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Does a Rise in Mortgage Interest Rate Necessarily Increase the Burden of Buying a House?

Ben David Evyatar[1], Ben David Nissim[2]* and Sabbah-Amar Anne[3]

[1]Department of Economics, Tel Aviv University, Israel
[2]Department of Economics and Management, Emek Yezreel Academic College, Israel
[3]Department of Management (Finance), Aix-Marseille University, France

Abstract

In this paper, we demonstrate that although the housing price and house price-to-income ratio can undergo a very large rise, the burden of repaying a mortgage might decrease due to a reduction in the interest rate. In order to check if burden on house buyers increases or decreases, we suggest calculating and depicting "equal repayment curves". These curves represent a borrower's equal periodical repayment given that house prices and mortgage interest rates vary. The curves enable us to compare the burden of buying a house during a certain time period compared to a bench mark point in time. Using Israeli data, we calculated a house price indexed to income and showed that although nominal house prices during the period 2003:1-2011:4 increased by more than 66%, the burden on house buyers did not increase. These results contradict the idea held by many that reducing the interest rate necessarily makes buyers worse off due to increased house price-to-income ratio.

Keywords: Mortgage; Interest rate; Housing price; JEL classification code: R210

Introduction

Most people who consider buying an apartment use a mortgage in order to finance a large part of the purchase. The size of the mortgage is limited by the buyer's repayment capability which is directly connected to income and the mortgage interest rate. It is not surprising that some authors only consider disposable income and interest rates as the real price drivers of housing prices [1,2], while others add more explanatory determinants such as housing stock supply [3], population growth [4] and stock market and real credit [5,6].

The measure of income elasticity on housing expenditure is often of considerable interest to applied researchers and policy makers in real estate economics. Several researchers [7-11] showed that the income elasticity for home owners is high and can range anywhere between 0.5 and 2.8. This variation should not be viewed as an anomaly since income elasticity can vary across regions, socioeconomic factors, and estimation techniques.

The strong relation between interest rates and housing prices has been mentioned by many researchers. For example, Anna J Schwartz [12] states that it has become a cliché to refer to the asset boom as a mania. The cliché, however, obscures why ordinary people become avid buyers of whatever has become the target of their desire. An asset boom is propagated by an expansive monetary policy that lowers interest rates and induces borrowing beyond prudent bounds to acquire the asset. John Taylor [13] argues that the Federal Reserve held the federal fund rate too low for too long during the critical years of 2002 through 2005, a period of time that coincides roughly with the most rapid inflation in housing prices. Shiller [14] recognizes that the period of very low federal fund rates coincided with the most rapid rise in housing price. Barth [15] suggests the mechanism through which the drastic cut in the federal funds rate can be linked to the housing price bubble.

The amount lent by a mortgage institution to an individual is critically dependent on current disposable income and interest rates. This amount largely depends on the fraction of income that goes to mortgage repayments and the duration of the mortgage using a standard annuity formula. Ultimately, this value should be an important determinant of housing demand.

The question we raise in this paper is whether increasing the interest rate necessarily makes the buyers worse off and whether reducing the interest rate makes them better off.

Two factors should be taken in consideration regarding the effect of interest rates on housing buyers: the first is that an increased interest rate has a negative effect on housing prices and the second is that increased an interest rate increases the repayment of a mortgage. These two effects have contradictory effects on the burden of repaying the mortgage.

In order to clarify the above ideas, let assume that two similar houses are offered for sale and that purchasing both of them can be fully financed by taking a mortgage. Let us also assume that one of the houses is immediately sold while the other is sold later on, only after the interest rate increased. Assuming that the effect of the interest increase on the housing price was fully absorbed, the house price is reduced. The buyer of this house would take a lower mortgage, but would pay a higher interest rate. The question is whether the mortgage repayment for the second house is higher or lower than that of the buyer of the first house.

A common way to examine if the burden of buying a house increases or decreases is to check the ratio of an average house price to an average monthly income, an index that gives the number of months of income (totally dedicated to buying a house) needed to finance the purchase (see Friggit [16,17] for example).

Himmelberg et al. [18] claim that in the US, the ratios used to investigate house price overvaluation are the price/rent ratios which increased, between 1995 and 2004, to a level above its long-term average.

Tsai et al. [19] claim that "theoretically, household income and house price should be integrated in the long run, since effective demand for housing depends on household income. Although speculative demand can also influence the fluctuation of housing markets, the effect should not be permanent. Hence, any variations in housing affordability will be temporary. In other words, house price-to-income ratio (PIR) is a stationary variable". This attitude might be misleading since it ignores the changes in mortgage interest rates. In order to demonstrate this, in Table 1 we present the average house price, average wage and the number of months worked needed to finance buying a house in Israel in the first quarter of 1995 and the 4th quarter of 2011.

As we can see the burden of buying a house increased dramatically from 99.1 months in 1995:1 to 128.6 months in 2011:4. As mentioned before, the results presented in Table 1 can be very misleading since they ignore the drastic changes in interest rate during this period of time [20]. In order to take in consideration the changes in interest rate, we used the data of housing prices and interest rates in Israel for the period 1995:1-2011:4 and calculated the monthly mortgage paid by an agent who purchased a house in each of these quarters, assuming that the agent fully financed the buying by a mortgage and took a Spicer loan for 20 years. For each year, dividing the monthly mortgage payment by the monthly average wage we get the share dedicated to mortgage repayment in Figure 1.

As we can see, the ratio fluctuates around a certain mean, but does not show a large deviation from the mean (See Appendix A for the data used in Figure 1).

The Model

Demand for housing and equal repayment curves

Let us define:

PV-mortgage size

T-duration of repayment

i-periodic mortgage interest rate

PMT - mortgage repayment

Mortgage standard annuity formula calculates the repayment according to the Spicer formula:

$$PMT = PV \frac{i}{1-(\frac{1}{1+i})^T} \qquad (1)$$

Let us consider two consumers: the first can dedicate 1,000 dollars each month to mortgage repayment while the second can dedicate 2,000 dollars.

Let us extract, for a Spicer loan taken for 240 months, the pairs of loan size and interest that are accompanied by a constant monthly repayment of 1,000 dollars and in the same manner the pairs of loan size and interest that are accompanied by a constant monthly repayment of 2,000 dollars.

Table 2 presents, for a given fix amount of periodic repayment (PMT), pairs of interest rate (i) and loan size (PV), assuming that the duration of repayment is fixed and equal to 240 months.

As we can see, the loan size (PV) is reduced as the interest rate is higher.

Figure 2 presents equal repayment curves for monthly repayment of 1,000 and 2,000 dollars.

Notice that for a given exogenously determined interest rate, and a given repayment capability of the borrower, the curve defines the higher amount the household can offer to pay for the house.

Each equal repayment curve can represent the demand curve for housing of households with a certain level of income that determines the available amount allocated for mortgage repayment.

Is a rise in house prices a burden on buyers?

According to empirical evidence, the price of a house is negatively connected to the interest rate.

Figures 3 and 4 present the connection between interest rates and average house prices in Israel for the period 1995:1-2011:4.

We can see a clear negative connection.

The question we should ask ourselves is whether a rise in housing prices increases the nominal burden on house buyers. In order to answer the question, we should combine Figure 2 with Figure 3. If we compare the buyer's situation in 2003.1, a period with the highest interest rate during the sample period, to his/her situation in other periods, there are 2 possible states:

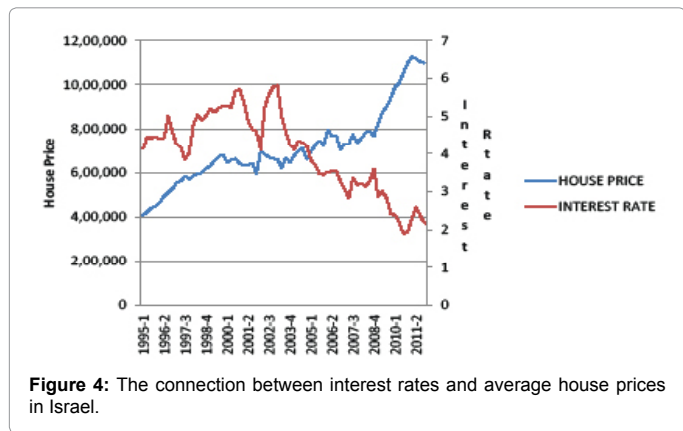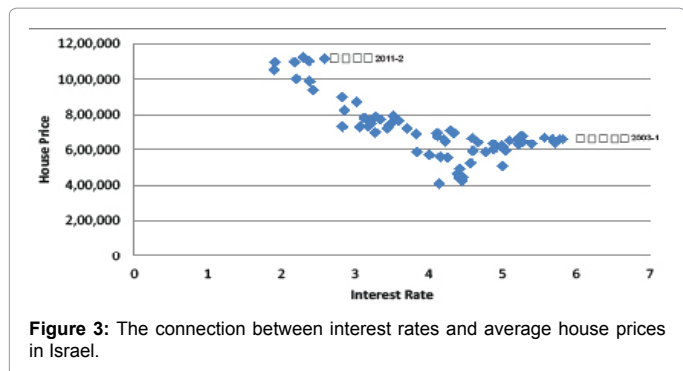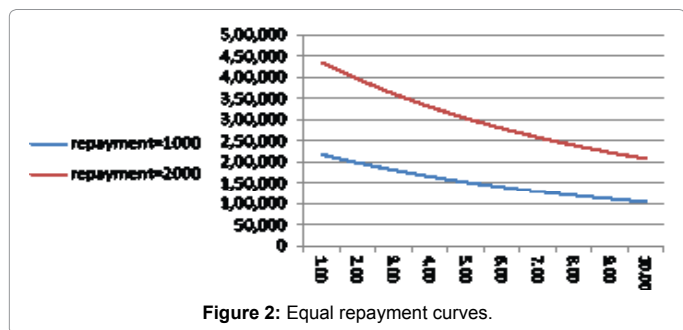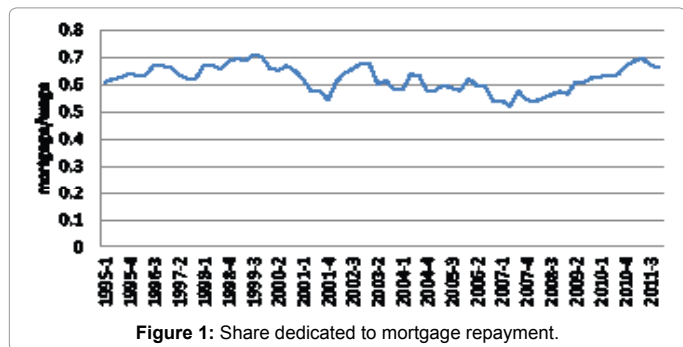1. S/He became worse off,

2. S/He became better off.

Figure 5 presents a situation where the buyer becomes worse off since the equal repayment curve is below most of the dots representing actual house prices. This means that a buyer financing a house by a mortgage in Israel would have had a higher repayment in periods other than 2003-1.

Figure 6 presents a situation where the buyer becomes better off since the equal repayment curve is above all the dots representing actual house prices. This means that a buyer financing the house by a mortgage in Israel would have had a lower repayment in periods other than 2003-1.

Actual situation in Israel

Number of months of work needed to finance purchasing a house	Average house price	Average wage	
99.1	4,08,696	4,123.30	1995-1
128.6	10,97,800	8,535.30	2011-4

Table 1: Number of months of work needed to finance buying a house in Israel.

Repayment = 1000	Repayment = 2000	Interest
2,17,441	4,34,883	1.00%
1,97,674	3,95,348	2.00%
1,80,311	3,60,622	3.00%
1,65,022	3,30,044	4.00%
1,51,525	3,03,051	5.00%
1,39,581	2,79,162	6.00%
1,28,983	2,57,965	7.00%
1,19,554	2,39,109	8.00%
1,11,145	2,22,290	9.00%
1,03,625	2,07,249	10.00%

Table 2: Interest rate and loan size, given periodic repayment.

Figure 1: Share dedicated to mortgage repayment.

Figure 2: Equal repayment curves.

Figure 3: The connection between interest rates and average house prices in Israel.

Figure 4: The connection between interest rates and average house prices in Israel.

First, we examine the burden of buying a house in nominal terms, namely if a buyer should pay a larger nominal repayment for a mortgage when buying a house. (For simplicity, we assume that the house is totally financed by a mortgage.) Referring to 2003.1 as a benchmark, we can see in Appendix B that the average house price in 2003.1 was

660,400 Israeli Shekels while the yearly interest rate was 5.813317%. Assuming that a buyer takes a mortgage for 240 months, the monthly repayment is 4,660.46 shekels. We calculate the equal repayment curve for a house bought at this period of time and depicted it with the data presented in Figure 3.

Figure 7 presents housing prices and interest rates in Israel (the curve in Figure 3) and the equal repayment curve for a house bought in 2003.1 with a repayment of 4,660.46.

As we can see in Appendix A, although the house price in 2009.1 was higher than in 2003.1, the nominal mortgage repayment was lower. Only after 2009-1 did the nominal mortgage burden increase relative to 2003.1.

Mortgage burden as a relative share of current income

Since the real burden on house buyers should be measured in terms of their current income and not in terms of nominal repayment, we made some adjustments in the model. Instead of referring to the nominal house prices during the sample period, we indexed the house prices according to the changes in the average wage. First, we built an index of average wages, defining the wage in 1995.1 as equal to 1 and then we divided nominal house prices by the income index.

Figure 8 presents the indexed houses price during the period 1995.1-2011.4.

Referring to 2003.1 as a benchmark, in Appendix B we can see that indexed (to income) house price in 2003.1 was 392,591 Israeli Shekels while the yearly interest rate was 5.8133%. Assuming that a buyer takes a mortgage for 240 months, the monthly repayment is 2,770.53 shekels. We calculate the equal repayment curve for a house bought at this point of time and depict it with the data presented in Figure 8.

Figure 9 presents the indexed average housing price and interest rate in Israel and the equal repayment curve for a house bought in 2003.1 with a repayment of 2,770.53.
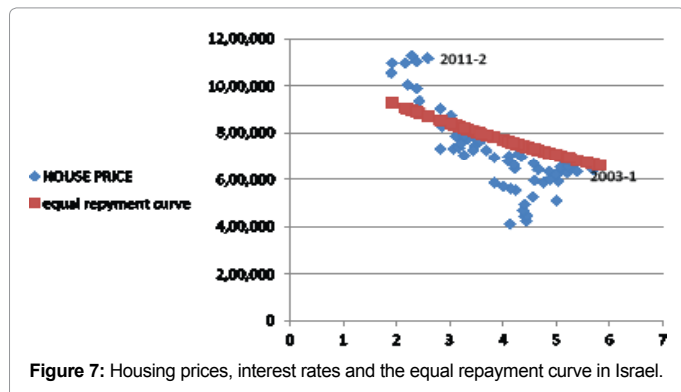

Figure 5: The buyer becomes worse off.

Figure 6: The buyer becomes better off.
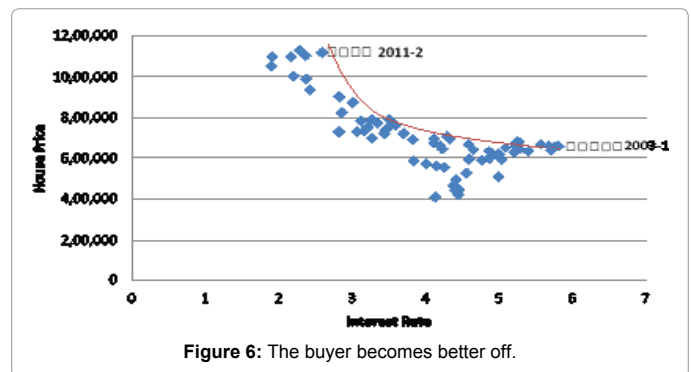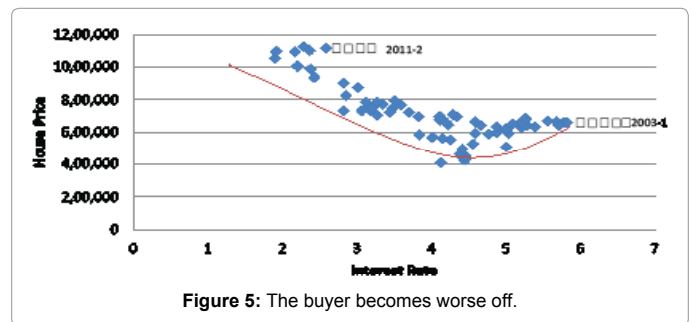
Figure 7: Housing prices, interest rates and the equal repayment curve in Israel.
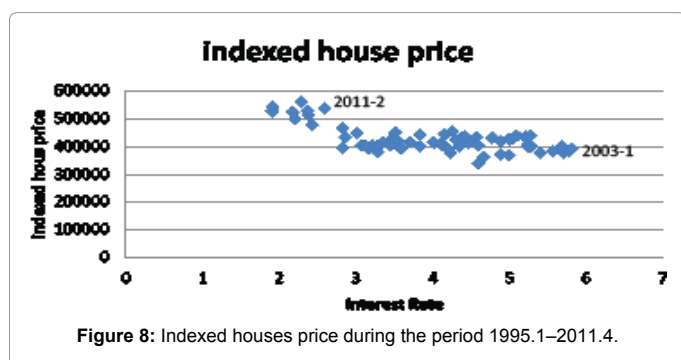

Figure 8: Indexed houses price during the period 1995.1–2011.4.

Figure 9: Indexed housing price, interest rate and the equal repayment curve in Israel.

The picture is much clearer now, although there has been a very large increase in housing prices in Israel since 2003-1. House buyers are better off in all periods following 2003-1 except in 2011-1 and 2011-2 (Appendix C).

Summary

Many agencies try to define indexes of the burden of buying a house. One of the most acceptable indexes is the number of months of work needed in order to buy one. According to this index, we find a very large increase in the burden of buying a house which increased from 99.1 months in 1995:1 into 128.6 months in 2011:4.

In this paper, we suggest to use a new and simple technique to examine the burden of buying a house on purchasers. We present a curve that represents a given fixed level of periodic mortgage repayment for changing pairs of loan interest rates and loan sizes. Since income level determines the maximum repayment capability (given credit limits defined by the banks), each equal repayment curve can be regarded as

agents' demand curve for houses as a function of interest rate, given fixed income levels. Assuming that the interest rate is determined by central bank policy, we can assume that given the interest rate level, equal mortgage curves determine the maximum house price capable of being paid by the buyers. We used quarterly Israeli data of mortgage interest rates, average house prices and income for the period 1995:1 until 2011:4 and showed that although there was an extreme rise in average house prices in Israel during the sample time period, it was not accompanied by an increased burden on the buyers due the very large decrease in interest rates. Referring to 2003.1 as a benchmark, we see that until 2009-1, although the average house price was rising, the nominal mortgage repayment was lower. Only after 2009-1 did the nominal mortgage burden increase relative to 2003.1.

In order to examine not only the effect of reduced interest rates, but also the rise in income on the mortgage burden, we built an index of house prices and used it to define house prices in terms of periodic current income. Building equal repayment curves for indexed house prices, we show that although there has been a very large increase in housing prices in Israel since 2003-1, house buyers are better off in all periods following 2003-1 except 2011-1 and 2011-2.

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