HOW TO MANAGE THE MORTGAGE CREDIT RISK IN TURKEY?
CAN DUAL-INDEXED MORTGAGES BE A REMEDY?

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Abstract
A market-oriented housing finance system has been under discussion in Turkey recently. In this article we analyze different types of mortgages that have been used in developed and developing countries to select the one that is most appropriate for Turkey-one which minimizes risks for both lenders and borrowers. Each type of mortgage presents different risks to borrowers and lenders. After taking into consideration the economic history of Turkey, we conclude that the most appropriate mortgage for Turkey that minimizes risk is the dual-indexed mortgage model. We test this model by using data from the most volatile period of the Turkish economy, applying historical simulation and Monte-Carlo simulation. We find that, using this model; the total loan is paid off in a reasonable period without causing substantial difficulty for lenders and borrowers. Analyses confirm that borrowers and lenders are exposed to minimum risk if this type of mortgage is originated in Turkey.

I. Introduction

Recently, "housing finance" is one of the core issues of academic and political debates due to the enduring problem of housing in developing countries. In many developing countries, institutionalized solutions for housing finance have not been successful. Contemporary housing policies require institutional solutions. As a developing country, Turkey still has a housing problem in terms of both supply and finance. Households mostly rely on traditional ways to finance housing since institutional housing finance has not been established properly. Recently, government has drafted a law proposal to find an institutional solution to this problem. This law introduces housing mortgage system similar to the systems in developed countries. When this law goes into effect financial institutions will provide long-term mortgage loans to households who can use the proceeds to finance their housing.

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There are various types of mortgage loans. Financial institutions, which provide mortgage loans, have created different types of loans in order to attract more customers, but at the same time not to endanger their financial positions. Types of mortgage loans offered differ substantially among the countries depending on the needs and preferences of both the financial institutions and the households in each country. Economic conditions of different countries also play an important role in determining the types of mortgage loans. In this paper we will try to find a suitable type of mortgage model for Turkey-one that minimizes risks for both lenders and borrowers.

II. Types of Mortgage Loans

Mortgage loans can be classified as classical mortgages (fixed-rate mortgages), adjustable (variable) rate mortgages and indexed mortgages. The classical mortgages have fixed interest rates and the amount of periodic payments that the borrowers pay throughout the life of the loan remains constant. They can be offered without major problems in the countries, where there is a history of low inflation rates and economic stability. Classical mortgages have two significant problems with high and fluctuating inflation (Fabozzi and Modigliani, 1992). The first problem is the mismatch problem of rates on the source and the use of the funds. Mortgages are long-term loans whose maturities are usually over 20 years. On the other hand, lenders generally have to finance the loans with shorter-term funds. As explained above, interest on classical mortgages does not change throughout the life of the loans. Since the funds to finance these loans have shorter maturities (mismatch problem), the financial institutions have to refinance the funds with higher interest rates during a high inflation period. The second problem is the diminishing economic value of payments due to the inflation (tilt problem). If inflation increases, financial institutions cannot profit from these loans and there is a high risk of loss.

Adjustable (variable) rate mortgages were introduced to alleviate this problem (Brueckner, 1993; Sprecher and William, 1993). In this type of mortgages, interest rate is adjusted periodically according to the loan agreement signed by the lender and the borrower. The amount of the loan balance does not change but the amount of the periodic payments is computed based on the new interest rate. Adjustment periods depend on the economic situations of the countries involved. Interest rates can be adjusted every 2-3 years if the inflation is low and stable. On the other hand, if the inflation is high and fluctuating, interest rates can be adjusted every 3-6 months. Interest rates must be tied to a carefully selected index so that the adjustment can be acceptable to both the lender and the borrower. On the adjustment date, the interest charged is calculated by adding a certain amount (margin) to the value of the index. The margin stays constant over the life of the loan. Financial institutions in developed countries use different incentives to make adjustable rate mortgages more attractive to the borrowers (Lino, 1992). The widely used incentive is to charge lower than market interest rates initially.

Another type of mortgage loan is price-level adjusted mortgages (Peek and Wilcox, 1991). In this type of mortgages, both the outstanding debt balance and the amount

of the periodic payments are increased according to a predetermined (inflation) index. Price-level adjusted mortgages resemble adjustable rate mortgages because the amount of the payments is adjusted periodically. Price-level adjusted mortgages also resemble classical mortgages because the periodic payments and the interest rate are fixed in real terms. Although the nominal value of the periodic payments changes in accordance with the inflation, the real value of the payments remains constant. Like periodic payments, interest rate is not nominal in this type of mortgages but it is also real. Although price-level adjusted mortgages protect the lenders, they present a problem to the borrowers. The amount of periodic payments is increased in accordance with the rate of inflation, but the income of the borrowers may not increase at that rate. If the income of the borrowers does not increase as much as the inflation rate then the borrowers may experience financial difficulties and may default which creates a problem to the lenders. Dual-indexed mortgages were introduced to solve this problem.

Dual-indexed mortgage is a loan where the outstanding debt balance is adjusted according to the inflation rate and the periodic payments are adjusted according to the income increase rate (Lipscomb and Hunt, 1999). If the inflation rate is 30% and the income increase rate is 20%, periodic payments are increased by 20% and the loan balance is increased by 30%. Like price-level adjusted mortgage loans Interest charged is based on the real interest rate. In another version of dual-indexed mortgages, the periodic payments are adjusted according to the income increase rate and the interest rate is tied to the inflation. Here, the interest is the nominal interest rate and if the interest computed is greater than the periodic payment the difference is added to the loan balance (negative amortization).

The classical mortgages, which were used before the 1970s in the developed countries, were transformed into adjustable-rate mortgages after the 1970s as a result of high inflation. Adjustable-rate mortgages originated in the 1970s helped saving institutions in the United States perform better. Adjustable-rate mortgages constituted more than 60% of single-family conventional mortgages in the United States by 1984 (Madura, 1989). Some developed countries introduced price-level adjusted mortgages to eliminate inflation risk. Also, studies were conducted in the US to introduce price-level adjusted mortgages (Sloan Management School, 1974). So far, classical mortgages and adjustable-rate mortgages have been the main types of mortgage loans in developed countries. Preferences for these loans have varied in accordance with the prevailing economic conditions in countries involved.

But the situation is different for developing countries. High (even hyper) and fluctuating rates of inflation have prevailed in most of the developing countries. Because of this economic instability, the financial institutions in these countries have not preferred classical mortgages. Another problem in developing countries is to make housing affordable to low and especially moderate-income households. As explained above adjustable-rate mortgages and price-level adjusted mortgages have some pitfalls in inflationary periods. Low and moderate-income households who take out these types of mortgages may experience payment difficulties in such periods. Dual-indexed mortgages have been originated to make housing more affordable for lower and

moderate-income households. This type of mortgage loan was first introduced in Mexico in 1984 and became the major type of mortgage in Mexico by 1993 (Lipscomb and Hunt, 1999). Other than Mexico, dual-index mortgages were successfully used in Poland and Colombia.

III.   An Appropriate Mortgage Model for Turkey

Since the beginning of rapid urbanization in the 1950s, a housing problem has persisted in Turkey and this problem is still continuing. The most important part of this problem is related to finance. Housing finance is mostly based on traditional means such as self-finance and uninstitutionalized borrowing. This situation makes it hard for the low and the moderate-income households to find necessary funds to buy a house. Establishment of the Housing Development Administration (HDA) was the first step towards institutionalizing of housing finance. This was a government-subsidized agency. HDA provided loans to the housing cooperatives and charged lower than market interest rates (Alp, 2000). Due to financial constraints level of support through HDA was low and the institution could not meet increased loan demand. Interest charged was low, but the inflation rate was very high. There was a mismatch between rate of interest and inflation. As a result, Housing Development Fund became insolvent. Emlak Bank and Vakıf Bank that were state-owned banks provided price-adjusted mortgages to the households in the late 1980s. This was followed by foreign exchange denominated housing loans originated by state and privately owned banks. During the early 1990s some banks also originated adjustable-rate mortgages. But during the economic crisis of 1994, inflation and the foreign exchange rates increased drastically which caused severe payment problems for the borrowers. After the crisis, housing loans provided by the banks reduced. Government took another step and Emlak Bank (a state-owned bank) began originating Civil Servants' Wage Indexed (CSW) housing loans. This loan was designed basically for the civil servants (Erol and Patel, 1995).

But none of these attempts produced the desired results. The need to introduce market-oriented housing finance system has urged the government to draft a law aiming at establishing efficient and market-oriented housing finance system. The economic stability and reducing rate of inflation also convinced the government for this action. Now the question is "which type of mortgage loan is most suitable for Turkey?" Classical mortgages are risky for the financial institutions.

Table 3.1: Monthly Average Income of a Civil Servant, Yearly Average Income Increase and the Consumer Price Index

Year	Monthly Average Income of a Civil Servant[1]	Yearly Average Income Increase (%)	Consumer Price Index[2] (%)
1984	40.090		49,7
1985	57.754	44,1	44,2
1986	78.986	36,8	30,7
1987	113.984	44,3	55,1
1988	182.307	59,9	75,2
1989	378.090	107,4	68,8
1990	697.227	84,4	60,4
1991	1.240.704	77,9	71,1
1992	2.400.300	93,5	66,0
1993	4.072.052	69,6	71,1
1994	6.556.503	61,0	125,5
1995	12.091.709	84,4	78,9
1996	23.463.672	94,0	79,8
1997	50.759.457	116,3	99,1
1998	92.481.635	82,2	69,7
1999	159.429.000	72,4	68,8
2000	218.520.153	37,1	39,0
2001	324.738.063	48,6	68,5
2002	497.849.199	53,3	29,7
2003	618.320.348	24,2	18,4
2004	701.482.053	13,4	9,3

As can be seen from Table 3.1, inflation rates are historically volatile in Turkey. Although current inflation is relatively low, an increase in the rate of inflation endangers the financial positions of institutions, which originate this type of mortgages. For example, turbulence in emerging markets in May and June 2006 also affected the Turkish Economy where, as a result, interest rates and inflation increased. Financial institutions prefer originating adjustable-rate or price-level adjusted mortgages to alleviate the problem that stems from a possible increase in interest rate. But, adjustable-rate mortgages and price-level adjusted mortgages are risky for the borrowers. If the income of the borrowers does not increase as much as the index or the inflation rate they may not be able to make the periodic payments. When we examine the average income increases in the past we see that the average income increases sometimes lagged behind the inflation rate. Table 3.1 shows that especially during the crisis years of 1994 and 2001 inflation rate outpaced the average income increase substantially. So, dual-indexed mortgages seem to be a compromise. But dual-indexed mortgages are not risk free. The main risk of the dual-indexed mortgages for the lenders is the liquidity risk. If the inflation outpaces the income increase rate consistently the lender receives less payment that increases the liquidity risk (Lea and Bernstein, 1996). Another risk is the prolonged term of the loan. We will test whether these risks would have materialized if dual-indexed mortgages had been used in Turkey.

[1] Source: The Ministry of Finance
[2] Source: Turkish Statistical Institute.

IV. Testing Dual-Indexed Mortgages in Turkey

Historical simulation and Monte-Carlo simulation are used to test dual-indexed mortgages. First, historical simulation is applied. We have chosen the most volatile period of the Turkish economy to apply historical simulation. We applied historical simulation in three different scenarios. Down payment and percentage of income for periodic payments differ in scenarios. In historical simulation, the actual inflation and income increase rates are used, seeking an answer to the question, "when the loan would have been paid off if it had been taken out in 1984?" Basic assumptions of the model are as follows:

- mortgage loan was taken out in 1984.
- cost of dwelling unit for 75 m² housing is calculated as 3,165,750 TL in 1984.[3] 75 m² housing is the most suitable one for a low income household.
- the borrower earns the average income of a civil servant.
- the borrower spends certain amount of his/her income for payments
- real interest rate is 0.078[4].

a. Scenario-1

In this scenario the borrower makes 25% down payment (amount of loan is 2,374,312 TL) and allocates 42% of his/her income for periodic payments.

Table 4.1: Amortization Table for Scenario-1

Year	Loan Balance Before Payment	Annual Average Income	Percentage of Income for Payment	Amount of Annual Payment	Real Interest Rate	Amount of Interest Payment	Loan Balance After Payment
1984	2.374.312	481.080	0,42	202.054	0,078	185.196	2.357.455
1985	3.399.450	693.048	0,42	291.080	0,078	265.157	3.373.527
1986	4.409.199	947.832	0,42	398.089	0,078	343.918	4.355.027
1987	6.754.648	1.367.808	0,42	574.479	0,078	526.863	6.707.031
1988	11.750.718	2.187.684	0,42	918.827	0,078	916.556	11.748.447
1989	19.831.378	4.537.080	0,42	1.905.574	0,078	1.546.847	19.472.652
1990	31.234.133	8.366.724	0,42	3.514.024	0,078	2.436.262	30.156.371
1991	51.597.551	14.488.448	0,42	6.085.148	0,078	4.024.609	49.537.012
1992	82.231.440	28.803.600	0,42	12.097.512	0,078	6.414.052	76.547.981
1993	130.973.595	48.864.624	0,42	20.523.142	0,078	10.215.940	120.666.393
1994	256.536.752	78.678.036	0,42	33.044.775	0,078	20.009.867	243.501.844
1995	435.624.799	145.100.508	0,42	60.942.213	0,078	33.978.734	408.661.320
1996	734.773.053	281.564.064	0,42	118.256.907	0,078	57.312.298	673.828.445
1997	1.341.592.433	609.113.484	0,42	255.827.663	0,078	104.644.210	1.190.408.980
1998	2.020.124.039	1.109.815.620	0,42	466.122.560	0,078	157.569.675	1.711.571.153
1999	2.889.132.107	1.913.148.000	0,42	803.522.160	0,078	225.352.304	2.310.962.251
2000	3.212.237.529	2.622.241.836	0,42	1.101.341.571	0,078	250.554.527	2.361.450.486
2001	3.979.044.068	3.896.856.756	0,42	1.636.679.838	0,078	310.365.437	2.652.729.668
2002	3.440.590.379	5.974.190.388	0,42	2.509.159.963	0,078	268.366.050	1.199.796.466
2003	1.420.559.016	7.419.844.176	0,42	3.116.334.554	0,078	110.803.603	-1.584.971.935

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[3]   Unit m² cost of dwelling unit was 28,140 TL in 1984 (Turkish Statistical Institute). 25 % land share and 20 % interest rate of entrepreneurship were added to dwelling cost.
[4]   This figure was calculated according to nominal interest and inflation rates of 2004. Since 1984 real interest rates were about 0.08, 0.078 is a good approximation.

In this scenario, the loan balance is adjusted according to the inflation rate each year. Borrower spends 42% of his/her income for periodic payments each year. So the periodic payments are adjusted according to the income increase. As can be seen from Table 4.1 the loan is paid off in 20 years, which is quite reasonable.

b. Scenario-2
In this scenario the borrower makes 40% down payment (amount of loan is 1,899,450 TL) and allocates 33% of his/her income for periodic payments.

Table 4.2: Amortization Table for Scenario-2

Year	Loan Balance Before Payment	Annual Average Income	Percentage of Income for Payment	Amount of Annual Payment	Real Interest Rate	Amount of Interest Payment	Loan Balance After Payment
1984	1.899.450	481.080	0,33	158.756	0,078	148.157	1.888.851
1985	2.723.723	693.048	0,33	228.706	0,078	212.450	2.707.467
1986	3.538.660	947.832	0,33	312.785	0,078	276.015	3.501.891
1987	5.431.432	1.367.808	0,33	451.377	0,078	423.652	5.403.707
1988	9.467.295	2.187.684	0,33	721.936	0,078	738.449	9.483.809
1989	16.008.669	4.537.080	0,33	1.497.236	0,078	1.248.676	15.760.109
1990	25.279.214	8.366.724	0,33	2.761.019	0,078	1.971.779	24.489.974
1991	41.902.346	14.488.448	0,33	4.781.188	0,078	3.268.383	40.389.541
1992	67.046.638	28.803.600	0,33	9.505.188	0,078	5.229.638	62.771.088
1993	107.401.331	48.864.624	0,33	16.125.326	0,078	8.377.304	99.653.309
1994	211.862.935	78.678.036	0,33	25.963.752	0,078	16.525.309	202.424.492
1995	362.137.417	145.100.508	0,33	47.883.168	0,078	28.246.719	342.500.968
1996	615.816.740	281.564.064	0,33	92.916.141	0,078	48.033.706	570.934.305
1997	1.136.730.201	609.113.484	0,33	201.007.450	0,078	88.664.956	1.024.387.707
1998	1.738.385.938	1.109.815.620	0,33	366.239.155	0,078	135.594.103	1.507.740.887
1999	2.545.066.617	1.913.148.000	0,33	631.338.840	0,078	198.515.196	2.112.242.973
2000	2.936.017.733	2.622.241.836	0,33	865.339.806	0,078	229.009.383	2.299.687.310
2001	3.874.973.117	3.896.856.756	0,33	1.285.962.729	0,078	302.247.903	2.891.258.291
2002	3.749.962.004	5.974.190.388	0,33	1.971.482.828	0,078	292.497.036	2.070.976.212
2003	2.452.035.835	7.419.844.176	0,33	2.448.548.578	0,078	191.258.795	194.746.052
2004	375.859.880	8.417.784.636	0,33	2.777.868.930	0,078	29.317.071	-2.372.691.979

In the second scenario above, when 40% down payment is made and the borrower spends 33% of his/her income for periodic payments the loan is paid off in 21 years, which is also reasonable.

c. Scenario-3
In this scenario the borrower makes 50% down payment (amount of loan is 1,582,875 TL) and allocates 33% of his/her income for periodic payments.

Table 4.3: Amortization Table for Scenario-3

Year	Loan Balance before Payment	Annual Average Income	Percentage of Income for Payment	Amount of Annual Payment	Real Interest Rate	Amount of Interest Payment	Loan Balance After Payment
1984	1.582.875	481.080	0,33	158.756	0,078	123.464	1.547.583
1985	2.231.614	693.048	0,33	228.706	0,078	174.066	2.176.975
1986	2.845.306	947.832	0,33	312.785	0,078	221.934	2.754.455
1987	4.272.160	1.367.808	0,33	451.377	0,078	333.228	4.154.012
1988	7.277.828	2.187.684	0,33	721.936	0,078	567.671	7.123.563
1989	12.024.575	4.537.080	0,33	1.497.236	0,078	937.917	11.465.255
1990	18.390.269	8.366.724	0,33	2.761.019	0,078	1.434.441	17.063.691
1991	29.195.976	14.488.448	0,33	4.781.188	0,078	2.277.286	26.692.074
1992	44.308.843	28.803.600	0,33	9.505.188	0,078	3.456.090	38.259.744
1993	65.462.423	48.864.624	0,33	16.125.326	0,078	5.106.069	54.443.166
1994	115.746.170	78.678.036	0,33	25.963.752	0,078	9.028.201	98.810.620
1995	176.772.199	145.100.508	0,33	47.883.168	0,078	13.788.232	142.677.263
1996	256.533.718	281.564.064	0,33	92.916.141	0,078	20.009.630	183.627.207
1997	365.601.769	609.113.484	0,33	201.007.450	0,078	28.516.938	193.111.258
1998	327.709.804	1.109.815.620	0,33	366.239.155	0,078	25.561.365	-12.967.985

In the third scenario, when 50% down payment is made, total loan is paid off within 15 years with a payment rate of 33% of income.

More scenarios may be developed for this model; however, since our purpose is to test the appropriateness of the dual-indexed mortgage model for Turkey, these three scenarios seem to be sufficient. These scenarios show that if a borrower had taken out a dual-indexed mortgage in 1984, he/she could have paid it off in at most 21 years, which is a reasonable period, without constraining his/her income. Also, the lender would not have faced any difficulty because the loan balance would have been adjusted according to the inflation rate and the lender would have been repaid within a reasonable period of time.

d. Monte-Carlo Simulation

Next we used Monte-Carlo simulation. Monte-Carlo simulation differs slightly from historical simulation. In historical simulation the actual inflation and income increase rates are used. In Monte-Carlo simulation inflation and income increase rates are represented by probability distributions and values for these variables are created randomly from the distributions in each year. Values of the variables in Table 3.1 are used to fit a distribution for each variable. The most appropriate distribution to represent inflation rate is found to be Logistics (0.65, 0.14), the most appropriate distribution to represent income increase rate is found to be Normal (0.65, 0.28). We also take the correlation between these variables into account. If the correlation is not incorporated into the model, a very high inflation rate may coincide with a very low income increase rate that is unrealistic. We also take into account the autocorrelation in inflation series. If this is not done, a very high inflation in one year my follow a very low inflation in the preceding year that is also unrealistic. The correlation between inflation and income increase rate is 0.693. One lagged autocorrelation in inflation series is 0.506. Random values for the variables in each year are created from the probability distributions by paying attention to this relationship. In each iteration a value is created randomly for the variables and the year when the loan is paid off is calculated. So, different

combinations of inflation and income increase rate (of course paying attention to the relationships) are considered and a loan pay-off year is calculated for each combination. After a certain number of iterations the mean of the loan pay-off year is calculated.

We run Monte-Carlo simulation for all three scenarios discussed above. In the first scenario the number of iterations is 1500 and 1500 pay-off years are calculated. When the mean pay-off year does not change considerably, the iterations end. The minimum of these years is 2000, the maximum is 2010. The minimum is the best case; the maximum is the worst case. The mean pay-off year is 2005. So, on average this loan is paid off in 22 years. If the worst case occurs the loan is paid off in 27 years, which is less than 30 years that is a common maturity for a mortgage loan in most of the developed countries. Simulation model reveals that the probability of a pay-off year over 2008 is 5%. So, it is a remote probability that the worst case occurs. Even if it occurs the loan is still paid off in a reasonable period.

In the second scenario the minimum pay-off year is 2000, maximum pay-off year is 2010, and mean pay-off year is 2005. The probability that pay-off year exceeds 2009 is 5%. The loan is also paid off in a reasonable period in this scenario.

In the third scenario the minimum pay-off year is 1995, maximum pay-off year is 2005, and mean pay-off year is 2000. The probability that pay-off year exceeds 2004 is 5%. On average the loan is paid off in 17 years. If the worst case occurs, the loan is paid off in 22 years, which is reasonable.

V. Conclusion

In Turkey, all concerned parties have been trying to find an institutionalized and market-oriented solution to the housing finance problem. The government has drafted a new law and submitted to the parliament, which introduces the issuance of mortgage loans by the financial institutions. There are different types of mortgage loans. So, it is important to choose the one, which is suitable for both the lenders and the borrowers, taking into consideration the economic conditions and the economic history of the country. If this is not done, the borrowers and the lenders may experience difficulties. Classical mortgages may cause mismatch and tilt problems for the lenders. Adjustable-rate and price-level adjusted mortgages may cause payment problems for borrowers which then also creates a problem for the lenders. If the borrowers default, lenders have to initiate legal procedures to foreclose the mortgage to get their money. Turkey has experienced high and fluctuating inflation in the past and household income increases have sometimes lagged behind the inflation rate substantially. Although the current inflation rate is low, there is no guarantee that it will not rise in the future because there are some uncertainties stemming from domestic politics, foreign affairs, and international economics, which have an impact on inflation. Mortgage loans are long-term in their nature. So no one can give assurance that there won't be any increase in the level of inflation throughout the life of the loan. Taking all of these facts into consideration, it seems that the most suitable mortgage loan for Turkey is dual-indexed mortgage, which minimizes risk taken by borrowers and lenders. We tested the appropriateness of this mortgage for Turkey by using historical simulation and Monte-Carlo simulation. We found that the loan is totally paid off in a reasonable period without causing any trouble for borrowers and lenders.

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