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Mortgage Design Under Inflation and Real Wage Uncertainty:
The Use of a Dual Indexed Instrument

by
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DISCUSSION PAPER

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Mortgage Design Under Inflation and Real Wage Uncertainty:
The Use of a Dual Indexed Instrument
Designing a mortgage system which protects lenders’ interests in an inflationary environment and at the same time provides continued accessibility to credit for borrowers has been a challenge during the past decade. Officials of lending institutions and agencies involved with mortgage lending have invariably developed approaches which addressed either the concerns of lenders (through indexation to inflation), or those of some borrowers (through various direct and indirect subsidies). Not much success has resulted from these approaches since they either excluded a majority of borrowers (through high initial and debt-servicing costs), or provided disincentives to lenders (with low or negative profit margins).

Instead of focusing upon the problems of lenders or borrowers separately, this paper presents a combined approach in which the effects of inflation upon lenders are addressed through indexation of payments to prices, while at the same time, borrowers have their payments tied to a wage index, with any shortfalls in real payments capitalized for later repayment. This dual indexed system safeguards the interests of both groups while it provides for continued lending activities.

The paper presents the underlying logic of a simple financial model that can examine such lending instruments. The model can also serve as an analytical tool for various officials involved in sector planning. It allows policymakers to analyse the effects of various lending policies, alternative norms and design standards, various inflation and wage prospects, interest rate issues, etc.

The proposed system would not function well in an environment of very high and/or continued precipitous declines in wages. Nor will it work effectively and sustainably unless the loan terms are set with careful attention to the risks involved. The recent implementation of this kind of instrument in Mexico, and Turkey, and the discussion of its prospective use in Ecuador suggests that the advantages and potential problems that might be associated with this type of instrument should be carefully spelled.
MORTGAGE DESIGN UNDER INFLATION AND REAL WAGE UNCERTAINTY:

THE USE OF A DUAL INDEXED INSTRUMENT

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1. INTRODUCTION

1.01 The failings of indexed mortgage systems in Argentina, Brazil, Chile, and Paraguay have made economists' claims that mortgage indexation would be an effective way to make housing more affordable while simultaneously fighting inflation appear to be naïve.1/ In recent years two of these countries introduced policies of deindexation. Chile closed down its mortgage lenders in the late 1970s and Paraguay abandoned indexed mortgage finance in 1982.2/

1.02 It is now fairly clear that designing a mortgage finance system that can deal with both the kinds of inflationary and real-side shocks experienced in many countries is much like fighting a many-headed monster. This is the case because of the inter-relations between the different aspects of housing finance, particularly the countervailing forces of sustainability of funds for the lending institution and affordability of funds for the borrower. For example, lowering the initial costs of financing so that homeownership becomes more affordable can make the system unsustainable; the real rate of return can become so low that the supply of funds mobilized to fund such "affordable" mortgages continually contracts in real terms. In this case, dealing with the affordability problem simply makes the funding sustainability problem worse.

1.03 Similarly, increasing future mortgage repayments to match increases in inflation preserves the real value of funds that are mobilized through the institution. But, unless the income of borrowers enables them to keep pace with the increases in prices, payments can become unaffordable. That is, when mortgages are tied to a price index, households cannot always continue to make the repayments promptly, particularly if real income suddenly falls sharply.

1.04 The difficulty in instrument design is that solving an inflation-related contracting problem seems to create another problem in its stead. It is not surprising therefore that the record of mortgage finance systems in developing countries experiencing high rates of inflation is not a happy one.3/ Besides the failed systems in Argentina, Brazil and Chile, a number of other countries--the Philippines, Ecuador, and until recently, Mexico and Turkey--have either virtually stopped all mortgage lending or resorted to large government transfers to sustain the supply of mortgage credit when inflation increased. In short, it appears that more often than not, the monster has won.

1/ See, for example, Milton Friedman (1974) for such a claim. On the other hand, for a prescient article on the potential problems with the forms of indexation in use in Brazil, see Fishlow (1974).


3/ Colombia is a notable exception. See Buckley and Dokeniya (1989) for a discussion of this case.
1.05 The purpose of this paper is to show that when carefully considered, it is possible in most cases to balance the needs for an affordable and sustainable means of financing housing by introducing a dual-indexed mortgage contract. This instrument indexes borrowers' ability to repay and lenders' concern with real repayment to different indexes. It then reconciles any difference in loan value implied by the different indexes by varying loan maturity. Such instruments effectively provide for the possibility of the rescheduling rather than the forgiving of real payments, if and only if such rescheduling is needed. They were recently introduced in Mexico and Turkey, (see Maydon et al. (1988) or Buckley et. al. (1989)), and in many circumstances such instruments can be highly beneficial to the economy and the financial system.

1.06 The paper demonstrates the advantages of a dual-indexed instrument through the use of a simple and accessible financial planning model (written in Lotus for personal computers). The model permits the complicated and often conjectural interactions between inflation and wage behavior to be made clear, explicit and comparable. It yields answers for "what if" kinds of questions about how workable an indexed mortgage would be if various wage, cost, and inflationary conditions were to prevail in the economy. By how much, for instance, would loan repayments be affected by rising inflation, falling wages? It allows policy-makers to consider how variations in loan terms, housing standards and rates of return will affect return and sustainability. In short, the model permits analysts to "roll their own" environment and then examine how varying loan terms will affect the viability of the contract.

1.07 In brief, then, the paper serves two broad purposes: first, to identify the important questions that need to be addressed in designing mortgage instruments under conditions of high and variable inflation and fluctuating real wages; and second, to show how a simple Lotus-based model can be used to help answer these questions. In carrying out these two objectives the analysis relies on applications of the model to Turkey. However, it also cites the experiences of other countries in Latin America that have recently considered how their mortgage finance systems should be redesigned to deal with higher levels of inflation.

1.08 The plan of the paper is as follows. The next section discusses the affordability problem of financing housing in an inflationary setting. The third section first discusses the shortcomings of credit subsidies as a means to offset the affordability problem. This is followed by a discussion of indexation as an alternative to credit subsidies. Here, the pitfalls of various indexation schemes are addressed--especially the failure of various schemes to consider the effects real wage reductions would have on the ability of borrowers to repay loans. A fourth section shows how a system of dual indexation would compare with single index instruments. It also deals with administrative issues of dual indexed mortgages, such as the importance of matching unit size with household income.\(^4\) A final section concludes.

\(^4\) The documentation for the model, including the line-by-line Lotus code required is presented in Persaud and Lipman (1989).
II. THE REPAYMENT "TILT": HOW INFLATION MAKES HOUSING UNAFFORDABLE

2.01 In discussing the affordability of mortgage finance, it is helpful to distinguish between two kinds of affordability problems. The first one is faced by the absolute poor whose resources are so low that they cannot even afford the minimum standard of shelter that is available. Their problems are most effectively addressed by improvements in the functioning of basic infrastructure supply and/or providing tenure security. The encouragement of homeownership through a more efficient housing finance system is not the most practical direct method of providing shelter for the very poor. Perhaps the central lesson of the shelter projects in developing countries is that, in a physical design sense, housing can be made affordable to most households. See World Bank (1980), (1988).

2.02 The second type of affordability problem arises because when contracts are written in nominal terms, inflation makes housing unaffordable to most families at market rates of interest. The focus here is on mortgage contracting procedures that can address this latter housing affordability problem. From this perspective, the objective for redesigning mortgage contracts is to eliminate financial constraints that impede the affordability of housing for greater numbers of lower and moderate income households. The objectives are not to produce more housing, although that outcome will often result. Rather, it is to provide a financing vehicle so that those who can afford to, and so desire, can purchase homes.

The Mortgage Contracting Problem

2.03 Over the 1934-1959 period, lenders throughout the world relied largely on fixed-rate, equal-payment mortgages.5 With these instruments, even if real interest rates remain low, expectations of increasing inflation can raise the nominal interest rates on long-term mortgage debt very quickly. In fact, even with mild inflation loan affordability will be significantly reduced, because, even though there may not be a change in the real interest rate, such mortgages "redistribute" real payments towards the early years of the loan.4 This tilting of the real repayment stream causes an increasing mismatch between real loan repayments and the income capacity of households over the life of the loan.

5/ The U.K., Canada and some former British colonies are exceptions to this description as was the U.S. prior to 1934. However, until some Latin American countries started to index loan repayments; Chile in 1959, Brazil 1964, Colombia 1972, Paraguay 1973, and Argentina 1976, fixed payment loans were the common financing vehicle in most countries.

2.04 For example, consider a household with a family income of $3,000 per year, and paying 20 percent of this initial income for mortgage payments on a 30-year fully-amortizing fixed-rate loan. In a world of zero inflation, and a 3 percent real interest rate, this payment would be sufficient to finance a loan for almost $12,000, an amount four times annual income. If inflation increases to 10 percent, nominal lending rates rise to approximately 13 percent to compensate the lender for the erosion in the value of later payments. With the same share of income the household can now afford a mortgage of only $4,500, a figure 1.5 times more than annual income. Put another way, when the inflation rate increases by 10 percent, households must more than double the initial share of income spent on mortgage repayments in order to finance the same amount of real debt. At the same time, however, the real payments required in the latter years of the loan are cut in half.

2.05 Given the scale of the increase in payment burden that occurs with only a 10 percent increase in the rate of inflation, an increase much less than the 50 percent average annual rate of inflation experienced by developing countries over the 1983-1987 period, it is obvious that under typical inflationary conditions in developing countries, financing for purchasing homes is not affordable for most families. 2/

III. ADDRESSING THE REPAYMENT TILT PROBLEM

3.01 Until the early 1980s, the mortgage repayment tilt problem was treated in one of two ways: (i) as an affordability problem that required subsidies; or (ii) as a contracting problem that could be solved by redesigning the mortgage instrument. In principle, this second approach attempts to deal with the concern of lenders by ensuring that the real value of repayments is not affected by inflation. It is discussed more fully later. But, first consider the first approach--credit subsidies--as a means to address the inflation-caused affordability problem.

A. Credit Subsidies as a Response to High Interest Rates

3.02 Most countries in the world have at one time or another used interest rate subsidies to reduce mortgage borrowing costs. Through this approach the cash-flow problems of households are solved by "re-tilting" the early payments back to what they would have been without inflation. Credit subsidies are used to "buy down" the cost of housing finance with below-market interest rates. While this practice is widespread, there are at least four problems with this approach.

3.03 First, if the objective of the subsidy is to increase housing consumption, then, because credit is at least partially fungible, subsidizing credit is less efficient than is subsidizing the housing expenditure itself. It is inefficient because, as Meltzer (1974) shows, over the long-term such a subsidy permits households to substitute subsidized credit for their own savings and, thereby, frees their savings to be used for other purchases. Hence, it allows the subsidies to be spent on activities other than those it was intended to encourage. Consequently, the efficiency of the subsidy in inducing the intended behavior is diminished.

3.04 Second, below-market credit provides a subsidy to solve what in most cases is a contracting problem. At rates of inflation lower than 25 percent a year, carefully designed mortgage indexation schemes can eliminate the cash-flow costs imposed by high nominal payments, and can do so without subsidy. While it is difficult to measure precisely how much a credit subsidy really is because of the difficulties in projecting inflation and the appropriate real interest rate, the per unit subsidy level necessary to eliminate the inflation-related tilting of repayment is certainly very large. For instance, with an inflation rate of 30 percent and a real interest rate of 8 percent, the subsidy necessary to eliminate the tilt problem is on the order of 60 to 70 percent.

3.05 For example, in Table 1 the implied subsidy rate is given for a 15-year mortgage with various assumptions about real interest rates, the expected inflation, and the nominal interest rate charged. The last column shows the subsidy rate required to get mortgage payments back to the same proportion of family income put towards payments when there is no inflation.
TABLE 1

CREDIT SUBSIDIES IMPLIED BY DIFFERENT INTEREST TERMS.

<table>
<thead>
<tr>
<th>EXPECTED INFLATION RATE</th>
<th>REAL INTEREST RATE</th>
<th>SUBSIDY RATE NEEDED TO ELIMINATE TILT</th>
</tr>
</thead>
<tbody>
<tr>
<td>15%</td>
<td>8%</td>
<td>53%</td>
</tr>
<tr>
<td>30%</td>
<td>8%</td>
<td>71%</td>
</tr>
<tr>
<td>30%</td>
<td>10%</td>
<td>68%</td>
</tr>
<tr>
<td>40%</td>
<td>8%</td>
<td>77%</td>
</tr>
<tr>
<td>30%</td>
<td>6%</td>
<td>73%</td>
</tr>
</tbody>
</table>

3.06 Third, interest rate subsidies do not really solve the repayment tilt problem by reducing the higher costs in the early years of a loan. Rather, they reduce real repayments throughout the loan's life. As a result, with a subsidy, interest payments in the later years of the loan can become trivial rather than just small. For example, instead of being required to allocate as much as 60 percent of income to repayments as could be the case with a fixed rate loan, a subsidy sufficient to reduce early payments to affordable levels would call for repayments in later years that account for 1 or 2 percent of income. Clearly this kind of subsidy mechanism gives beneficiaries larger than necessary subsidies.

3.07 The final problem with credit subsidies is that the aggregate level of subsidy needed to eliminate the effects of inflation on housing affordability is simply too large. For example, Figure 1 shows the income group for which fixed nominal payment mortgage instruments become unaffordable due to an increase in the rate of inflation.

3.08 The income distribution figures are for urban family income for Turkey for 1985. Point A represents the income level needed for buying a house that costs 2.5 times the median urban family income, if the household was able to make a 30 percent downpayment and could finance a 20 year fixed-interest rate loan with 25 percent of their income. Interest on the loan at 15 percent, reflects a 6 percent real interest rate, and the slightly less than 9 percent inflation rate that characterized the 1950-74 period in Turkey. The income needed to qualify is slightly more than the median income level, the 60th percentile.

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8/ Buckley et. al. (1989). The income levels needed to buy a house are those sufficient to amortize a loan with a given percent of income, i.e., 25 percent. Lenders could of course increase this ratio and thereby permit a means of adjusting to the cash-flow problem. In practice, however, this kind of adjustment is rarely made. One explanation for the lack of this kind of adjustment is that the increase in this ratio would increase the risk and hence the required interest rate at a faster rate.
SHARE OF TURKISH URBAN HOUSEHOLDS ABLE TO AFFORD MORTGAGE REPAYMENTS WITH DIFFERENT RATES OF INFLATION.

ANNUAL INCOME (MIL TL)

INCOME PERCENTILE

INFLATION = 30%

INFLATION = 9%
Point B, the 90th percentile, reflects the income level needed to finance a fixed interest rate loan that incorporates the higher inflation rates of more recent years. Instead of a 15 percent nominal interest rate, the appropriate nominal interest rate is 38 percent. The increase in inflation from 9 to approximately 30 percent has, in the absence of contracts that adjust for the change in the distribution of real repayments, priced homeownership beyond the ability to pay for most families. Hence, the absence of indexed mortgage contracts had priced all those between the 60th and 90 percentiles out of the housing market. If these households require the level of subsidy for a 30 percent rate of inflation described in Table 1, on the order of 73 percent, it is clear that the government expenditures needed to eliminate the tilt problem for all the families affected are enormous and not sustainable.

B. Indexed Mortgages: Indexed to Wages or Prices?

3.09 As a potential solution to the central problem facing housing finance institutions in an inflationary environment--i.e., sustaining the flow of funds, indexed mortgage contract seem promising. For lenders it is a way to preserve the real value of the repayments over the maturity of the loan. For borrowers, if indexation reduces the large payment burden in the early years of repayment, it may help prevent them from being locked out of the housing market by a cash-flow constraint. Yet, as suggested earlier, recent experience with indexed mortgage contracts in a number of countries has underscored the point that indexation is not by any means an automatic solution to housing finance problems. In order to consider the types of problems that can arise it is helpful to consider a hypothetical example in a real historical setting.

The Turkish Experience Simulated

3.10 Consider the situation of a middle-income Turkish family earning 733,000 Turkish Lira (TL), approximately US$500, per month who wants to construct and purchase a 70 square meter home. Assume (i) the house costs 230,000 TL per square meter to build for a total cost of 16,100,000 TL, (ii) a loan is provided at a 75 percent loan-to-value ratio so that the family can borrow 12,075,000 TL, (iii) inflation is running at 30 percent annually, (iv) the rate of interest charged the family is the market rate of 38 percent, that implies a real interest rate of approximately 6 percent, (v) during an 18 month construction period, no payments are made but interest is capitalized at 38 percent, and (vi) once completed, the family begins to amortize the loan, which has a beginning balance of almost 16,000,000 TL.

9/ This income figure corresponds to approximately the 60 to 70th percentile of urban households. The calculation of this household’s location in the income distribution must be viewed as a very rough approximation. However, for reference consider the following: Turkish per capita income in 1987 was US$1150 and family size 5 yielding an average household of US$5800. If urban incomes are 20 percent higher than this national figure, average urban family income is approximately US$7000 per year, US$1000 more than the annual income of our representative beneficiary.
3.11 Now, consider how the family's earnings are likely to behave. Assume the future income of the family follows the same general pattern of real wage behavior that has occurred in the past. For the examples that follow, actual historical wage data for the period 1966-1986 were taken and used in reverse chronological order. That is, because the economy in Turkey has been recently more turbulent, it was assumed that early future years would most likely mirror the recent past, and that in more remote future years conditions would revert to what they have been throughout most of Turkey's history. The data come from the wage indices for Turkish civil servants, one of the more volatile indices and therefore, a conservative choice to demonstrate the effects of indexation. The data series for recent years are shown in Figure 2.

3.12 With fixed nominal annual payments, 6,069,000 TL would be required to amortize the loan over a twenty year period. This is a large amount even for this moderate to upper-income household. In order for such a loan to be made payments would have to account for almost 70 percent of the family income in the early years of the loan before dwindling to under 10 percent in later years. Clearly few families would enter into such contracts.

3.13 One way to lower the high front-end costs is to index the monthly mortgage payments to the overall increases in prices in the economy. Thus, if the lender required the payment level to increase 30 percent each year to keep pace with inflation, the real value of the payment stream would not be eroded by inflation. The real payment stream would become identical to the nominal payment stream under conditions of no inflation. This is shown in Figure 3. Indexation shifts area ABC to the later years of the loan. However, as discussed earlier, such a solution leaves unchecked the vulnerability of the borrower to wage shocks.

3.14 For example, if payments start at 25 percent of income and are allowed to rise along with the price level at 30 percent each year while real wages follow the historical pattern, a repeat of the Turkish past would result in significant increases in the share of income devoted to repayments. The overall pattern is not terribly disruptive, with the percent of income allocated to payments rising to just over 33 percent at its highest point. But, it is worth remembering that the increase in the share of income allocated to mortgage repayments comes at the same time that real income is declining. As a result, there is an inherent difficulty with this form of indexation. Depending on the behavior of real wages, the income percentages allocated to payments could be much higher and increase at exactly the "wrong" times. It is this kind of problem that has created serious drawbacks for systems in Brazil and Argentina.

3.15 In short, mortgages that rely on price indexes can experience problems when the level of the borrowers' income does not keep pace with the general level of prices in the economy. When the burden of real mortgage repayments increases, repayment becomes more uncertain. And, when this happens, the lending institution is faced with the prospect of large numbers of defaults on its loans.

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10/ The wage data comes from various Country Economic Memoranda.
EXPENSES
REFER TO NET REAL SALARIES BY PERSONNEL

PERCENT CHANGE

ANNUAL PERCENTAGE CHANGE (TL/DAY)
TURKEY--CIVIL SERVANT SALARIES

FIGURE 2
FIGURE 3

MORTGAGE PAYMENTS FOR A HOUSE UNDER DIFFERENT INFLATION RATES.

MORTGAGE PAYMENTS/HOUSEHOLD INCOME(%) vs TIME IN YEARS

- △ INFLATION = 10%
- ★ INFLATION = 6%
- ★★ INFLATION = 3%
- ○ INFLATION = 0%
When real wages oscillate, the indexation of repayments to prices does not eliminate the tilt in the repayment stream in Figure 3. Instead it replaces the initial tilt of the real payment/income ratio with the possibility of "hills" and "valleys" in the ratio. Real payments are constant, but real income is not. Hence, there remains the possibility of sharp increases in the ratio.

3.16 Attempts to address this hills and valleys problem in the payment-to-income ratio have prompted some countries to focus their indexation schemes on wage, rather than price, indices. Typically, a fixed proportion of family income—say 25 percent—is designated for repayment of the mortgage. Each year, as wages nominally increase, so do the monthly payments. The advantage of this approach is that it protects borrowers from the sudden shocks that can occur if real incomes fall, since the portion of income devoted to repayment remains the same.

3.17 Using the same Turkish wage data and capping monthly payments at 25 percent of income, we find that real payments are sometimes higher and sometimes lower than those in the price indexation system. But, because of the cap on the amount of increase, the "hills" in the payment-to-income ratio are eliminated. Real wage reductions do not require increases in the share of income allocated to repayments. Similarly, because payments increase with wage increases the reduction in the ratio due to increasing wages is also eliminated. In the end, however, all is not sanguine with this method of indexation. While borrowers are protected under a system of wage indexation, the lender is not afforded the same protection.

3.18 Lenders' protection is reduced because, if wages fall, the amount that would have been required to preserve the real value of the payment and to match inflation is implicitly "forgiven." For the lender not to incur a loss he must realize real payment increases of sufficient size and timing to offset the losses. Depending upon the pattern of the amounts "forgiven," they can amount to a substantial subsidy on the part of the lender. In the Turkish example, the present value of this subsidy amounts to some 20 percent.

3.19 So far, two forms of indexation—one tying payments to prices, the other tying payments to wages—have been shown to be often flawed if and when real wages fall. On the one hand, indexing payments to inflation places the risk on the shoulders of the borrower whose concern is that payments can quickly become unaffordable when real wages do not keep pace with inflation. On the other hand, indexing payments to wages places the onus on the lender. The lender must take the risk that real wages will be unaffected by inflation. If they do not, the lender may recoup only a portion of the real amount lent.

C. Combining Wage and Price Indices

3.20 One way out of this quandary was recently introduced in new regulations for the Mass Housing Fund in Turkey and by the Central Bank in Mexico.\textsuperscript{11} This method involves a dual system of wage and price indexation designed to tackle

\textsuperscript{11}/ Maydon et al (1988) on the Mexican case and Buckley et. al. (1989) for a discussion of the Turkish case.
the concerns of both borrowers and lenders. Borrower concerns are addressed because loan repayments are indexed to wages so that a borrower never has to pay a portion of his income that exceeds a comfortable or commonly accepted level (about 25 percent). At the same time lenders concerns are taken care of because: (i) the loan balance is indexed to prices rather than wages, so that any portion of interest and principal due over and above a given portion of income is capitalized into the amount of the loan outstanding; and (ii) the loan maturity is variable to permit shortfalls in real repayments to be offset, or earlier real repayments to pay off the loan more rapidly.

3.21 Like instruments that rely on a wage index, with a dual index instrument real repayments are accelerated in years when incomes are rising relative to inflation, and in years when real wages fall, the loan is repaid more slowly. However, unlike a wage-indexed loan the real value of the loan is no longer uncertain. In principle, with this instrument it is the loan's maturity date rather than its value that is uncertain. In practice, the analytical question becomes one of setting an initial loan maturity schedule such that the loan terms provide for a sufficient amount of possible maturity extension that any shortfalls in real payments can be accommodated by term lengthening.

3.22 For example, if loan terms are such that: (i) in the absence of any real wage changes the loan would fully amortize in 15 years, but (ii) borrowers are told that a payment of a specific percent of their income for at the most 20 years assures full repayment of the loan, then lenders gain the possibility of 5 more years of repayments to "cushion" any losses attributable to payment reductions due to real wage declines not offsetting payment increases.12/ The cost to borrowers of this kind of arrangement is that the payments are higher because the original loan is set to amortize in 15 rather than 20 years. However, borrowers also gain from this method of indexation because real wage increases amortize the loan more rapidly, and accordingly, their loan can be paid off earlier if such gains are achieved. With systems that relied only upon wage index the value of this accelerated repayments did not accrue to borrowers. Most importantly, borrowers gain from this method of financing because the lender or the government bears the risk that even with maturity lengthening the loan may not amortize. In a sense, this arrangement is much like writing an insurance contract with deductables: borrowers are responsible for anticipated possible volatility in real wages, but they are not responsible beyond some limit.

3.23 In summary, a dual index mortgage is like wage indexation in its attempts to balance out fluctuations in real repayments over the course of the loan. However, unlike wage indexation, balance is achieved not only by smoothing

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12/ An important feature of the loan term setting is that a payment factor is selected such that: (i) the loan would fully amortize in a period less than the extended maturity period, if there are no real wage reductions, and (ii) the amount of term extension to cushion the possible real wage reductions is such that the extended loan fully amortizes after accounting for the anticipated possible real wage shocks. If these conditions are not fulfilled the loan can introduce moral hazard into the contract. That is, borrowers could be induced to take "too big" a loan because the risk of repayment at the end is not theirs.
the hills and valleys of the payment-to-income payment ratio, but also by allowing the length of the repayment period to vary. In other words, the constancy of the ratio is maintained by building in what we have termed a rescheduling cushion of sufficient length that the loan is fully repaid.

3.24 Of course it is possible that if the real wage environment is sufficiently volatile then the size of the rescheduling cushion needed to amortize the loan may become so large that the initial payments are not reduced very much relative to what they would be with a nominal interest rate loan or, loan forgiveness is necessary at the end of the loan. However, even in the relatively volatile Turkish wage environment a 5 year rescheduling cushion would have been sufficient for full repayment as long as the initial housing standards matched the household's initial income level. As the next section suggests the model can be useful in the important issue of sorting of housing standards and initial income levels.
IV. ADMINISTERING DUAL Indexed MORTGAGES: HOW A MODEL CAN HELP

4.01 A mortgage is affordable to a borrower when the borrower's payment of a reasonable percentage of its income over a fairly long period of time fully amortizes the loan. This definition generally incorporates the expectation that, although economic conditions may vary considerably, they will not become and remain unduly harsh for extended periods of time. If they do, no financial instrument will work. For example, while the Turkish real wage reductions in recent years were often precipitous, they have not been lasting, and indeed they have been accompanied by sharp increases in real per capita income.

4.02 One difference between, on one hand, a world of relatively low inflation, steady real wage growth, and fixed-rate mortgages i.e., pre 1975 and, on the other, a world of high and variable inflation, real wage shocks, and indexed mortgages; i.e., the present, is that affordability is much harder to calculate in the current environment. That is, determining the maximum amount that a household can afford to borrow is a straightforward calculation if the loan is a fixed-rate, fixed-term mortgage. And, once the maximum mortgage amount is known, calculating whether or not a unit is affordable is not very difficult. When inflation increases it may be close to impossible for most families to afford to pay off such loans, but it is not difficult to calculate this lack of affordability. By contrast, in an era of inflation and wage uncertainty, determining the maximum affordable loan, and therefore the housing unit size, is less easy because the value of repayments is contingent upon so many hard-to-predict factors. This is why the Lotus-based mortgage repayment model can be useful.

4.03 Table 2 shows how, by charting different trends in the factors affecting repayment, the model can help estimate the appropriate unit size or loan amount for different income classes. For instance, as indicated by the Table, one of the most important factors that drive affordability for a household is the real interest rate. If all other factors are held constant, except this real rate, the size of the unit affordable for a household in a given income class can vary by up to twenty square meters, and the gap is much greater across income levels.

4.04 Alternatively, an economy that is experiencing more severe volatility would require a longer period of possible rescheduling, and correspondingly, a shorter maturity for the loan to amortize if no wage reductions occur. The model can help trace through the effects of real wage volatility on initial maturity through to the size of unit that is affordable for a given income level.
TABLE 2

AFFORDABLE HOUSE SIZES IN SQUARE METERS FOR VARIOUS CONSTRUCTION PERIODS IF REAL WAGES ARE CONSTANT

<table>
<thead>
<tr>
<th>FAMILY MONTHLY INCOME (TL '000):</th>
<th>260</th>
<th>533</th>
<th>733</th>
<th>260</th>
<th>533</th>
<th>733</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 MONTHS CONSTRUCTION PERIOD, 25 PERCENT OF INCOME.</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>33 MONTHS CONSTRUCTION PERIOD, 25 PERCENT OF INCOME.</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
<tr>
<td>REAL INTEREST RATE:</td>
<td>0.04</td>
<td>0.06</td>
<td>0.08</td>
<td>0.04</td>
<td>0.06</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>40</td>
<td>30</td>
<td>30</td>
<td>80</td>
<td>70</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>70</td>
<td>60</td>
<td>100</td>
<td>90</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>&lt;30</td>
<td>&lt;30</td>
<td>30</td>
<td>50</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>70</td>
<td>60</td>
<td>100</td>
<td>90</td>
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<td>100</td>
<td>&lt;30</td>
<td>&lt;30</td>
<td>30</td>
<td>50</td>
<td>40</td>
</tr>
</tbody>
</table>

ASSUMES A 75 PERCENT LOAN TO VALUE RATIO, CONSTRUCTION COSTS OF TL 230,000 PER SQUARE METER. THE INCOME LEVELS LISTED CORRESPOND APPROXIMATELY TO THE 25TH, 50TH, AND 75TH PERCENTILES OF URBAN HOUSEHOLD INCOMES IN 1987.

4.05 Similarly, the model could be used to translate the effects of greater real wage uncertainty on the length of the rescheduling cushion and/or subsidy that would be needed to provide the financing for a housing unit of a particular size for a family of given income level.

4.06 In short, then, the model allows policy makers, lenders, and borrowers to make better informed judgements about whether or not a indexed mortgage scheme is workable in a particular economic environment, and it helps them determine how sensitive those judgements are to expectations about the future.
4.07 Early experience with dual index loans suggests that because the dual indexed mechanism is so different from traditional ones that in some countries a shift to such an instrument will require a comprehensive reorganization of the repayment collection system. The use of a new software package, and reorientation of the staff may be needed so that the underwriting requirements protect both lenders and borrowers. For example, borrowers whose real payments have been accelerated need to be told that their debt is terminated earlier. Even more importantly, loan terms need to be set so that the rescheduling period does not simply become a means of providing implicit subsidies. While there is no doubt the this system is more administratively complex, there is also no doubt that these higher administrative costs are but a fraction of the costs involved with providing either "affordable" fixed interest rate loans or partially indexed loans, and it can often be considerably less risky to use this approach than relying upon only a wage or price index instrument.
V. CONCLUSION

5.01 Mortgage indexation has been tried in a number of countries as an alternative to lowering interest rates through subsidies. Thus far, its effectiveness as a means of making mortgage finance more affordable has been mixed. However, its failings have not been the result of the naive application of an abstract economic concept to "real world problems." Nor have the failings been the inevitable consequence of "surrendering to inflation." Rather, problems have arisen for two reasons. First, under the extremely high rates of inflation that have occurred, indexation of mortgage repayments provides little help. When inflation rates exceed 50 percent, even indexed instruments simply cannot adjust fast enough to keep up with the inflation rate. Second, there have been inherent flaws in the way repayments have been implemented. Adequate attention was not paid to the effects that real wage volatility could have on loan values. Provision was not made for the kind of real wage shocks that occurred, i.e., just price indexes were used, or too much provision was allowed, i.e., just wage indexes were used. A dual-indexed mortgage contract in principle provides the kind of cushioning against these shocks that can make housing finance both affordable and in many circumstances sustainable. Moreover, a simple lotus-based model can be used to determine whether this type of instrument can be effectively implemented in a particular economic environment.

5.02 Nevertheless, the difficulties in implementing this kind of instrument should not be understated. How reliable, for example, are the wage indexes to be used? Are these indexes produced on a timely basis? How will the funding for the risk of continual real payments declines be structured? And finally, who will insure that prudential concerns are emphasized in the development of loan terms? For this kind of instrument to work and be sustainable these kinds of technical questions require equally technical rather than political answers. Otherwise, dual indexed instruments can easily become an even more circuitous way of providing credit subsidies.
REFERENCES


