Renting versus Buying: System Dynamics Approach to Housing

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Abstract

This paper studies a widespread and important life dilemma of renting and buying a home. We adopt a system dynamics approach to housing research and clarify the benefits of system dynamics and double-entry bookkeeping in modeling the determinants of buying and renting a home decision. We included all important inflows and outflows of money and accumulation dynamics of assets, liabilities and equity for both dilemma choices. The model is general in the sense that one can use data from any market, but in this paper the parameters are estimated using Croatian historical data. We consider two policy scenarios; one in which there are tax deductions on interest payments, and the other without the tax policy measure. Our results suggest that the renting scenario is optimal in comparison to the buying scenario when there are no tax deductions on interest payments. This suggests that tax deductions should be introduced in case the government wants to stimulate the real estate market and the construction sector, or abandoned if the government perceives a housing bubble is being supported by a certain tax policy.

Keywords: equity flow, home ownership, home renting, system dynamics

Introduction

Buying or renting a home is a widespread personal dilemma and one of the most difficult and most important ones, as it usually represents the largest life investment for most people. In its core, the dilemma boils down to a choice between renting a home and renting money from a financial institution in order to buy a home. Due to its large scale in financial terms and far-reaching consequences from the dilemma holder's view, it deserves the attention of the dilemma holder in the first place, but also the attention of the public policy maker, and the academia [1, 2].

A thirty-year period prior to the stock market collapse of 2007 that was coupled with substantial increase in house prices, buying a house was considered a good investment. Although the estimates for the US show that nominal house prices increased on average by

3 percent, while the rise in real prices, adjusted for inflation, was just a bit above zero [2, 3], housing was indeed a good investment because it was usually leveraged to a great degree. For example, a house price increase of only three percent and a mortgage with a 20 percent down payment brings a 15 percent increase in homeowner's equity. In bad times however, leverage turns against the holder. A 20 percent down payment coupled with a 20 percent price decline, wipes out all of the buyer's equity [3]. Therefore, taking up a mortgage to buy a house at the peak of the housing cycle, in 2006 or in 2007, usually meant that the mortgage owners were soon confronted with falling values of their collateral that was driving down their net worth, seriously threatening their ability to service the mortgage. This most recent housing bubble and its burst showed the "good" and the "bad" side of buying a house and manifested just how severe a mortgage can become if taken at the wrong time. Now, more than ever, it seems that housing decisions should be done with great care, taking into consideration all available factors.

This paper uses the system dynamics and double-entry bookkeeping approach in order to model all available determinants of buying and renting a house. We included all important inflows and outflows of money and accumulation dynamics of assets, liabilities and equity for both dilemma choices. The conclusions we made are based on the dynamics of the equity flow and the stock accumulation in different scenarios. Our results offer an analysis of both strategies and provide straightforward advice on the choice of housing strategy.

The key parameters of the model are: housing appreciation rate (measured by prices), mortgage fixed interest rate, interest rate on saving deposits or return on investment if the saving deposit is invested, property tax rate, and deductibility of the mortgage interest. To estimate the parameters we use historical data available for the Croatian real estate market. However, as the modeling approach is general, the data can be from any market and especially from the US real estate market which has the longest historical data series.

Most people confronted with the dilemma, naively compare monthly annuity payments with monthly rent payments, and make their decisions based on this simple comparison. However, this way they ignore the fact that a part of the monthly annuity payment goes to the principal (inflow to equity) which is similar to saving, while the interest portion of the

payment is deductible and in some degree can offset the interest expense on home mortgage. Moreover, simply comparing the housing and the stock market ignores the fact that housing pays something as a dividend because one can live in it without paying rent. In order to make the comparison credible, living in a house should pay an "occupancy dividend" of around seven percent [3].

Besides tangible variables, there are also many intangible ones. For example, in case the landlord decides to raise the rent or if he decides to sell the property, the renters are in distress. Not negligible is also the fact that in some countries, owning a house is often regarded as a sign of success [4]. On the other hand, the renting a home offers the flexibility and the alternative when the housing market is overpriced [1]. The recent study [5] has shown that the high levels of home ownership are strongly linked to subsequent rises in unemployment because labor mobility becomes reduced.

The buying vs. renting dilemma is obviously complex, implying that a complex analysis should be applied in order to study it. We therefore take the system dynamics approach because it seems to be the right tool for simulating and optimizing the choice between renting and buying a home.

The rest of the paper is organized as follows. The following section displays the methodology employed in detail. The third section presents results, while in the last section we discuss the results and conclude the paper.

Stylized Facts

In this moment, 92% of households in Croatia are owners of their apartment or house. The average apartments' area is around 74.4 m2, with the average nominal price 1309 EUR/m2 in 2013 gives the initial home price set to 100.000 EUR.

Historical data series for the home price index are available at [6, 7] are shown in Figure 1, covering the period of last 15 year (from 1998 to 2013).

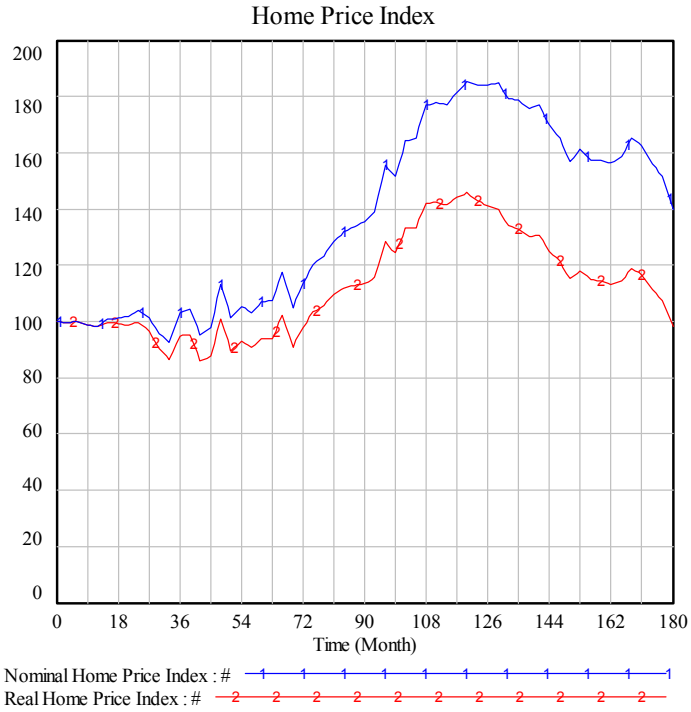

Figure 1. Historical Home Price Index for last 180 months (15 years).

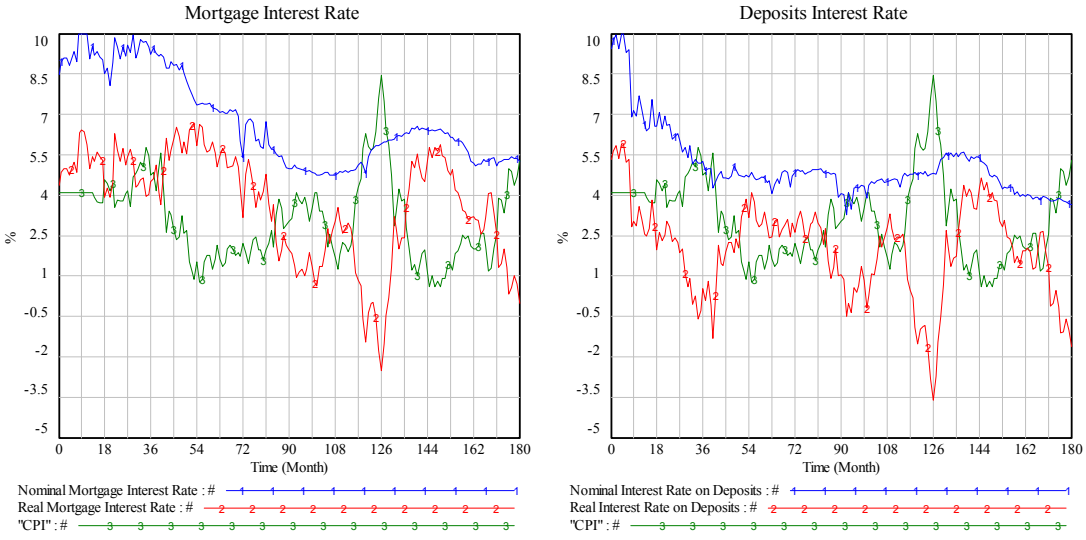

Figure 2. Mortgage and Deposits Interest Rates in last 180 months (15 years).

Figure 2 shows mortgage interest rates (with historical annual mean 7.06% and median 6.49%) and interest rate on deposits (with historical annual mean 5.41% and median 4.84%) which both give a bank spread premium of 1.65% annually.

Methodology

We set the tax rate for buying a house (property sales tax) at 5 percent. As property tax has not yet been introduced in Croatia, we use the expected rate that is assumed to be around 0.15 percent of the house value paid annually. We have examined the effect of both of these taxation scenarios on the buying versus renting dilemma.

We set the initial house price at 100,000 euros allowing both appreciation and depreciation of the house value, as defined by the annual appreciation/depreciation rate.

We design two versions of the model: (1) the renting model shown in Figure 3 and (2) the buying model shown in Figure 4. Both models are inspired by the work of the colleague, professor Kaoru Yamaguchi [8], who has applied double-entry bookkeeping principles in his modeling methodology. Bookkeeping principles make models more organized, and they increase visualization quality, understanding, and motivation for research.

As shown in Figure 3, the renting model has only one liability stock which accumulates renting expenses equal to a monthly rent. On the asset side, the renter has an initial saving deposit (the principle), which is enlarged periodically by depositing new monthly savings. These savings inflows depend on disposable income, renting expenses, and the marginal propensity to consume. The renter also receives interest on saving that is included in the amount of saving. Conservatively, we use the average bank passive interest rate on deposits as the investment interest rate on saving deposits. Alternatively, the average return on investments in securities or stocks can be used as well. We differentiate between the interest and the principle in order to detect the exact contribution of savings, and the exact contribution of interest in the appreciation of the renter's asset.

We define the equity stock as a difference between assets and liabilities. Therefore the "Net Worth of Equity" stock is defined as the accumulation of the difference between equity

inflows (saving and interest) and equity outflows (renting expenses), where initial equity is equal to initial saving deposits. We were mostly interested in the dynamics of "Net Worth of Equity" stock and the "Equity Inflow/Outflow Balance" flow. Obviously, positive and maximal performance of both of these two variables is preferable. From these flows and stocks we can derive some investment measures, such as return on assets (ROA) and present value (PV) of future equity cash flows.

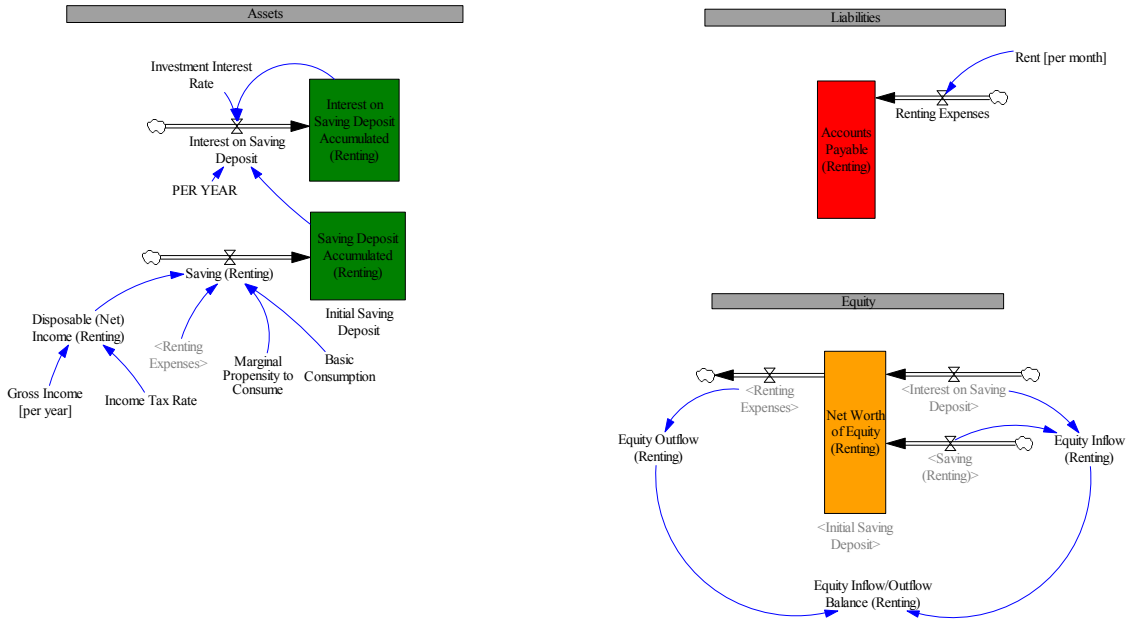

Figure 3. The renting model.

Figure 4 presents the buying model. The liabilities in the model are the "Mortgage Loan" and the "Interest on Mortgage Loan" that have to be paid to the mortgage provider. Again we separate the flows of the "Principle Payment" and the "Interest Payment", because only the interest is allowed to be recognized for tax deductions, and because the interest is treated as equity outflow while the principle payment is treated as equity inflow (similar to savings in the renter's model).

The initial mortgage loan depends on the initial house price and on the amount of down payment (that is 20 percent of the house price on average).

On the asset side we allow the house value to appreciate/depreciate depending on the appreciation/depreciation rate. The system is very sensitive to this parameter, and for the moment we have conservatively set the appreciation rate to 1.74% percent as our historical data suggest. Later on, we plan to set the appreciation/depreciation rate to higher levels, as one can usually notice in the short- and medium-run.

In the buying model, we also allow for saving, depending on the amount of disposable income less taxes and expenses incurred as a consequence of buying a house (such as property tax, maintenance costs, and mortgage payments). Tax deductions in the form of income tax savings are included because the owner incurs tax deductible costs related to property tax and mortgage interest payments.

Initial “Net Worth of Equity” is equal to “Initial Saving Deposit” reduced by the “Property Sales Tax” that has to be paid in the moment of buying the house. The buying model is obviously more complex, but from flows and stocks similar investment measures as return on assets (ROA) and present value (PV) of future equity cash flow can be derived.

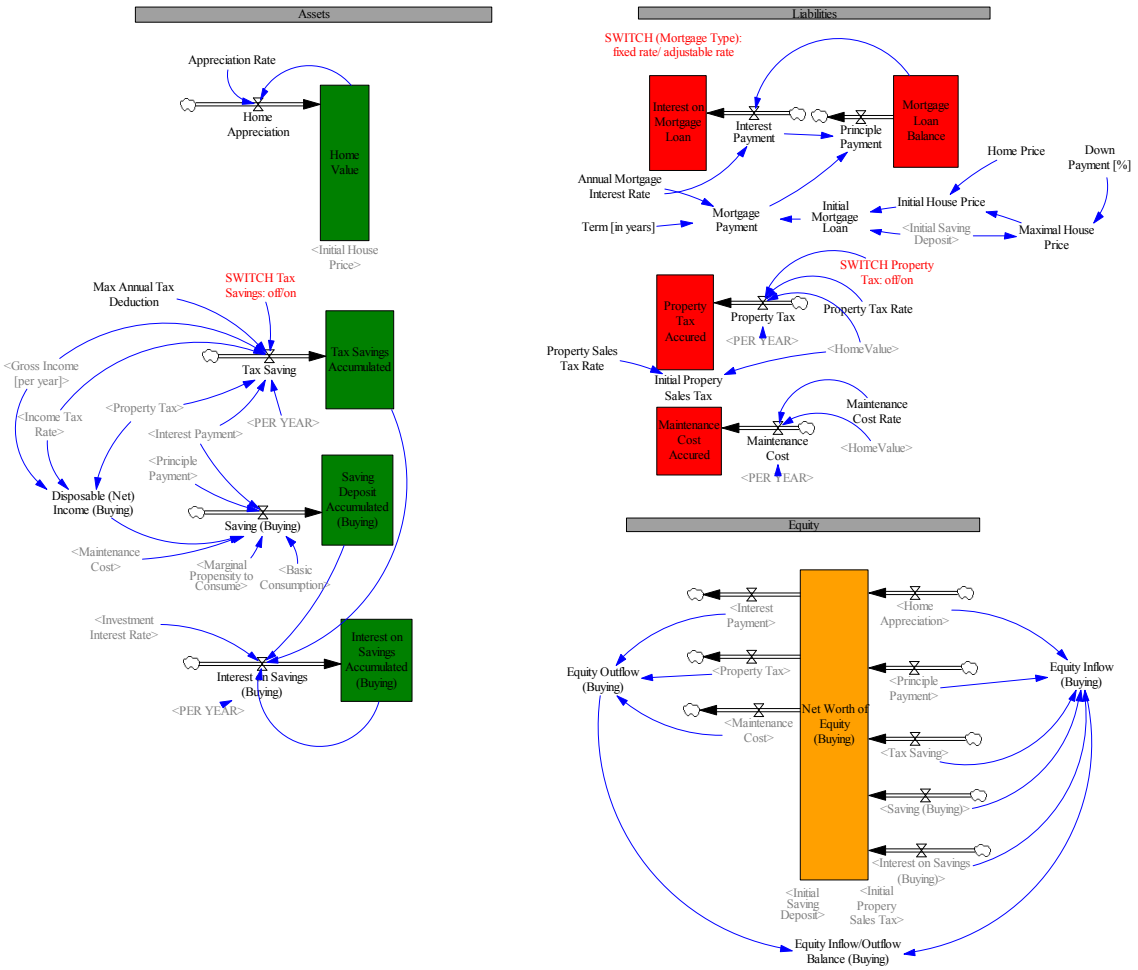

Figure 4. The buying model.

Table 1 presents the list of all variables and their initial values used for estimating model parameters.

Table 1. Model parameters' names and default values.

Parameter	Value
Gross Income	16,800 EUR/year
Income Tax Rate	12% and 25% (income dependable)
Marginal Propensity to Consume	0.7
Basic Consumption	100 EUR/month
Initial Saving Deposit	20,000 EUR
Investment / Interest Rate on Deposit (annual)	5.41%

Rent	400 EUR/month
Discount Rate (=Cost of Capital)	7%
Appreciation Rate (annual)	1.74%
Maximal Annual Tax Deduction	1600 EUR/year
Mortgage Interest Rate (annual)	6.49%
Term (of mortgage)	30 year
Property Sales Tax Rate	5%
Property Tax Rate (annual)	0.15%
Maintenance Cost Rate (annual)	0.5%
Down Payment	20%
Initial House Price	100,000 EUR

Results

Figure 5 shows the results of simulation for the renting model (blue line, marked with "1") and the buying model (red line, marked with "2") in the "Scenario A" without tax deduction.

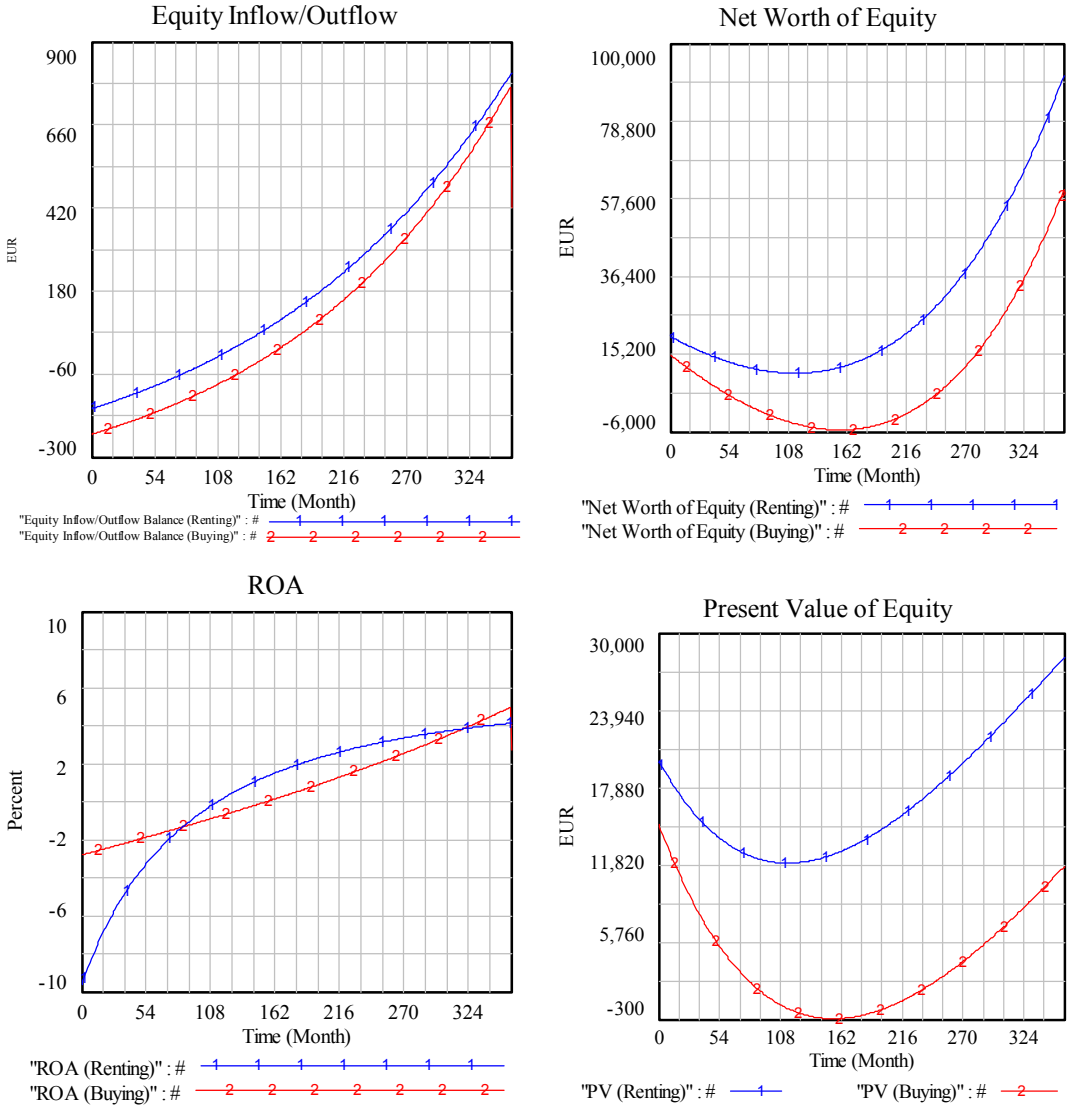

Figure 5. Scenario (A), without tax deductions. Equity Inflow/Outflow Balance, Net Worth of Equity, ROA and Present Value of Equity.

Figure 6 shows the results of simulation for the renting model (blue line, marked with "1") and the buying model (red line, marked with "2") in the "Scenario B" with tax deduction included.

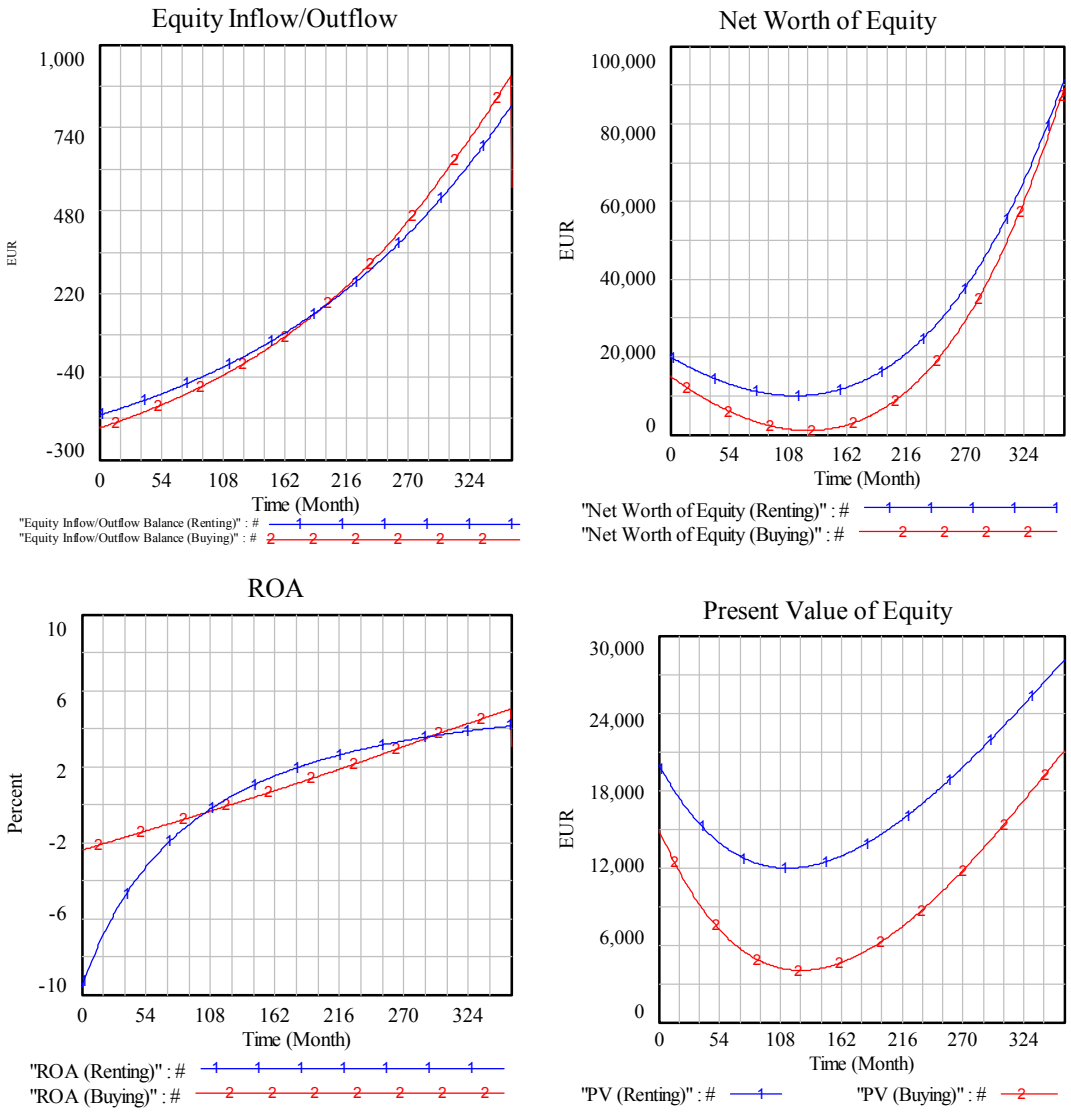

Figure 6. Scenario (B), with tax deductions. Equity Flow Balance, Net Worth of Equity, ROA and Present Value of Equity.

Discussion & Conclusion

Scenario (A) in Figure 5 clearly shows that at the moment, as described by parameters in Table 1, the renting scenario is optimal in comparison to the buying scenario. The equity flow is negative for the first 10 years (or 120 months) but afterwards it becomes and stays positive. The effective ROA bottoms out at around −9.6 percent and stays negative in the first 10 years, but eventually it starts to increase as the capital invested from saving deposits grows and converges towards a 4 percent annual return.

The renting scenario also allows higher savings due to a lower monthly cash outflow (around 400 EUR a month), which eventually leads to higher saving after consumption. At the end of the 30-year period, the equity from the initial 20,000 EUR accumulates to 91,238 EUR. The present value of equity future cash flows discounted by the average cost of capital set at 7% is equal to 28,113 EUR.

In the buying scenario, the initial saving deposit is substantially decreased by the initial 5% property sales tax. The cash outflow due to mortgage payments is higher (505.13 EUR), and the equity flow is more negative and it takes 12.5 years (or 150 months) before it becomes positive. The net worth of equity is negative for substantial time, and the initial saving deposit invested as the part of equity is wiped out, and it takes 28 years (period between 220-360 months) when the equity to become positive, due to a higher portion of the principle payment at the mortgage term ending. After 30-years period, the net worth of equity is equal to 60,090 EUR, significantly lower in comparison to 91,238 EUR from the renting model. If we discount the future cash flow to equity with the discount rate of 7 percent, the present value of the future equity flow is only 11,713 EUR.

The reason for such discrepancy between the two scenarios for Croatia is in the tax deduction which was abandoned in 2010. Before 2010, income tax deductions were recognized for mortgage interest payments to the amount up to 1,600 EUR annually.

In Scenario (B) we model the market prior to 2010, therefore allowing the tax deduction. From Figure 6 we can conclude that the dynamics of both models looks fairly similar and

the buying model accumulates slightly less equity at the amount of 89,076 EUR in comparison with the 91,238 EUR accumulated in the renting model.

These results have interesting policy implications as they provide evidence of tax policy effect on the housing market. In case the government wants to stimulate the real estate market and the construction sector, it should allow for tax deductions on mortgage interest or similar measures that make the buying strategy preferred when compared to the renting strategy. On the other hand, if the government perceives a housing bubble is being supported by a certain tax policy, it should reconsider its policy aims and adjust tax rates and incentives accordingly.

For further research we would like to introduce the inflation rate and discuss real values and nominal values when making housing investment decisions.

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