Decision Making Approaches upon Home Buying versus Home Renting for Individual Households

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***Abstract*:** *One of the most important financial decisions that households encounter during their life is the decision to buy or rent a residential home for living. In this case, not only financial factors, but also cultural, social and political factors are effective. These factors tend to drive households into ownership. This is obvious that ownership is considered as a credit in most countries and this question whether you are owner or not is usually posed in questionnaires related to the credibility of individuals. On the other hand, the decision making between renting or buying has large effects on the household's financial lives. This decision also has consequences on macroeconomic factors. In this paper it is shown that how net present value of buying versus renting could be considered as the basis for decision making. Holding period, inflation rate and discount rate are among the most important factors that determine the net present value. It is obvious that reaching the breakeven point for net present value of buying versus renting depends entirely on individuals' circumstances and economic factors of the society. This model is fully adaptable to the situations of individuals.*

Keywords: *Buying versus Renting, House Price, Housing Market, Real Estate*

1. Introduction

Housing supply is one of the most important concerns of people in their lives. Nowadays, housing is not only an essential commodity, but also is a capital good for households. Investment in housing market as an inflation hedge, has functioned well and could be a viable investment. Aside from financial factors, cultural, political and personal beliefs affect decision making about buying or renting. These factors usually lead people to ownership. Buying gives households mental relaxation. On the other hand, laws also affect the tenure choice. For example, in countries where there is a lot of protection for tenants, the risk of renting is reduced, caused people to have more tendency toward renting or in countries such as US, mortgages are such that if house prices go down, banks will take the same as mortgage payment and do not ask for the rest of the mortgage, causes to increase support for owners, lead people to ownership. This study provides a mechanism for readers that households can measure the financial implications of their attitudes. This method is flexible and could be used in different situations.

The main purpose of this paper is to provide a quantitative model for financial estimation of decision making toward buying or renting. Important financial factors are linked to each other in this model and the effects of inflation rate and discount rate are examined separately by sensitivity analysis. The scope is a topic in the field of financial consultant that has been conducted in Tehran and its case study has been conducted from an apartment located in Tehran. Its time has been lasted from February 2016 to September 2017.

Many studies have been conducted both inside and outside the country on the housing market, that have focused on investment in housing section, factors affecting buying or renting and the efficiency of the housing market. The subject of housing market and its efficiency in far years has not been so much considered due to lack of micro data. About 50 years ago, following the release of such information in the world, research and investigation on this topic became strong. Some of the fundamental problems in these studies are pricing, inflation, discount rate and other uncertain factors.

Other studies also discussed the tenure choice, as far as that these researches show, none of them has investigated cumulative effects of holding period, inflation, discount rate and other factors considering mortgage payments. This method allows households to assess their financial conditions through tax rate, discount rate, holding period, etc. On the other hand, this model is not limited to one-time decision making and could be used for different conditions.

Studies show that, factors affecting investment in the housing market include households and enterprises savings, mortgage payment situations, internal rate of return on investment in the housing market, inflation rate, population and etc. (Rafiee 2003) Some factors determining rent to price ratio in Tehran include property characteristics, its location, vacancy rate, etc. Results indicate an inefficient market in Tehran. (Nafari 2012) Many households are involved with the annual fluctuations of rents. Home buying will allow households to earn an equivalent of annual cost of renting which is a cover for the risk of renting. For example, if rental cost rises, all households will experience an increase in the implicit future rental dept. In return, owners will be compensated for this rise in housing prices. On the other hand, at the time of selling and moving, owners are at risk. Because the selling is difficult and has low liquidity. So, if people live for a long term at the same home, selling risk will be very limited. The longer the horizons of households are, the higher the risk of renting and the demand for owning a home is expanded. (Sinai and Seloules 2005) However, if someone buy an apartment without a loan, then the fluctuation in the return on this asset is less than the stock market. But the fluctuation in ownership return, when it comes with debt, will be higher. (Lin and Vandel 2007) For periods over 10 years, means long-term horizon, the hypothesis that prices are changing proportionally with macroeconomic variables, seems logical. But, in short term, there are significant deviations. Also, the characteristic of inflation hedge that is created by ownership, in the short term, is more important than transaction costs, liquidity, etc. (Mizuno and Tabner 2011). The cost of transaction and liquidity risk causes in most cases, buying versus renting has higher risk. On the other hand, obtaining the benefits of renting requires individuals, invest in appropriate portfolios (Beracha and Johnson 2012).

To do this study, first thing is thinking on the target. Clearly, the purpose is that if a person faces the issue of choosing between buying or renting, regardless of cultural, political and social issues that generally lead the decision towards ownership, how could he/she make a decision to be financially right. In order to analyze this case, first thing is to examine financial factors that affect this decision. There are two ways to achieve these factors. The first way is to get help from real estate experts. Secondly, we have to search in library resources. Individuals' analyzes have effects on this decision. Finally, all quantitative factors that impact on this model have been taken into account even the cost of real estate consultants. After fully identifying the factors, the purpose is to provide a model based on the managerial finance methods. Referring to authoritative library resources in financial management field, it is obvious that for mathematical modeling, the best way is to use the net present value, internal rate of return, and financial mathematical relations. After mathematical modeling, a real case study has been conducted. Finally, a sensitivity analysis will be carried out on key factors such as discount rate and inflation rate.

Review Stage

2. Inputs and Model Developing

A complete list of model inputs and their definitions are presented here. Some model inputs have been derived from market and require some correction. For example, determining the price of apartments at the time of purchase is almost easy. Similarly, there are reliable estimates for the costs of buying and selling, including tax, discount rate on mortgages, costs of property consultants and etc. It is usually easy to determine the imputed rent. Because it can be determined by comparing it with the rent of a property that an owner would rent if he/she didn't buy. Other inputs such as discount rate, inflation rate and real growth rate need judgment, and it's difficult to determine the exact amount of them. The more difficult and challenging task is to determine the appropriate amounts for the growth rate in house price and growth rate of imputed rent. The discount rate is determined on the basis of individual situations. Suggestions for these factors are presented in the case study.\

House price at the time of tenure choice (P0): There are three major structural features of the housing market; the staggering growth of housing price, the severe periodic fluctuations and high share in the household's expenditures portfolio. Housing price, unlike inflation, do not have an increasing linear trend, but its curve has a staggering trend that fluctuates around the axis of inflation. Studies show that in the long term, the inflation rate and housing price index are roughly equal. The pattern of price changes is a very important topic in the analysis

of the housing market, as well as this pattern and the resulting shocks of it have a devastating effect on the household's effective demand, causes severe periodic fluctuations in housing production. Another topic that is worth noting as the structural feature of the housing sector is the high share of housing costs in the households' portfolio. Statistical studies indicate high share of housing. Indeed, the largest share of household income in Iran is spent on housing. Thus, the fluctuations in the price of this commodity, including housing price and rent price, have significant effects on economic aspects of life in different societies. The largest share of American households' income (about 20%) has been allocated to housing (Chetty & Szeidl 2004), which this figure goes up to 40% for urban households in Iran. (Qodosi, 2009). The point obtained in the results is that the decision making upon tenure is always independent of the house price. a

Holding period (T): The meaning of the holding period is the amount of time that we intend to live in the desired apartment. This is an important factor because during the holding period, transaction costs are eliminated. Therefore, the longer the holding period, the lower the transaction costs. In addition, during periods of rising prices, longer holding periods, ownership will result in inflation hedging. Policy makers and risk managers who work at the macro level can consider an acceptable average value as a precondition for their length of business, while it is possible at individual level, the holding period to be estimated based on personal situations, such as job and financial conditions, purposes that they have in life, etc. The purposes of living are usually formed based on the social pressures that come from family and friends, as well as the purposes that a person has for future generations about wealth transfer.

Loan -to-value (LTV): The loan to value indicates how much the buyer pays for the price of the house in cash and how much is mortgage. Someone may pay the full amount in cash, in which case the value of this term is zero

Mortgage Terms in Years (MT): This period represents the number of years of repayment of a loan. It should be noted that in Iran, the maximum mortgage term for mortgage in the form of depreciation of equal installments is 20 years.

Inflation Based on Consumer Price Index (π): This paper has been used inflation forecasts based on consumer price index, which is one of the most reliable reports. BMI has predicted that in the next 5 years, the average inflation rate in Iran will be 10%, with range of 2% change.

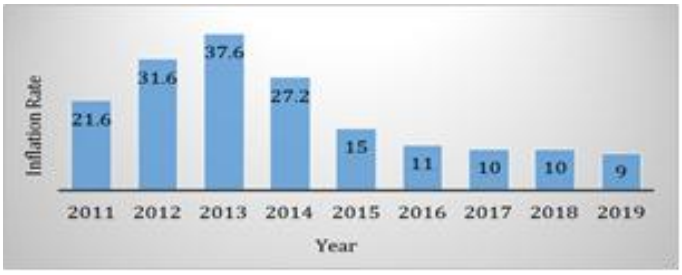

Fig 3-1. Forecasting Inflation Rate Based on Consumer Price Index (Source: BMI)

Discount rate (r_n): Discount rate is the rate to prevent a depreciation of a paid value today which is received in the future due to inflation. But Fischer believes discount rate is the percentage of remuneration paid on money, in terms of money, at a certain date, usually one year after the specified date. The discount rate is the rate of return expected by home buyers to receive a profit as a result of the cost of opportunity they have been incurred. In fact, they have not invested their capital and the relevant revenues elsewhere. (Himmelberg, Mayer and Sinai, 2005) An important point about discount rate is that this rate is determined by the ability of individuals to earn money. That is different depending on individuals. Finally, it's necessary to note that we use nominal discount rate in this model. The concept is that the inflation rate is directly related to the nominal discount rate and, as a result of an increase in inflation rate, the nominal discount rate will increase. Nominal discount rate is one of the factors that we analyze the sensitivity in this paper.

Equation (3-1)

$$r_n = r_r + \pi$$

Mortgage Interest Rate(MIR): The issue of obtaining housing mortgages is not limited to Iran, and in many countries, one of the most popular banking facilities is this kind of loans.

Real Growth Rate on House Price (GPr): Another factor that determines how to decide whether to buy or rent is the growth rate of house price. This rate, of course, has a direct relationship with inflation. In this paper, it has been tried to finally use the real annual growth rate of house price in order to do sensitivity analysis on inflation.

Equation (3-2)

$$GP_n = GP_r + \pi$$

In mature economies, the zero value for real growth rate of house price is fair. In many markets, such as the United States, Britain and Japan, real growth rate for house price are positive for long periods. (Mizuno and Tabner 2011).

Real Growth Rate on Imputed Rent (GRr): At an introductory level, the imputed rent is equal to annual rent. For house customers, the tax on imputed rent is usually zero, which will improve the competitive environment in the housing market compared to other assets. Of course there are exceptions like Switzerland. (Bourassa and Hoesli 2008). Economic experts believe that nominal growth rate on imputed rent (GRn) should not be greater than the economic growth of the region in which household individuals are working. In a mature economy, it is usually appropriate to consider the simplistic hypothesis that GRn is equal to the inflation rate, so the real growth rate GRr is zero.

Equation (3-3)

$$GR_n = GR_r + \pi$$

Real Growth Rate on Insurance Costs (GIr): The types of building insurance include fire insurance, responsibility insurance which we insure against the building fall, earthquake, flood, lightning, etc. The growth rate of insurance costs is directly related to the inflation rate. So, if the real growth rate is zero, it is equal to the inflation rate.

Equation (3-4)

$$GI_n = GI_r + \pi$$

Real Growth Rate on Maintenance Costs (GMr): The growth rate of building maintenance costs is usually proportional to the growth rate of Imputed rent. This amount includes apartment charge. In fact, this amount is paid for preventing home depreciation.

Equation (3-5)

$$GM_n = GM_r + \pi$$

Yearly Imputed Rent Factor (KIR): It is natural that a percentage of the final price of an apartment is considered as yearly imputed rent factor.

*Initial Transaction Cost Factor (Kpc)**:*** Housing transactions are accompanied by a series of additional costs, which are usually directly related to the price of the property. These costs include sales tax, property consultant fees, etc.

Transaction Cost Factor after Holding Period (KSC): At the time of sale, at the end of holding period, there is also this cost for individuals. Here, in the real case study, there is a logical amount for it.

Renovation & Furnishing Cost Factor (KF): At the beginning of holding period, it is normal to have cost of renovation and furniture. If this cost exists, it can be expressed as a percentage of the house price.

Maintenance Cost Factor of first year (Km): The cost of maintenance has also been discussed in advance about its growth rate, including the costs that is used to prevent depreciation of the building. This is also expressed as a percentage of house price.

First year Insurance Cost Factor (Ki): As it was noted, insurance costs include fire insurance, liability insurance, flood insurance, earthquake, etc. It is worth mentioning that insuring an apartment in Iran is not common, but it is necessary in some countries.

Tax on Imputed Rent (TIR): Imputed rent means the rent amount for a house which owners use which is considered the property benefit. In some countries this rent is subject to tax. But in Iran, the tax on imputed rent is always zero.

Net Present Value (NPV): As it is shown in table 3-1, calculating the net present value of buying versus renting is by using the current value calculation of all cash inflows and all cash outflows. Naturally, the higher the cash inflow, the higher the net present value. On the other hand, the higher the discount rate, the lower the net present value.

TABLE 3-1. Method for Calculating the NPV

The NPV of ownership versus renting is equal to: the present value of all property incomes minus the present value of all property cost
Present Value of All ownership benefits is equal to sum of: Present value of imputed rent Present value of expected sales prices after holding period
present value of all ownership costs is equal to sum of: Cash payment for initial purchase: The initial purchase costs of the apartment Renovation and furniture costs Present value of sales costs after the holding period Present value of maintenance costs during the holding period Present value of insurance costs during the holding period Present value of mortgage payments during the holding period, including principal and interest Present value of the outstanding principal mortgage after the holding period

The method described above is limited to one-time decision making on how to decide. In order to make good financial decisions, this method should be evaluated periodically. But due to individual circumstances and new macroeconomic conditions, its inputs should be updated. In order to manage correctly, we assume that during each holding period, the inputs of the model will remain unchanged. If there is a conscious and fundamental change in the above hypothesis, a new assessment should be initiated in such a way as to include new and revised financial decisions of households .For households that are financially limited or exposed to external variables, this model is useful in determining the margin of confidence that is needed to withstand imposed shocks. The purpose is to avoid making as many decisions as possible in the decision-making process. The NPV method for choosing the type of enterprise can be evaluated both at micro level and at macro level. At the micro level, it introduces a decision that is profitable for households and at a macro level, it could contribute to economic analysis and policy.

Present Value of Imputed Rent (PVIR): Assume initial house price is P0. As a rule, the first year imputed rent will be equal to:

Equation (3-6)

$$IR = K_{IR} \times P_0$$

This rate rises annually with the rate GRn. Therefore, if the length of the holding period is equal to T, using the formula, the present value of imputed will be:

Equation (3-7)

$$PVIR = \frac{K_{IR} \times P_0}{r_n - GR_n}\left[1 - \left(\frac{1 + GR_n}{1 + r_n}\right)^T\right]$$

And, if we want to use real growth rates and enter inflation into the equation, the present value of the imputed rent of the holding period will be equal to:

Equation (3-8)

$$PVIR = \frac{K_{IR} \times P_0}{r_n - (GR_r + \pi)}\left[1 - \left(\frac{1 + (GR_r + \pi)}{1 + r_n}\right)^T\right]$$

Present Value of Expected Sale Price (PVPT): As discussed before, house price is subject to a nominal increase every year. As a rule, after the holding period, we have to sell it and calculate the present value of the expected sales price, which will be:

Equation (3-9)

$$PVP_T = P_0 \times \left(\frac{1 + GP_n}{1 + r_n}\right)^T$$

Equation (3-10)

$$PVP_T = P_0 \times \left(\frac{1 + (GP_r + \pi)}{1 + r_n}\right)^T$$

Down Payment (DP): The initial cash payment is a function of loan to value ratio:

Equation (3-11)

$$DP = P_0 \times (1 - LTV)$$

Initial Purchase Cost (PC): As previously mentioned, the purchasing costs are proportional to the initial house price:

Equation (3-12)

$$PC = K_{PC} \times P_0$$

Renovation & Furnishing Cost (F): The cost of renovation may also be zero in some places, depending on the persons and the condition of the apartment, which will also be directly related to the initial house price:

Equation (3-13)

$$F = K_F \times P_0$$

Present Value of Selling Cost after Holding Period (PVSC): At the end of the holding period, there are some costs for selling which is expected to be proportionate to the expected sale price of the property. With regard to inflation, we can calculate the following relation to the present value of sales costs after the holding period:

Equation (3-14)

$$PVSC = K_{SC} \times P_0 \times \left(\frac{1 + GP_n}{1 + r_n}\right)^T$$

Equation (3-15)

$$PVSC = K_{SC} \times P_0 \times \left(\frac{1 + (GP_r + \pi)}{1 + r_n}\right)^T$$

Present Value of Maintenance Cost During Holding Period (PVm): if the initial price of the house is P0. As a rule, the maintenance costs of the first year will be equal to:

Equation (3-16)

$$m = K_m \times P_0$$

This maintenance cost is increased every year at GMn rate. Therefore, if the length of the holding period is T, then using the present value formula:

Equation (3-17)

$$PVm = \frac{K_m \times P_0}{r_n - GM_n}\left[1 - \left(\frac{1 + GM_n}{1 + r_n}\right)^T\right]$$

And, if we want to use real growth rate amounts and enter the inflation rate into the equation, the present value of maintenance costs of the holding period will be:

Equation (3-18)

$$PVm = \frac{K_m \times P_0}{r_n - (GM_r + \pi)}\left[1 - \left(\frac{1 + (GM_r + \pi)}{1 + r_n}\right)^T\right]$$

Present Value of Insurance Cost During holding Period (PVi): If the initial house price is P0, Typically, the cost of the first year insurance will be equal to:

Equation (3-19)

$$i = K_i \times P_0$$

This cost increases every year at GIn rate. Therefore, if the length of the holding period is equal to T, then using the present value formula:

Equation (3-20)

$$PVi = \frac{K_i \times P_0}{r_n - GI_n}\left[1 - \left(\frac{1 + GI_n}{1 + r_n}\right)^T\right]$$

And, if we want to use real growth rates and discuss the inflation, the present value of insurance costs will equal to:

Equation (3-21)

$$PVi = \frac{K_i \times P_0}{r_n - (GI_r + \pi)}\left[1 - \left(\frac{1 + (GI_r + \pi)}{1 + r_n}\right)^T\right]$$

Present Value of Mortgage Payment During Holding Period, Principal & Interest (PVMP): If the house demander receives mortgage with a MIR annual interest rate and MT repayment period, then the annual installment payment will be equal to:

Equation (3-22)

$$P_0 \times LTV = YM \times \frac{1 - \frac{1}{(1 + MIR)^{MT}}}{MIR}$$

Equation (3-23)

$$YM = \frac{P_0 \times LTV \times MIR}{1 - \frac{1}{(1 + MIR)^{MT}}}$$

And the present value of the mortgage payments during the holding period will be equal to:

Equation (3-24)

$$PVMP = P_0 \times LTV \times \frac{MIR}{r_n} \times \frac{1 - \frac{1}{(1 + r_n)^T}}{1 - \frac{1}{(1 + MIR)^{MT}}}$$

With the same calculations, the present value of the principal repayment and interest on the loan can be calculated separately, although only the sum of these two terms has been used in this model.

Equation (3-25)

$$PVMPP = \frac{P_0 \times LTV \times MIR}{r_n - MIR} \times \left[\frac{1 - \left(\frac{1 + MIR}{1 + r_n}\right)^T}{1 - \frac{1}{(1 + MIR)^{MT}}} + \left(\frac{1 + MIR}{1 + r_n}\right)^T - 1\right]$$

Equation (3-26)

$$PVMIP = PVMP - PVMPP$$

The purpose of choosing annual payments in this example is to simplify calculations and methodologies. Typically, turning it from annual to monthly in real life is a tangible work. Whether monthly and continuous status, or yearly and intervals used, the results that have been reported here will not change. However, when this model is used in practice, the choice of the period should be similar to that of the households, otherwise the difference is so important that it can change the decision.

The next point is that this method is only effective when the discount rate is not exactly equal to the mortgage interest rate. In fact, a small amount of 1×10^{-9} in such cases is effective. It is obvious to ensure that discount rate is not exactly equal to the interest rate of mortgages.

Present Value of Mortgage Principal outstanding at the end of the Holding Period(PVMPT): As previously calculated, the annual payment is equal to:

Equation (3-27)

$$YM = \frac{P_0 \times LTV \times MIR}{1 - \frac{1}{(1 + MIR)^{MT}}}$$

Which is equal in all years. In the first year, the amount of interest paid equals:

Equation (3-28)

$$\frac{P_0 \times LTV \times MIR}{1-\frac{1}{(1+MIR)^{MT}}} - P_0 \times LTV \times MIR = P_0 \times LTV \times MIR \times \left(\frac{1}{1-(1+MIR)^{MT}}\right)$$

The principal of repayment on a mortgage increases with mortgage interest rates in each period. Therefore, the sum of principal payments during the T year of the holding period is a geometric progression and is equal to:

Equation (3-29)

$$P_0 \times LTV \times MIR \times \left(\frac{1}{1-(1+MIR)^{MT}}\right) \times \frac{(1+MIR)^T - 1}{MIR}$$

Therefore, if we calculate the principal of the unpaid loan and calculate its present value:

Equation (3-30)

$$PVMP_T = \frac{P_0 \times LTV}{(1+r_n)^T} - \frac{P_0 \times LTV \times [(1+MIR)^T - 1]}{(1+r_n)^T \times [(1+MIR)^{MT} - 1]}$$

Finally, the NPV of the buying versus renting is calculated from the following equation:

Equation (3-31)

$$NPV = [PVIR + PVP_T] - [DP + PC + F + PVSC + PVm + PVi + PVMP + TIR + PVMP_T]$$

It should be noted that the Capital Gain Tax is assumed to be zero. By entering the values of the real growth rate and the inflation rate, we will find the following equation:

Equation (3-33)

$$\begin{aligned}\frac{NPV}{P_0} = {} & \frac{K_{IR}}{r_n - (GR_r + \pi)}\left[1 - \left(\frac{1+(GR_r+\pi)}{1+r_n}\right)^T\right] + \left(\frac{1+(GP_r+\pi)}{1+r_n}\right)^T - (1-LTV) - K_{PC} - K_F \\ & - K_{sc} \times \left(\frac{1+(GP_r+\pi)}{1+r_n}\right)^T - \frac{K_m}{r_n - (GM_r+\pi)}\left[1 - \left(\frac{1+(GM_r+\pi)}{1+r_n}\right)^T\right] \\ & - \frac{K_i}{r_n - (GI_r+\pi)}\left[1 - \left(\frac{1+(GI_r+\pi)}{1+r_n}\right)^T\right] - TIR - LTV \times \frac{MIR}{r_n} \times \frac{1-\frac{1}{(1+r_n)^T}}{1-\frac{1}{(1+MIR)^{MT}}} \\ & - \frac{LTV}{(1+r_n)^T} + \frac{LTV \times [(1+MIR)^T - 1]}{(1+r_n)^T \times [(1+MIR)^{MT} - 1]}\end{aligned}$$

Summary: The application of the above process has been shown in Table 3-2 to households for decision-making, in summarized 11 steps. Table 3-3 also includes 5 steps from the process summary. Policy makers and professional investors who might be willing to provide a loan-to-value ratio may require financial institutions to protect more capital. Investors may use a similar analysis to judge whether investment is beneficial in providing mortgages, banks, or similar assets or not. Similarly, risk managers in banks may use a similar analysis to decide on a loan. The important point about the above model is seen that the positive or negative net present value is independent of the house price.

TABLE 3-2. Micro Analysis for Households

Step	activity
1	Determine the properties of the desired house.
2	Determine an expected holding period with a logical domain of error.
3	Determine the cost of buying and the cost of renting a home. Calculate the imputed rent.
4	Identify the economic constraints of households, such as income and purchasing power..
5	Identify types of attitude towards risk and adjust the extent of risk to the household's economic ability.
6	Assess the degree of immunity against investment inflow.
7	Calculate housing costs inflation for households.
8	Consider the inflation and the ability of the household and set an appropriate discount rate.
9	Calculate NPV of buying versus renting using the process in the previous section.
10	If the NPV derived from the above calculation was not acceptable or not economical, it would be advisable to rent the property.
11	If the NPV is an acceptable and economical amount, do the calculations again, with the assumptions that are likely to occur. For example, higher interest rates, shorter holding period, more inflation. In this scenario with low probability, even if financial purchasing power and the risk-taking of households are still unacceptable, it is suggested that the household rent a house.

TABLE 3-3. A Macro Analysis for Policy Makers And Investors

Step	activity
1	Identify a household demographic section that is an important topic.
2	Determine the best available market information on the average price, rental, expected inflation, mortgage interest rate, loan to value ratio, income, and holding period.
3	Put this information for each section of the market separately in the model so that for those sections, the information is available, and calculate the interest rate that comes from the current market information. Is this value probable, depending on the ratio of the loan to the value and the revenue of the investigated department?
4	Finally, determine the discount rate that represents the risk of this segment of the market. Then calculate the net present value using market interest rates and market information. Is the expected value probable or not?
5	If the amounts received from sections three and four are likely, do your calculations with different values and decisions due to market conditions so that inputs are within a reasonable range. In this different scenario, which of these sectors involved in the market are in difficulty and in difficult situations? Households? Banks... ?

Case Study: A complete list of model inputs and their related explanations, as well as some numerical values have been obtained from an example in the market, has been presented in Table 3-4. Some model inputs have been derived from the market. The right column shows the values that have been considered for our calculations. These hypotheses have been considered in the sensitivity analysis as follows.

Features of the apartment: 107 m. Residential apartment in the 2nd district of Tehran, Iran. new building, 2nd floor consists of 2 bedrooms, elevator, 1 parking lot and a storage room with an acceptable architectural plan.

TABLE 3-4. List of Factors, Their Values And Definitions In Case Study

row	sign	Definition and explanation	amount
1	P_0	Apartment price at the time of decision making	750000000T
2	T	Holding period; after this period, owner intends to sell the apartment.	5 years
3	LTV	Loan to value ratio	40 %
4	MT	Mortgage repayment period in years	15 years
5	r_n	Nominal interest rate that reflects the opportunity cost when buying a property. The opportunity cost is due to the return that the customer could lease and to invest his /her money in the capital market with the same risk.	25 %
6	π	Inflation rate based on the consumer price index to convert nominal growth rates to real growth rates. As stated above, based on BMI forecast, the average inflation rate in the next 5 years is 10% and with a range of 2%.	10 %
7	MIR	Mortgage interest rate which is paid during the holding period. This amount is zero for buyers who pay the full amount in cash. In this case, the buyer is able to receive a loan of 300 million Tomans at a rate of 18% with a 15-year repayment period.	18 %
8	GP_r	Real annual growth rate in house price which has been dropped to zero in recent years in Iran. But according to a buyer's researches and forecast, this rate will reach an average of 8% in future years.	8 %
9	GR_r	Real annual growth rate of imputed rent which is zero for this study.	0
10	GI_r	Real annual growth rate of insurance costs. The annual cost of building insurance is a percentage of the property price.	0
11	GM_r	Annual growth rate of maintenance costs. The average annual maintenance costs required to eliminate depreciation which is expressed as a percentage of apartment price.	0
12	K_{IR}	Imputed rent factor. This amount will be saved by the owner during the holding period. The amount is one fifth of apartment price for this case.	6 %
13	K_{PC}	Purchase cost factor for initial transaction. The purchase costs, include cost of transactions, legal fees, consultant fees, transfer taxes etc. It is expressed as a percentage of the apartment price. For this case study the rough amount is 4 million Tomans.	0.5 %
14	K_F	Renovation and furniture costs which occurs at purchase time. The apartment here is new. So there is no renovation cost. On the other hand, the buyer uses previous furniture. So this value is zero. Otherwise, it's a percentage of P_0.	0
15	K_{SC}	Selling cost factor after holding period. Sales costs include transaction costs, legal costs, consultant costs, taxes etc.	5 %
16	K_m	First year maintenance cost factor	0.5 %
17	K_i	First year insurance cost factor. The buyer does not intend to insure his/her property in this case.	0
18	TIR	Tax on imputed rent. This value is zero in many countries. But in some countries such as Switzerland, it's not zero.	0

TABLE 3-5. Calculating All Affecting Terms

NPV of ownership is equal to PV of all apartment benefits minus PV of all apartment costs	
PV of all apartment benefits is the sum of the following terms: (All amounts are in Tomans)	
Present value of imputed rent	141680000
Present value of expected sales prices after holding period	562239000
PV of all apartment costs is the sum of the following terms:	
Cash payment for initial purchase	(450000000)
The initial purchase costs of the apartment	(3750000)
Renovation and furniture costs	0
Present value of sales costs after the holding period	(28112000)
Present value of maintenance costs during the holding period	(11807000)
Present value of insurance costs during the holding period	0
Present value of mortgage payments during the holding period, principal and interest	(158455000)
Tax on imputed rent	0
Present value of the outstanding principal mortgage after the holding period	(86768000)
NPV of ownership versus renting	(34973000)

Sensitivity analysis on inflation rate: By placing all amounts of table 3-4 except inflation rate, we can draw the NPV diagram versus holding period for different inflation rates. In this analysis, it is assumed that the NPV is in million Tomans.

Equation (3-34)

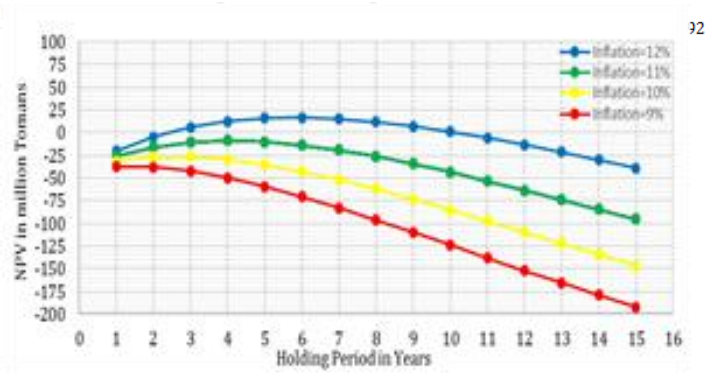

Fig 3-2. The NPV of ownership vs renting for different inflation rates and data in table 3-4

Sensitivity analysis on discount rate: By placing all amounts of table 3-4 except discount rates, it is possible to graph NPV versus holding period for different discount rates. In this analysis, the amount of NPV is in million Tomans.

Equation (3-35)

$$\frac{NPV}{P_0} = 0.98645\left(\frac{1.18}{1+r_n}\right)^T - \frac{0.055}{r_n - 0.1}\times\left(\frac{1.1}{1+r_n}\right)^T + \left(\frac{0.07856}{r_n} - 0.43645\right)\left(\frac{1}{1+r_n}\right)^T + \left(\frac{0.055}{r_n - 0.1} - \frac{0.07856}{r_n} - 0.605\right)$$

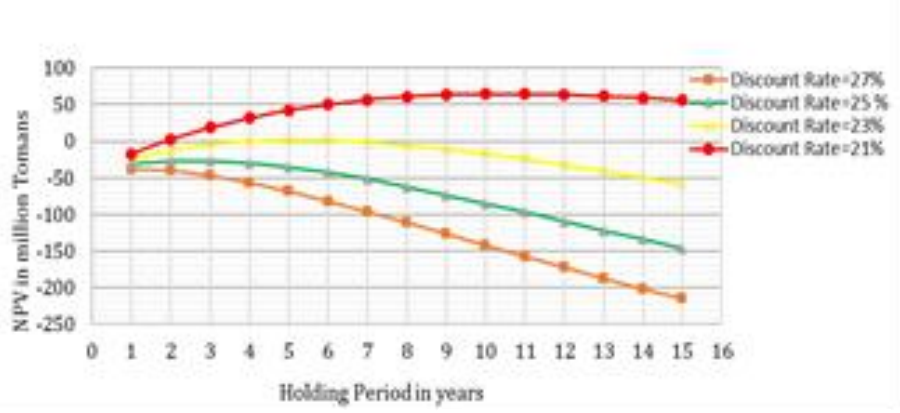

Fig 3-2. The NPV of ownership vs renting for different inflation rates and data in table 3-4

Obtaining Internal Rate of Internal Return: Considering the data in table 3-4, if we want to calculate the internal rate of return, we can use the equation (3-35) and solve the equation for T=5 and NPV=0 using MATLAB software. The internal rate of return reach zero at 23 % of discount rate. At this point there is not

financial difference between buying or renting. The lower the interest rate, the higher the NPV. Therefore, the applicant must choose a renting for interest rates lower than this amount but ownership for amounts above 23 %. Clearly, in this method, the degree of superiority of these two options is not clear in relation to each other, and in contrast to the previous method, it responds in relative terms to us. The above relationship diagram, for a 5-years holding period, will be as follows

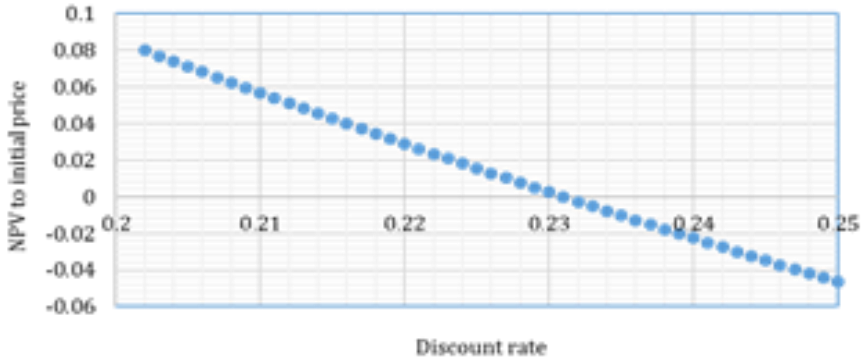

Fig 3-4. The NPV to initial price versus discount rate for data in table 3-4

Also, by taking into account the data in Table 3-4, and having a five-year holding period, we can figure NPV to initial price versus inflation rate as:

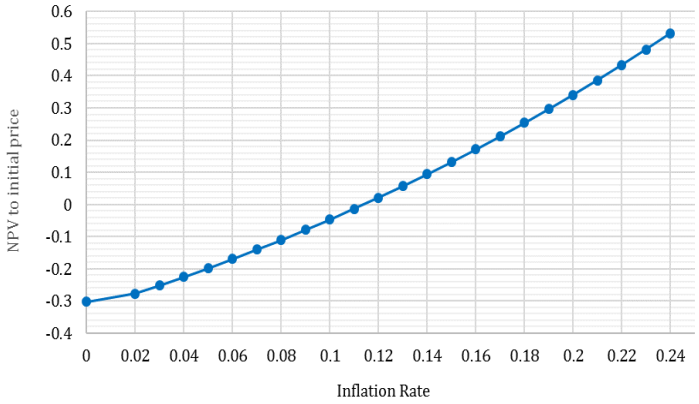

Fig 3-5. The NPV to initial price versus inflation rate for data in table 3-4

3. Conclusion

Figures 3-2 and 3-3 show the NPV calculated by the method described in this paper versus holding periods for the apartment with market price of 750 million Tomans. Various diagrams represent changes in the relationship between key inputs of the model and show how changes in these variables over holding period affect the NPV. These diagrams show that usually NPV varies with a nonlinear pattern versus holding period. This change is positive in some places and in some places is negative, which is clearly obvious in diagrams. The way in which this relationship is and how it grows depends on the financial situation, inflation, imputed rent, interest rates, and other factors.

In figure 3-2, inflation changes in each diagram. Showing diagrams in this way allows us to directly see the relationship between inflation and holding period in determining NPV. The hedging characteristic of ownership against inflation, is obvious in diagrams. (Sinai & Souleles 2005) The next point is that many attempts have been made to adapt this model to different financial conditions. But in recognizing that, it is not always possible to predict all probabilities. For example, the opportunity to buy a housing below the market price may reduce the amount invested by a seller who is under pressure or from a generous family, but it is unlikely to reduce the price of a home sale. If a house is sold at market price, the real rate of increase in the value

of expected capital over the holding period will be higher. Subsequently, if a customer is worried about lack of job security and the risk that his/her real income may decrease in the future, it is more appropriate to consider higher interest rates. Also, it is important to emphasize that the focus of this approach is entirely on the financial aspects of tenure choice. Therefore, if a customer has sufficient financial resources and believes that the non-financial benefits of ownership are high enough, he/she may choose ownership. Because it gives him /her more satisfaction. This analysis simply introduces a tool by which an applicant can see the financial consequences of his decision.

In this paper, factors affecting the decision making of residential buildings have been investigated. These factors were linked to financial models such as net present value and internal rate of return, and then sensitivity analysis was conducted on two important factors; inflation and interest rates. The results indicated that with the assumption of other factors being constant, the net present value of buying versus renting would be reduced by raising interest rates, and a breakeven NPV amount was obtained for a certain amount of interest rate which is internal rate of return. At this point, there is no financial difference between buying or renting. When an applicant can earn more by investing in other sectors, it is clear that financial advisers direct him/her to renting. On the other hand, by examining the inflation rate, it was found that the inflation rate and NPV are directly proportional which is the hedging characteristics of inflation. Rising in inflation will increase the NPV, lead the applicants to ownership. This model is completely flexible and could be used in different countries and different individual circumstances. Using the internal rate of return also allows us to achieve a zero value for the NPV. That is, the applicant will estimate the discount rate at which there is no difference between renting and buying. The model shows that obtaining internal rate of return is independent of the house price.

Using probable assumptions, this paper demonstrates how the NPV varies over time. If there is a relatively high inflation and holding period over 4 years lead individuals to buying. This conclusion is accurate which means ownership is a hedge against inflation. (Sinai and Souleles, 2005) Decrease in inflation, on the other hand, pushes the balance towards rent. In the borderline, the difference between households' risk aversion and their tax rates will result in different capital costs, and therefore different answers will be given to the question of renting or buying. However, when macroeconomic conditions result from the NPV value for households at aggregate levels, it indicates the transfer of wealth from tenants and lenders to owners during the inflationary period, and vice versa.

Conducting this study will pave the way for further studies and the introduction of a new ideas. For example, in later studies, the effect of social indexes on the financial factors affecting this type of decision-making, such as inflation and interest rates, can be examined. An implicit and fascinating theory but challenging is to consider a multi-period structure with a random interest rate and inflation. Examining such a method is much more useful than simple methods, and communicating with households that are not financially complicated about their profitability may be a challenge for the future studies. Needed policy recommendations such as the optimal amount of purchase and sale taxes and the strengthening of the information system will be prevailed in the absence of the Iranian housing market. Increasing transaction costs, including taxes and sales, reduces the possibility of interest on some transactions and leads to a recovery in the capital market. This model can be used as an application for operating systems such as android and i.o.s and can provide advice to individuals. The program should be fully flexible and can be used for mortgage payments and other scenarios. To write this application, COMFAR software and solving similar problems with the help of that can be useful.

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