse for the lender, below what was originally agreed when the mortgage was taken out at the nominal fixed interest rate of that time.

Therefore, the adjustment that must be made between the real payment and the naïve real payment is given by the expression:

$$\frac{RP_t^{naive}}{RP_t} = \frac{\prod_{i=1}^{t}(1+\pi_i)}{(1+\pi)^t} \tag{3}$$

This correction factor must be applied to each one of the payments, so that the real return projected at the time the mortgage was taken out (which is given by the relationship between the initial nominal rate and initial inflation) may be kept constant throughout the life of the mortgage, and the loan may run its course under the naïve scenario, under which the real return is conserved.

Thus, the future value of payments that would compensate for changes in inflation is given in the expression:

$$ADJUSTED\ FV = \sum_{t=1}^{N} PYMT \times \frac{\prod_{i=1}^{t}(1+\pi_i)}{(1+\pi)^t} = \sum_{t=1}^{N} PYMT \times CRF_t \quad (4)$$

What this model proposes is to compensate the nominal rate with the "factor that causes the flaw", which we will call the Constant Rate Factor (CRF), and use this "depreciation factor" as part of an efficient financial tool that allows us to obtain "Constant Real Rates" throughout the life of the mortgage, while maintaining fixed spread and efficiently protecting mortgages from inflation. Later in this paper this proposal will be tested out for the extreme conditions of Latin America economies over the last 30 years.

A closer look at the Constant Rate Factor operation shows that, if we apply it to each payment, the situation becomes as it would under the naïve scenario, under which the real return projected at the time the mortgage was taken out is maintained. Below we can see the result of CRF-adjusted payments deflated against the price index:

$$\frac{PYMT \times CRF_t}{CPI_t} = \frac{PYMT \times \frac{\prod_{i=1}^{t}(1+\pi_i)}{(1+\pi)^t}}{CPI_0 \prod_{i=1}^{t}(1+\pi_i)} = \frac{PYMT}{CPI_0(1+\pi)^t} = \frac{PYMT}{CPI_t^{naive}} = RP_t^{naive} \quad (5)$$

This procedure is mathematically accurate, and substantially reduces the strain of inflation upon payments. However, it must be considered as a different process, since the CRF adjusts only small differences in the CPI in order to maintain constant real rates; this factor also produces a moderate "process of monetary correction" which is accumulative from the beginning of the operation [4]. Its effectiveness can be verified by applying IRR (Internal Rate of Return) and NPV (Net Present Value) tests to adjusted and deflated payments: the result is a real return rate equal to the originally established rate. Mathematically, it can be shown that the future value of payments including interest, adjusted by the Constant Rate Factor, is equal to the value of payments carried to a future value by the real interest rate and the inflation registered in each period. This can be shown thus:

[4] Note that the CRF implies that in each additional period the factor increases by the inflation factor for that period, but at the same time another factor is added in the denominator, equal to the initial inflation factor at the moment the mortgage was taken out.

$$\sum_{t=1}^{N} PYMT_t^* \times (1+R)^t \times CRF_t = \sum_{t=1}^{N} PYMT_t^* \times (1+r)^t (1+\pi)^t \times \frac{\prod_{i=1}^{t}(1+\pi_i)}{(1+\pi)^t}$$

$$= \sum_{t=1}^{N} PYMT_t^* \times (1+r)^t \prod_{i=1}^{t}(1+\pi_i) \tag{6}$$

where $PYMT_t^*$: Fixed payment carried to present value by the nominal rate.[5]

It can be seen in equation (6) that the interest rate that is applied in each period adjusts only by the difference registered in inflation for that period, keeping real return constant throughout the life of the loan.

The accuracy of the Constant Rate Factor can also be confirmed at the moment of determining the interest rate that applies each period of the mortgage. The interest rate which, as mentioned earlier, is variable in each period, is given by the expression:

$$1+\rho_t = \frac{(1+R)^t \times CRF_t}{(1+R)^{t-1} \times CRF_{t-1}} = \frac{(1+r)^t (1+\pi)^t \times \frac{\prod_{i=1}^{t}(1+\pi_i)}{(1+\pi)^t}}{(1+r)^{t-1}(1+\pi)^{t-1} \times \frac{\prod_{i=1}^{t-1}(1+\pi_i)}{(1+\pi)^{t-1}}} = (1+r)(1+\pi_t) \tag{7}$$

where ρ_t: Nominal interest rate in force in each period.

Thus, the nominal interest rate that applies to mortgage payments will always fulfil Fisher's Law. However, we must bear in mind that the interest rate applied in each period depends solely on the inflation registered for that period, and not on expected future rates of inflation.

It is important to mention that when the CRF is applied to the payments, two things happen: 1) the nominal interest rate is changed continuously and automatically, and, 2) the interest charged increases but the original relationship between the balance of the mortgage and its amortization does not vary. For this reason the interest rate will no longer match the remaining balance.

The factor (CRF) may fluctuate between ± 1 from the beginning of the operation. When the factor (CRF) is less than "1" then the rate of inflation and nominal rate have fallen against their original values. In this case a CRF with a value of "1" must be applied, which avoids reducing payments (and hence the nominal rate), since a lower rate would affect returns on fixed-rate Mortgage Back Securities. In any case, this eventuality could be dealt with using savings-financed loans.

[5] This new payment is calculated thus: $\frac{PYMT}{(1+R)^t}$

The main achievement of this methodology is that it creates balance between the mortgage lender and the borrower[6]. The lender will be very likely to recover the entire loan, and there will be a good chance that the borrower can service the debt under any economic conditions. Once this has been achieved there will no longer be any uncertainty or need to predict the future value of the credit or investment, since all parts of the loan will always have the same value throughout the operation. The essence of equilibrium lies in equalising the real interest rate of credits and investments.

The Constant Rate Factor (CRF) reduces the risk of imbalance since it adjusts payments to inflation by only small exponential differences in each period. This is unlike the indexed systems, in which payments increase tied to inflation, producing a severe impact on payments and the uncertainty that comes with changes in income levels and the usual lagging-behind of wages in high-inflation scenarios.

3 Empirical Evidence of the Application of the Constant Rate Factor

In order to verify the methodology herein presented in the context of mortgages, and its advantages compared with adjustable rate mortgages (ARMs), simulations were carried out for the economy of the United States. Likewise, in order to illustrate the factor's performance in more local economies, simulations were also carried out for crisis scenarios in the extreme economic situation of Latin America[7]. The tests examine the application of the Constant Rate Factor for fixed rate mortgages in Brazil, Colombia and Mexico[8] , whose economies have experienced major periods of wage slumping, volatile inflation and unstable exchange rates. The simulations tested the effect of adjusted payments on family income by taking into account minimum wage figures[9] . A mortgage interest rate of 15% was applied for the Mexican economy and 15.71% for Brazil, and although this may seem high for this type of transaction, it is consistent with the high levels of inflation that have been registered in these countries. The internal return rate was also obtained for payments adjusted by the correction factor in order to observe nominal and real returns from mortgages. In the same way, the actual net values, reduced by the nominal and real interest rates originally established, were obtained to show that, in real terms, spread is maintained. Graphs are also shown for each country, indicating changes in payments throughout time and comparing them to the price index, wages and

[6] The real interest rate must be adjusted to balance the offer and demand of credit. This task is left up to the credit market.

[7] Tests were carried out with annual data. Results from monthly data were the same as those obtained with annual simulations.

[8] The study also included other countries, such as Venezuela, Ecuador and Peru, but for reasons of limited space it was decided to concentrate on the economies mentioned above. The results from the other countries are consistent with those presented in this paper.

[9] In order to make evident the feasibility of the methodology we use the "Payment / Family Income" ratio.

exchange rates. Tables 1 and 2 and Graph 2, in Appendix 1, show the results of a comparison between a fixed rate mortgage adjusted by the factor and an adjustable rate mortgage for the United States. Tables 3 to 5 and Graphs 3 to 5, in Appendix 2, show the results obtained from simulations for Latin America.

From the results obtained for the United States, the following may be observed (Tables 1 and 2):

i. The Net present Value (NPV) of the Constant Rate Mortgage (CRM)[10] adjusted by the factor is less than the NPV obtained for the Adjustable Rate Mortgage (ARM): The NPV for the first type of mortgage is US$ 112,025.90, while for the second it is US$ 117,331.14.

ii. The internal return rate, in nominal terms, for the CRM is 8.94%, whereas for the ARM it is 9.53%.

iii. The internal return rate, in real terms, for the CRM is 1.37% (equal to the real return stipulated at the moment the mortgage was taken out), while for the ARM it is 1.92%.

iv. The average "Payment / Family Income" effort ratio is 15.52% for the CRM and 16.29% for the ARM.

It may be inferred, then, that the methodology herein proposed ensures the real return of the investment, and keeps the effort ratio lower than it would be under an adjustable rate mortgage[11] . The results are quite appealing, particularly the result that shows the return on deflated payments to be equal to the return originally stipulated when the mortgage was taken out. In this way, the equilibrium of the mortgage market is subject to the real interest rate being adjusted so that offer and demand are balanced, as stated in the classic theory of equilibrium[12] .

The following observations can be made for the simulations carried out for Mexico, Brazil and Colombia (Tables 3 to 5):

i. The internal return rates in nominal terms are as so: Mexico 37.02%, Brazil 146.27% and Colombia 20.93%.

ii. The internal return rates in real terms are as so: Mexico 2.63%, Brazil 1.5% and Colombia 2.22%, all equal to the real return stipulated at the moment the mortgage was taken out.

iii. The average effort ratios are as follows: Mexico 12.53%, Brazil 8.79% and Colombia 7.58%.

[10] The Constant Rate Mortgage (CRM) is a fixed rate mortgage (FRM) adjusted by the constant rate factor (CRF).

[11] In Graph 2, Appendix 1, we can see changes in payments adjusted by the CRF compared to payments for an Adjustable Rate Mortgage. Note that the line is much smoother in the first case.

[12] Graph 6, in Appendix 3, also shows changes in nominal and real interest rates for the two types of mortgage. We can see how the fixed rate mortgage adjusted by the CRF maintains its real interest rate for the entire term of the mortgage.

From the graphs giving the economic indicators for the countries under study, which include payments adjusted by the Constant Rate Factor (CRF) (Graphs 3 to 5), the following observations can be made:

i. For Mexico, payments adjusted by the CRF increase at a lower rate than the price index, wages and exchange rate, staying below all the indicators given throughout the life of the mortgage.

ii. For Brazil, payments adjusted by the CRF always stay below the price index, wages and the exchange rate and increase at a lower rate than these indicators throughout the time of the study.

iii. For Colombia, the only indicator that payments adjusted by the CRF rise above is the exchange rate, and this occurs for 11 years between 1975 and 1985. Payments stay below the other indicators and increase at a lower rate.

Although the model does not take the exchange rate into account, we may observe the performance of the model in dollars in the tables for Mexico, Brazil and Colombia. These results have been included given that certain development loans from international organisations are paid in US currency. The results show a quite acceptable level of profitability, given by the internal return rate (Mexico 10.74%, Brazil 7.11% and Colombia 7.62%).

4 Additional Considerations regarding the Constant Rate Factor.

Although there is no doubt that the new methodology is important in terms of maintaining real returns throughout the life of the mortgage, we must also bear in mind that, as with any other credit tool, if the initial interest rate is sufficiently high, then demand for these instruments will not be as families would like it to be. This situation may also affect the proposal set out in this paper since payments could decrease nominally over time in a scenario of falling inflation and interest rates, causing problems for the financing of funds. However, this "problem" also applies to all other financial alternatives available on the loans market and not just to the proposal contained in this study.

In the following section we shall offer some possible solutions to financing problems that may arise using the proposed methodology, and also consider some possible applications of the Constant Rate Factor, together with some of its advantages and disadvantages.

4.1 Financing CRM Mortgages

The difference that sets the Constant Rate Factor apart from existing mortgages and financial instruments is its variable payment and collection method, which is a consequence of changes in purchasing power. The options available to confront financing problems are mortgage bonds and savings.

Bonds and Mortgage Bonds.- These are the main recourse for raising long-term funds and have basically the same features as existing instruments, with the exception of profitability adjustments produced by the Constant Rate Factor throughout the life of the mortgage. This feature could be widely accepted for investments by banks, insurance companies and other financial assets. Mortgage bonds maintain the Constant Rate Factor above "1" in order to sustain nominal value. Above "1", real profitability always fluctuates according to the CPI, and in no way affects the position of the investor, even in extreme conditions of hyperinflation.

Savings and Credit.- In savings and credit operations it is more feasible that interest rates may equalised, since operations are sustained by savings accounts and could easily keep going when the Constant Rate Factor ≤ 1, which means that the nominal value of payments could decrease if inflation falls against its initial level. This will facilitate the payment of loans since it will go hand in hand with the deposits.

4.2 Applications of the Constant Rate Factor

Nominal rates are used in almost all economic and financial activities, and one must always be aware that they are exposed to inflation and to constant periodical changes from referential rates. It must be borne in mind that when nominal rates are used as a planning tool for financial assets, they may lag behind and show negative real rates, as occurred in the United States in the 1970s, not to mention Latin America, where the situation is more critical still. Some possible applications are listed below.

- Nominal Referential Rates.
- Banks and Financial Institutions.
- Fixed Rate Mortgages (FRM).
- Mortgage Bonds.
- Mutual Funds (Savings and Loans).
- Life Insurance.
- Investment Portfolios.
- Tools for planning financial assets.

The model eliminates uncertainty and the need to predict inflation or the value of financial instruments, since spread stays fixed at a constant value throughout the life of the loan. The impact of this model on economic activities remains to be seen and will depend upon how widely it is accepted. As a financial tool, however, it stands up particularly well to the empirical tests carried out for mortgage transactions in Latin America.

4.3 Advantages and Disadvantages of the Constant Rate Factor

The advantages of the Constant Rate Factor are:

(a) It operates with nominal rates at the beginning (Fisher's Law).

(b) It obtains constant real rates throughout the life of the mortgage.

(c) Fixed term.

(d) It avoids payment shocks.

(e) There is no risk of negative amortizations in nominal or real terms.

(f) It eliminates long-term uncertainty and the impact of inflation for lenders and borrowers.

(g) It encourages long-term mortgage financing.

The disadvantages of the Constant Rate Factor are:

(a) This type of mortgage has the same limitations as mortgages that operate with nominal rates (ARM and FRM). If the rate of inflation is high at the beginning, the interest rate will rise, and with it the value of payments in monetary units, which reduces the purchasing power of potential buyers.

(b) Payments constantly vary. Although this type of mortgage is subject to small and manageable variations in payments, they constantly vary as a result of changes in the inflation rate. The effect is slight, but could become annoying due to its constant nature. However, these variations always stay below the "Payment / Family Income" ratio, or effort ratio, (between 20% and 30%) which is considered at the start of the operation.

(c) The model's main disadvantage is that it proposes an innovative approach that goes against traditional thinking and previously accepted models for mortgages.

5 Conclusions

Although there is no doubt that in the international context of credit and investments various methodologies and instruments have been developed to ensure profit margins in credit transactions, this study has formally demonstrated the origin of an adjustment factor that allows a constant real return to be made on investments. It has also shown the viability of applying this factor in high-inflation economies such as those of Latin America.

Besides offering protection against variations in the level of prices, the new methodology of the Constant Rate Factor does not make payments untenable in terms of family income, as inflation indexed mortgages do. This means that financial services incorporating this adjustment factor would be generally welcomed by customers in the housing market. Furthermore, the Constant Rate Factor could be extended to other financial services, and, by ensuring real returns on investments, lead to new dynamics that would invigorate the credit market and the economy as a whole.

It is important to highlight that one of the main results of applying the factor is the reduction of uncertainty in financial transactions, since real return

remains at the originally projected level and is no longer an aleatory variable throughout the life of the credit. A deeper inspection of this result allows us to infer that the level this real interest rate adjusts to will depend on the credit market, but a credit market now free from the uncertainty created by the risk of inflation which has characterised Latin American economies.

The proposal of this study has been to extend the length of time during which Fisher's Law is valid, and to turn the Law from a hypothesis into a reality. The study may be applied to create a more secure environment and bring about positive changes in the development of economics and finance. It constitutes a starting point on the path that other studies and investigations may wish to follow, particularly studies concerned with the development and strengthening of the financial assets market, the impact of the methodology herein contained on the economy and on economic growth, and the everyday implementation and use of a model such as the one presented here.

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Table 1
ARM (ADJUSTED RATE MORTGAGE)

UNITED STATES 1972-1991

(ARM) LEVEL PAYMENT MORTGAGE

Spread	1.37%
Nominal Interest Rate	7.45%
Inflation Rate	6.00%
IRR Adjusted Payments	9.53%
IRR Deflated Payments	1.92%
Loan Amount	$ 100,000.00

Annual Payments

		Annual Inflation Rate %	d CPI	"R" ARM Rate %	1 Outstanding Balance (Principal)	2 Amortization	3 Scheduled Payments	4 Effective Interest Rate	5 Interest Charged	6 Adjusted Anual Payments	7 Deflated Payments (6) / (d)	8 Net Present Value Disc rate 1.92%	9 Wages Hour Rate Increment	10 Household Income	11 Effort Ratio (6) / (10)
	Year	π			100,000.00		(100,000.00)			(100,000.00)	(100,000.00)				
1	1972	6.00	1.06	7.45	97,678.05	2,321.95	9,771.95	7.45%	7,450.00	9,771.95	9,218.82	9,044.82	6.97%	39,087.80	25.00%
2	1973	6.22	1.13	7.78	95,266.85	2,411.20	9,771.95	7.78%	7,599.35	10,010.55	8,890.89	8,558.44	6.80%	41,745.33	23.98%
3	1974	11.04	1.25	8.71	92,893.53	2,373.32	9,771.95	8.71%	8,297.74	10,671.07	8,535.55	8,061.31	8.49%	45,288.70	23.56%
4	1975	9.13	1.36	8.75	90,322.91	2,570.62	9,771.95	8.75%	8,128.18	10,698.80	7,841.94	7,266.45	9.05%	49,385.72	21.66%
5	1976	5.76	1.44	8.77	87,532.11	2,790.81	9,771.95	8.77%	7,921.32	10,712.12	7,423.93	6,749.28	8.07%	53,372.01	20.07%
6	1977	6.50	1.54	8.80	84,503.68	3,028.43	9,771.95	8.80%	7,702.83	10,731.25	6,983.10	6,228.69	8.71%	58,022.68	18.49%
7	1978	7.59	1.65	9.93	81,467.57	3,036.11	9,771.95	9.93%	8,391.22	11,427.32	6,911.42	6,048.40	8.78%	63,116.28	18.11%
8	1979	11.35	1.84	10.49	78,251.93	3,215.64	9,771.95	10.49%	8,545.95	11,761.59	6,388.51	5,485.26	8.42%	68,431.33	17.19%
9	1980	13.50	2.09	10.49	74,698.97	3,552.96	9,771.95	10.49%	8,208.63	11,761.59	5,628.71	4,741.67	8.74%	74,410.77	15.81%
10	1981	10.32	2.31	12.26	71,133.31	3,565.66	9,771.95	12.26%	9,158.09	12,723.75	5,519.78	4,562.14	9.82%	81,718.97	15.57%
11	1982	6.16	2.45	14.13	67,477.98	3,655.34	9,771.95	14.13%	10,051.14	13,706.48	5,601.04	4,541.94	6.37%	86,923.29	15.77%
12	1983	3.21	2.53	14.49	63,369.64	4,108.33	9,771.95	14.49%	9,777.56	13,885.89	5,497.75	4,374.03	3.82%	90,245.20	15.39%
13	1984	4.32	2.63	11.49	58,120.78	5,248.86	9,771.95	11.49%	7,281.17	12,530.03	4,755.62	3,712.17	4.05%	93,899.30	13.34%
14	1985	3.56	2.73	12.11	52,379.46	5,741.32	9,771.95	12.11%	7,038.43	12,779.75	4,683.61	3,586.96	3.89%	97,553.40	13.10%
15	1986	1.86	2.78	11.88	45,905.38	6,474.08	9,771.95	11.88%	6,222.68	12,696.76	4,568.28	3,432.60	2.04%	99,546.55	12.75%
16	1987	3.65	2.88	11.09	38,547.52	7,357.86	9,771.95	11.09%	5,090.91	12,448.77	4,321.34	3,185.77	1.78%	101,318.23	12.29%
17	1988	4.14	3.00	8.74	30,085.99	8,461.53	9,771.95	8.74%	3,369.05	11,830.58	3,943.59	2,852.41	2.84%	104,197.22	11.35%
18	1989	4.82	3.14	8.83	20,892.97	9,193.03	9,771.95	8.83%	2,656.59	11,849.62	3,768.37	2,674.23	2.87%	107,186.94	11.06%
19	1990	5.40	3.31	9.77	10,933.03	9,959.94	9,771.95	9.77%	2,041.24	12,001.18	3,620.92	2,521.09	3.31%	110,730.31	10.84%
20	1991	4.21	3.45	9.71	-	10,933.03	9,771.95	9.71%	1,061.60	11,994.62	3,472.80	2,372.33	3.30%	114,384.41	10.49%
						100,000.00			135,993.68	235,993.68	117,575.96	100,000.00			
									IRR	9.53%	1.92%			Max (start)	25.00%
									NPV	117,331.14	104,635.74			Averg	16.29%
										(disc 7,45%)	(disc 1,37%)			Min	10.49%

Table 2
CRM (CONSTANT RATE MORTGAGE)
UNITED STATES 1972 - 1991

(FRM) LEVEL PAYMENT MORTGAGE

Spread	1.37%
Nominal Interest Rate	7.45%
Inflation Rate	6.00%
IRR Adjusted Payments	8.94%
IRR Deflated Payments	1.37%
Loan Amount	100,000.00

Annual Payments

		Annual Inflation Rate %	d $\Pi(1+\pi_i)$	e $(1+\pi)^t$	f Constant Rate Factor (CRF) d / e	1 Outstanding Balance (Principal)	2 Amortization	3 Annual Payments	4 Effective Interest Rate	5 Interest Charged	6 Adjusted Anual Payments (3) x (CRF)	7 Deflated Payments (6) / (d)	8 Net Present Value Disc rate 1.37%	9 Wages Hour Rate Increment	10 Household Income	11 Effort Ratio (6) / (10)
	Year	π				100,000.00		(100,000.00)			(100,000.00)	(100,000.00)				
1	1972	6.00	1.06	1.06	1.00	97,678.05	2,321.95	9,771.95	7.45%	7,450.00	9,771.95	9,218.82	9,094.42	6.97%	39,087.80	25.00%
2	1973	6.22	1.13	1.12	1.00	95,183.12	2,494.94	9,771.95	7.45%	7,277.01	9,792.24	8,697.00	8,463.86	6.80%	41,745.33	23.46%
3	1974	11.04	1.25	1.19	1.05	92,502.31	2,680.81	9,771.95	7.45%	7,091.14	10,257.47	8,204.72	7,877.02	8.49%	45,288.70	22.65%
4	1975	9.13	1.36	1.26	1.08	89,621.78	2,880.53	9,771.95	7.45%	6,891.42	10,560.14	7,740.30	7,330.87	9.05%	49,385.72	21.38%
5	1976	5.76	1.44	1.34	1.08	86,526.65	3,095.13	9,771.95	7.45%	6,676.82	10,536.44	7,302.17	6,822.59	8.07%	53,372.01	19.74%
6	1977	6.50	1.54	1.42	1.08	83,200.94	3,325.71	9,771.95	7.45%	6,446.24	10,586.40	6,888.84	6,349.55	8.71%	58,022.68	18.25%
7	1978	7.59	1.65	1.50	1.10	79,627.46	3,573.48	9,771.95	7.45%	6,198.47	10,745.27	6,498.90	5,909.30	8.78%	63,116.28	17.02%
8	1979	11.35	1.84	1.59	1.16	75,787.75	3,839.70	9,771.95	7.45%	5,932.25	11,287.57	6,131.04	5,499.58	8.42%	68,431.33	16.49%
9	1980	13.50	2.09	1.69	1.24	71,661.99	4,125.76	9,771.95	7.45%	5,646.19	12,086.07	5,784.00	5,118.27	8.74%	74,410.77	16.24%
10	1981	10.32	2.31	1.79	1.29	67,228.86	4,433.13	9,771.95	7.45%	5,338.82	12,578.13	5,456.61	4,763.40	9.82%	81,718.97	15.39%
11	1982	6.16	2.45	1.90	1.29	62,465.46	4,763.40	9,771.95	7.45%	5,008.55	12,597.19	5,147.74	4,433.13	6.37%	86,923.29	14.49%
12	1983	3.21	2.53	2.01	1.26	57,347.19	5,118.27	9,771.95	7.45%	4,653.68	12,265.91	4,856.36	4,125.76	3.82%	90,245.20	13.59%
13	1984	4.32	2.63	2.13	1.24	51,847.60	5,499.58	9,771.95	7.45%	4,272.37	12,071.19	4,581.47	3,839.70	4.05%	93,899.30	12.86%
14	1985	3.56	2.73	2.26	1.21	45,938.30	5,909.30	9,771.95	7.45%	3,862.65	11,793.45	4,322.14	3,573.48	3.89%	97,553.40	12.09%
15	1986	1.86	2.78	2.40	1.16	39,588.75	6,349.55	9,771.95	7.45%	3,422.40	11,332.70	4,077.49	3,325.71	2.04%	99,546.55	11.38%
16	1987	3.65	2.88	2.54	1.13	32,766.17	6,822.59	9,771.95	7.45%	2,949.36	11,081.42	3,846.69	3,095.13	1.78%	101,318.23	10.94%
17	1988	4.14	3.00	2.69	1.11	25,435.29	7,330.87	9,771.95	7.45%	2,441.08	10,886.69	3,628.95	2,880.53	2.84%	104,197.22	10.45%
18	1989	4.82	3.14	2.85	1.10	17,558.27	7,877.02	9,771.95	7.45%	1,894.93	10,765.32	3,423.54	2,680.81	2.87%	107,186.94	10.04%
19	1990	5.40	3.31	3.03	1.10	9,094.42	8,463.86	9,771.95	7.45%	1,308.09	10,704.71	3,229.76	2,494.94	3.31%	110,730.31	9.67%
20	1991	4.21	3.45	3.21	1.08	-	9,094.42	9,771.95	7.45%	677.53	10,523.75	3,046.94	2,321.95	3.30%	114,384.41	9.20%
							100,000.00	195,439.00		95,439.00	222,224.01	112,083.49	100,000.00			
							IRR	7.45%			8.94%	1.37%			Max (start)	25.00%
							NPV	100,000.00			112,025.90	100,000.00			Averg	15.52%
											(disc 7,45%)	(disc 1,37%)			Min	9.20%

Graph 2

ARM vs CRM NOMINAL AND REAL RATES
UNITED STATES 1972-1991

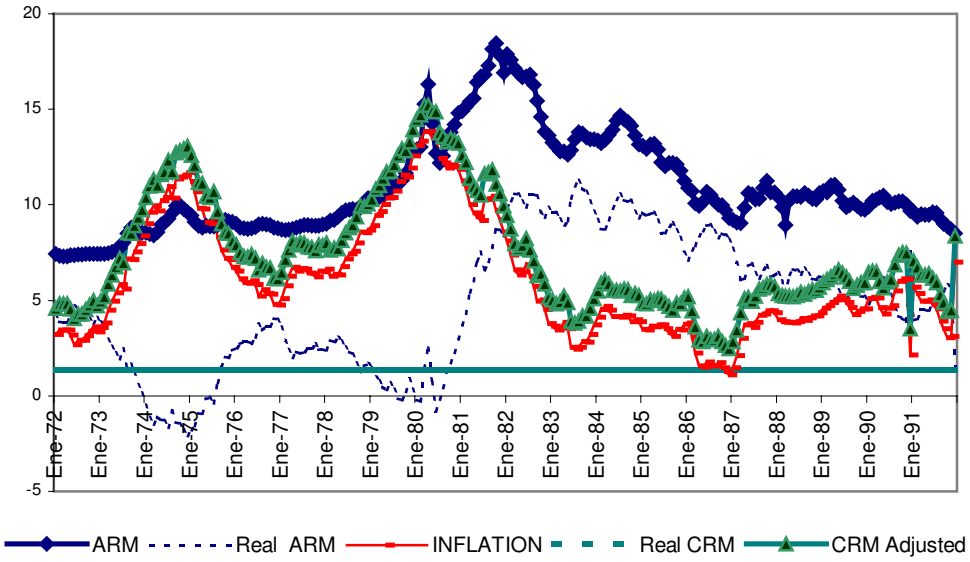


Table 3

SIMULATION TESTS IN MEXICO 1973 - 1992

CRM (CONSTANT RATE MORTGAGE) LEVEL PAYMENTS

ANNUAL PAYMENTS

Financial Margin (Spread)	2.63%
Nominal Interest Rate	15.00%
Inflation Rate	12.05%
IRR Adjusted Payment (7)	37.02%
IRR Deflated Payment (8)	2.63%
IRR Adjusted Payment in Dollars (9)	10.74%
LOAN AMOUNT (mexican pesos)	$ 56,956.71
LOAN AMOUNT (dollars)	$ 3,955.24
LOAN TERM	20 Years

		Anual Inflation Rate %	d $\Pi(1+\pi_t)$	e $(1+\pi)^t$	f Constant Rate Factor (CRF) d / e	1 Outstanding Balance (Principal)	2 Annual Payments	3 Effective Interest Rate	4 Interest Charged	5 Adjusted Interest (CRF) (7) - (6)	6 Amortization	7 Adjusted Annual Payments (2) x (CRF)	8 Deflated Payments (7) / (d)	9 Annual Payments (U.S. Dollars) (7) / Exch Rate	10 Official Minimun Salaries	11 Family Income (year) SMV	12 Effort Ratio (7) / (11)
	Year	π				56,956.71						(56,956.71)	(56,956.71)	(3,955.24)	1 SMV	36,39 SMV	
1	1973	12.05	1.12	1.12	1.00	56,400.73	9,099.49	15.00%	8,543.51	8,543.51	555.98	9,099.49	8,120.92	594.58	1,000.00	36,397.95	25.00%
2	1974	23.79	1.39	1.26	1.10	55,761.35	9,099.49	15.00%	8,460.11	9,413.50	639.38	10,052.88	7,247.58	656.88	1,350.90	49,169.99	20.45%
3	1975	15.77	1.61	1.41	1.14	55,026.06	9,099.49	15.00%	8,364.20	9,651.35	735.29	10,386.63	6,468.17	709.81	1,657.20	60,318.68	17.22%
4	1976	29.01	2.07	1.58	1.31	54,180.49	9,099.49	15.00%	8,253.91	11,113.19	845.58	11,958.76	5,772.57	515.93	2,017.80	73,443.78	16.28%
5	1977	17.47	2.43	1.77	1.38	53,208.07	9,099.49	15.00%	8,127.07	11,564.81	972.41	12,537.23	5,151.78	453.95	2,736.00	99,584.79	12.59%
6	1978	18.17	2.88	1.98	1.45	52,089.79	9,099.49	15.00%	7,981.21	12,103.71	1,118.28	13,221.99	4,597.75	446.61	3,104.70	113,004.72	11.70%
7	1979	26.36	3.63	2.22	1.64	50,803.78	9,099.49	15.00%	7,813.47	13,624.56	1,286.02	14,910.58	4,103.31	495.63	3,593.40	130,792.39	11.40%
8	1980	29.8	4.72	2.48	1.90	49,324.85	9,099.49	15.00%	7,620.57	15,793.67	1,478.92	17,272.59	3,662.03	582.33	4,220.70	153,624.83	11.24%
9	1981	28.7	6.07	2.78	2.18	47,624.10	9,099.49	15.00%	7,398.73	18,138.44	1,700.76	19,839.20	3,268.21	649.85	5,491.50	199,879.34	9.93%
10	1982	98.8	12.07	3.12	3.87	45,668.22	9,099.49	15.00%	7,143.61	33,242.99	1,955.87	35,198.86	2,916.74	233.59	7,344.90	267,339.30	13.17%
11	1983	80.8	21.82	3.50	6.24	43,418.97	9,099.49	15.00%	6,850.23	54,546.41	2,249.25	56,795.66	2,603.07	376.91	11,942.70	434,689.80	13.07%
12	1984	59.2	34.74	3.92	8.87	40,832.33	9,099.49	15.00%	6,512.85	78,108.31	2,586.64	80,694.95	2,323.14	427.53	17,959.98	653,706.45	12.34%
13	1985	63.7	56.86	4.39	12.96	37,857.69	9,099.49	15.00%	6,124.85	114,917.05	2,974.64	117,891.69	2,073.30	288.79	28,164.30	1,025,122.78	11.50%
14	1986	105.7	116.96	4.92	23.78	34,436.85	9,099.49	15.00%	5,678.65	213,003.26	3,420.83	216,424.10	1,850.34	240.39	44,235.00	1,610,063.32	13.44%
15	1987	159.2	303.17	5.51	55.02	30,502.89	9,099.49	15.00%	5,165.53	496,709.73	3,933.96	500,643.69	1,651.35	220.17	91,500.00	3,330,412.43	15.03%
16	1988	51.2	458.40	6.17	74.24	25,978.84	9,099.49	15.00%	4,575.43	671,043.34	4,524.05	675,567.39	1,473.76	289.94	232,950.00	8,478,902.45	7.97%
17	1989	19.7	548.70	6.92	79.31	20,776.18	9,099.49	15.00%	3,896.83	716,487.80	5,202.66	721,690.47	1,315.27	269.36	259,200.00	9,434,348.64	7.65%
18	1990	29.2	708.92	7.75	91.45	14,793.12	9,099.49	15.00%	3,116.43	826,166.95	5,983.06	832,150.01	1,173.83	281.67	302,400.00	11,006,740.08	7.56%
19	1991	18.8	842.20	8.69	96.96	7,912.60	9,099.49	15.00%	2,218.97	875,399.01	6,880.52	882,279.53	1,047.59	285.23	357,000.00	12,994,068.15	6.79%
20	1992	15.5	972.74	9.73	99.94	-	9,099.49	15.00%	1,186.89	901,532.16	7,912.60	909,444.76	934.93	291.68	399,900.00	14,555,540.21	6.25%
																Max (start)	25.00%
											TIR	37.02%	2.63%	10.74%		Averg	12.53%
											VAN	$ 56,956.71	$ 56,956.71	$ 3,955.24		Min	6.25%

Table 4

SIMULATION TESTS IN BRAZIL 1973 - 1992

CRM (CONSTANT RATE MORTGAGE) LEVEL PAYMENTS

ANNUAL PAYMENTS

Financial Margin (Spread)	1.50%
Nominal Interest Rate	15.71%
Inflation Rate	14.00%
IRR Adjusted Payment (7)	146.27%
IRR Deflated Payment (8)	1.50%
IRR Adjusted Payment in Dollars (9)	7.11%
LOAN AMOUNT (brazilian cruzeiros)	20,100.00
LOAN AMOUNT (dollars)	3,350.00
LOAN TERM	20 Years

		Anual Inflation Rate %	d $\Pi(1+\pi_i)$	e $(1+\pi)^t$	f Constant Rate Factor (CRF) d / e	1 Outstanding Balance (Principal)	2 Annual Payments	3 Effective Interest Rate	4 Interest Charged	5 Adjusted Interest (CRF) (7) - (6)	6 Amortization	7 Adjusted Annual Payments (2) x (CRF)	8 Deflated Payments (7) / (d)	9 Annual Payments (U.S. Dollars) (7) / Exch Rate	10 Official Minimun Salaries	11 Family Income (year) SMV	12 Effort Ratio (7) / (11)
	Year	π				20,100.00	(20,100.00)					(20,100.00)	(20,100.00)	(3,350.00)	Cruzeiros 1973	(42,79 SMV)	
1	1973	14	1.14	1.14	1.00	19,919.67	3,338.04	15.71%	3,157.71	3,157.71	180.33	3,338.04	2,928.11	560.07	312.0	13,352.17	25.00%
2	1974	25	1.43	1.30	1.10	19,711.00	3,338.04	15.71%	3,129.38	3,451.47	208.66	3,660.13	2,568.52	521.39	376.8	16,125.31	22.70%
3	1975	30	1.85	1.48	1.25	19,469.56	3,338.04	15.71%	3,096.60	3,932.39	241.44	4,173.84	2,253.08	491.04	532.8	22,801.40	18.31%
4	1976	38	2.56	1.69	1.51	19,190.19	3,338.04	15.71%	3,058.67	4,773.17	279.37	5,052.54	1,976.39	442.82	768.0	32,866.88	15.37%
5	1977	44	3.68	1.93	1.91	18,866.92	3,338.04	15.71%	3,014.78	6,058.89	323.26	6,382.16	1,733.67	432.10	1,106.4	47,348.85	13.48%
6	1978	38	5.08	2.19	2.31	18,492.87	3,338.04	15.71%	2,963.99	7,351.72	374.05	7,725.77	1,520.77	407.91	1,560.0	66,760.85	11.57%
7	1979	53	7.77	2.50	3.11	18,060.06	3,338.04	15.71%	2,905.23	9,935.98	432.81	10,368.79	1,334.01	281.23	2,932.0	125,476.16	8.26%
8	1980	99.7	15.52	2.85	5.44	17,559.25	3,338.04	15.71%	2,837.24	17,662.77	500.81	18,163.58	1,170.18	313.22	5,788.8	247,734.11	7.33%
9	1981	93.51	30.04	3.25	9.24	16,979.77	3,338.04	15.71%	2,758.56	30,252.40	579.48	30,831.88	1,026.47	274.23	11,928.0	510,463.73	6.04%
10	1982	100.31	60.17	3.71	16.23	16,309.25	3,338.04	15.71%	2,667.52	53,504.34	670.52	54,174.86	900.42	247.10	23,568.0	1,008,602.38	5.37%
11	1983	177.97	167.24	4.23	39.57	15,533.39	3,338.04	15.71%	2,562.18	131,320.50	775.86	132,096.36	789.84	157.57	57,120.0	2,444,474.20	5.40%
12	1984	209.12	516.99	4.82	107.31	14,635.64	3,338.04	15.71%	2,440.30	357,291.96	897.75	358,189.70	692.84	135.47	166,560.0	7,128,004.59	5.03%
13	1985	239.12	1,753.21	5.49	319.21	13,596.86	3,338.04	15.71%	2,299.26	1,064,481.33	1,038.78	1,065,520.11	607.76	123.32	600,000.0	25,677,249.95	4.15%
14	1986	59.12	2,789.70	6.26	445.54	12,394.89	3,338.04	15.71%	2,136.07	1,486,039.78	1,201.98	1,487,241.75	533.12	118.25	804,000.0	34,407,514.94	4.32%
15	1987	394.6	13,797.86	7.14	1,933.03	11,004.08	3,338.04	15.71%	1,947.24	6,451,151.04	1,390.81	6,452,541.85	467.65	111.50	3,600,000.0	154,063,499.72	4.19%
16	1988	993.28	150,849.25	8.14	18,538.11	9,394.78	3,338.04	15.71%	1,728.74	61,879,399.02	1,609.30	61,881,008.32	410.22	108.41	40,425,000.0	1,730,004,715.65	3.58%
17	1989	1863.56	2,962,015.44	9.28	319,304.36	7,532.66	3,338.04	15.71%	1,475.92	1,065,849,652.76	1,862.12	1,065,851,514.88	359.84	136.44	788,180,000.0	33,730,491,447.91	3.16%
18	1990	1585.18	49,915,291.84	10.58	4,720,046.65	5,377.99	3,338.04	15.71%	1,183.38	15,755,714,124.65	2,154.66	15,755,716,279.31	315.65	121.79	8,836,820,000.0	378,175,393,230.84	4.17%
19	1991	475.1	287,062,843.38	12.06	23,811,393.21	2,884.83	3,338.04	15.71%	844.88	79,483,439,894.85	2,493.16	79,483,442,388.01	276.89	99.97	42,000,000,000.0	1,797,407,496,780.00	4.42%
20	1992	1149.06	3,585,587,151.50	13.74	260,893,498.30	-	3,338.04	15.71%	453.21	870,873,580,879.78	2,884.83	870,873,583,764.61	242.88	94.86	522,186,940,000.0	22,347,207,635,157.30	3.90%
																Max (start)	25.00%
											TIR	146.27%	1.50%	7.11%		Averg	8.79%
											VAN	$ 20,100.00	$ 20,100.00	$ 3,350.00		Min	3.16%

Table 5

SIMULATION TESTS IN COLOMBIA 1970 - 1989

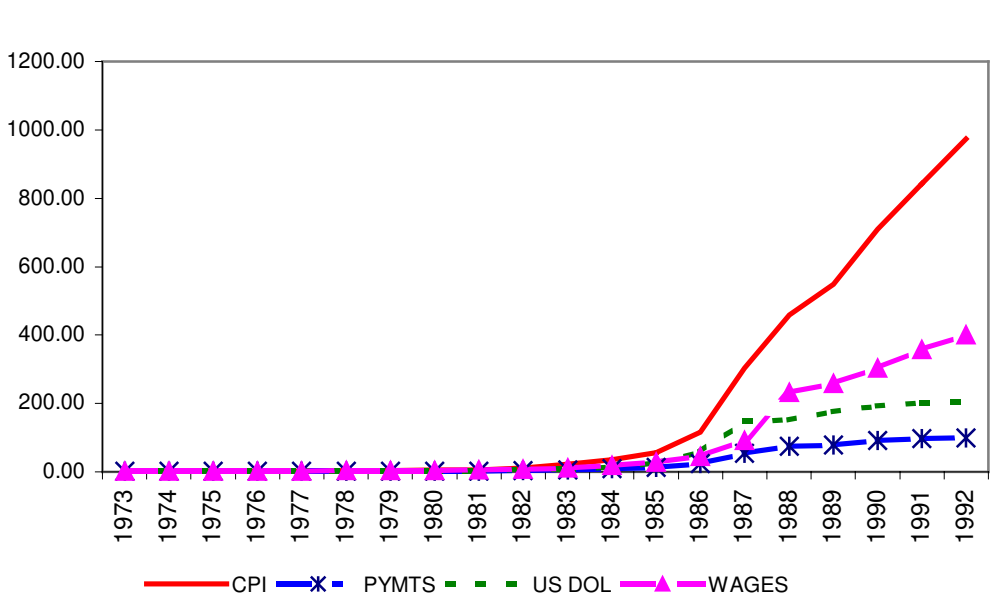
CRM (CONSTANT RATE MORTGAGE) LEVEL PAYMENTS

ANNUAL PAYMENTS

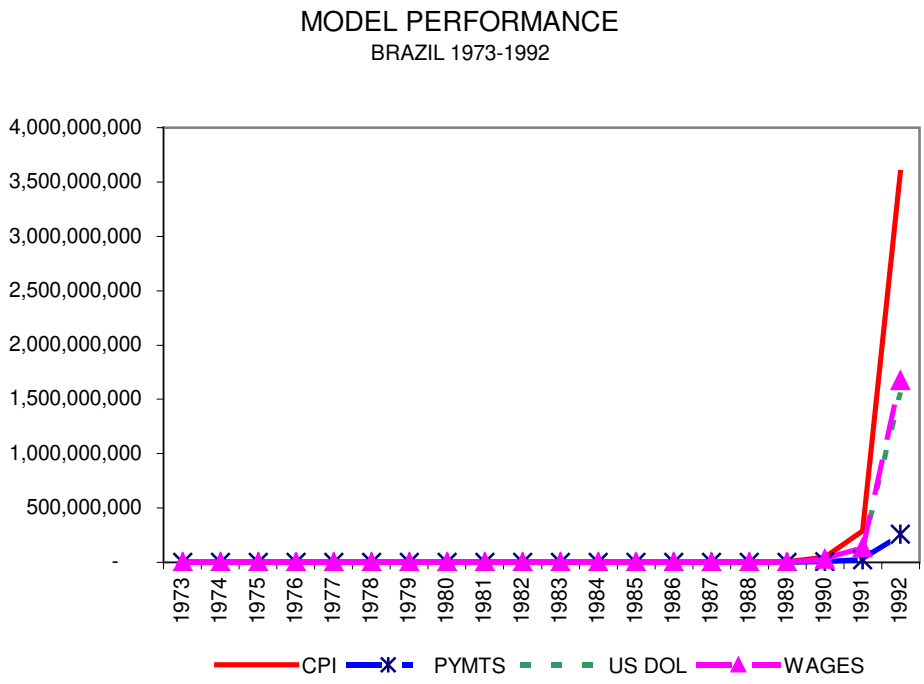
Financial Margin (Spread)	2.22%
Nominal Interest Rate	15.00%
Inflation Rate	12.50%
IRR Adjusted Payment (7)	20.93%
IRR Deflated Payment (8)	2.22%
IRR Adjusted Payment in Dollars (9)	7.62%
LOAN AMOUNT (colombian pesos)	$ 22,782.68
LOAN AMOUNT (dollars)	$ 1,193.44
LOAN TERM	20 Years

	Year	Anual Inflation Rate % π	d $\Pi(1+\pi_t)$	e $(1+\pi)^t$	f Constant Rate Factor (CRF) d / e	1 Outstanding Balance (Principal) 22,782.68	2 Annual Payments	3 Effective Interest Rate	4 Interest Charged	5 Adjusted Interest (CRF) (7) - (6)	6 Amortization	7 Adjusted Annual Payments (2) x (CRF) (22,782.68)	8 Deflated Payments (7) / (d) (22,782.68)	9 Annual Payments (U.S. Dollars) (7) / Exch Rate (1,193.44)	10 Official Minimun Salaries 1 SM	11 Family Income (year) SMV 48,53 SM	12 Effort Ratio (7) / (11)
1	1970	12.50	1.13	1.13	1.00	22,560.29	3,639.79	15.00%	3,417.40	3,417.40	222.39	3,639.79	3,235.37	191.37	300.00	14,559.18	25.00%
2	1971	5.56	1.19	1.27	0.94	22,304.54	3,639.79	15.00%	3,384.04	3,159.51	255.75	3,415.26	2,875.89	150.44	300.00	14,559.00	23.46%
3	1972	15.79	1.38	1.42	0.97	22,010.43	3,639.79	15.00%	3,345.68	3,221.02	294.11	3,515.14	2,556.34	142.07	390.00	18,926.70	18.57%
4	1973	18.18	1.63	1.60	1.01	21,672.19	3,639.79	15.00%	3,301.56	3,354.38	338.23	3,692.61	2,272.31	123.48	390.00	18,926.70	19.51%
5	1974	26.92	2.06	1.80	1.14	21,283.23	3,639.79	15.00%	3,250.83	3,776.96	388.97	4,165.92	2,019.83	118.85	690.00	33,485.70	12.44%
6	1975	21.21	2.50	2.03	1.23	20,835.92	3,639.79	15.00%	3,192.48	4,041.15	447.31	4,488.46	1,795.40	116.33	1,020.00	49,500.60	9.07%
7	1976	20.00	3.00	2.28	1.32	20,321.51	3,639.79	15.00%	3,125.39	4,273.28	514.41	4,787.69	1,595.91	113.46	1,320.00	64,059.60	7.47%
8	1977	33.33	4.00	2.57	1.56	19,729.94	3,639.79	15.00%	3,048.23	5,082.59	591.57	5,674.16	1,418.59	123.06	1,500.00	72,795.00	7.79%
9	1978	18.75	4.75	2.89	1.65	19,049.64	3,639.79	15.00%	2,959.49	5,309.08	680.30	5,989.39	1,260.97	112.13	2,310.00	112,104.30	5.34%
10	1979	25.00	5.94	3.25	1.83	18,267.29	3,639.79	15.00%	2,857.45	5,872.53	782.35	6,654.88	1,120.86	114.81	3,382.00	164,128.46	4.05%
11	1980	26.32	7.50	3.65	2.05	17,367.59	3,639.79	15.00%	2,740.09	6,572.69	899.70	7,472.39	996.32	115.06	4,567.00	221,636.51	3.37%
12	1981	27.50	9.56	4.11	2.33	16,332.93	3,639.79	15.00%	2,605.14	7,434.05	1,034.66	8,468.71	885.62	123.17	5,760.00	279,532.80	3.03%
13	1982	24.18	11.87	4.62	2.57	15,143.07	3,639.79	15.00%	2,449.94	8,158.09	1,189.86	9,347.95	787.22	120.56	7,545.00	366,158.85	2.55%
14	1983	19.47	14.19	5.20	2.73	13,774.74	3,639.79	15.00%	2,271.46	8,558.77	1,368.33	9,927.11	699.75	106.81	9,585.00	465,160.05	2.13%
15	1984	16.30	16.50	5.85	2.82	12,201.16	3,639.79	15.00%	2,066.21	8,688.84	1,573.58	10,262.42	622.00	91.93	12,533.00	608,226.49	1.69%
16	1985	24.24	20.50	6.58	3.11	10,391.54	3,639.79	15.00%	1,830.17	9,523.74	1,809.62	11,333.36	552.89	59.92	15,207.00	737,995.71	1.54%
17	1986	18.90	24.37	7.41	3.29	8,310.47	3,639.79	15.00%	1,558.73	9,897.04	2,081.06	11,978.10	491.46	44.71	18,811.00	912,897.83	1.31%
18	1987	23.08	30.00	8.33	3.60	5,917.25	3,639.79	15.00%	1,246.57	10,711.35	2,393.22	13,104.58	436.85	35.03	22,509.00	1,092,361.77	1.20%
19	1988	28.13	38.44	9.37	4.10	3,165.04	3,639.79	15.00%	887.59	12,173.03	2,752.21	14,925.24	388.31	33.09	28,037.00	1,360,635.61	1.10%
20	1989	25.85	48.37	10.55	4.59	-	3,639.79	15.00%	474.76	13,531.33	3,165.04	16,696.37	345.16	29.28	35,621.00	1,728,687.13	0.97%
																Max (start)	25.00%
											TIR	20.93%	2.22%	7.62%		Averg	7.58%
											VAN	$ 22,782.68	$ 22,782.68	$ 1,193.44		Min	0.97%

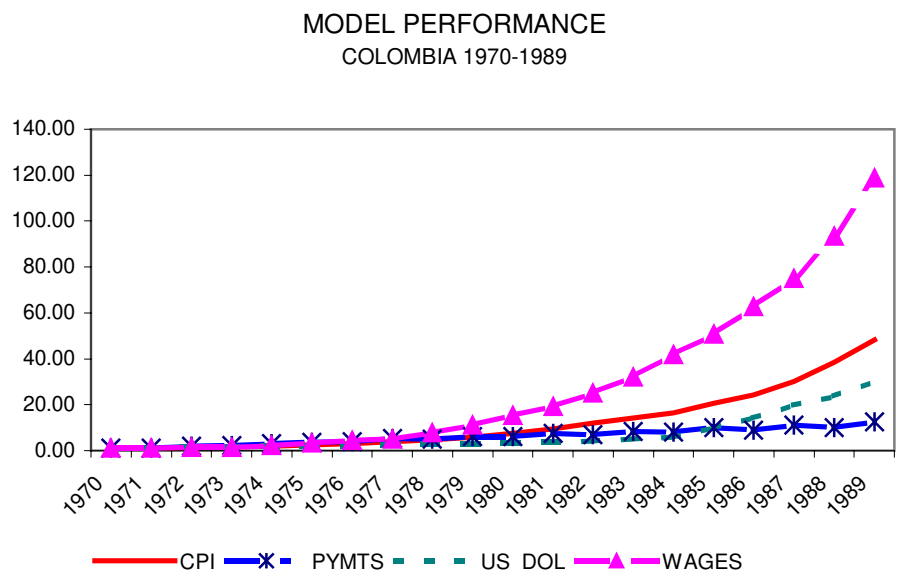
Graph 3



Graph 4



Graph 5


MODEL PERFORMANCE
COLOMBIA 1970-1989
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
CPI
PYMTS
US DOL
WAGES

Appendix 3

Graph 6