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Wealth portfolio of Hungarian households – Urban legends and facts

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Wealth portfolio of Hungarian households – Urban legends and facts

(A magyar háztartások vagyona – legendák és tények)

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Abstract

As significant part of national wealth, households' wealth is the central issue in both policy debate and academic literature. Nevertheless, in Hungary little effort has been made so far to conduct thorough evaluation of households' wealth for the last decade. Under the auspices of 'the plural of anecdote is not evidence' axiom, this study provides a formal evaluation of Hungarian wealth and connects the development of wealth elements to economic events. Doing so, as a by-product, we also display the estimated wealth levels of households. Based on international comparison and econometric techniques, it is confirmed that the recent financial wealth level of Hungarian households is still relatively low, meanwhile the current housing wealth is not evidently below the equilibrium level. These results provide an explanation why governmental housing subsidy scheme has its major effect on house prices rather than housing stock. Besides, the soaring house prices, via housing loans, vanished financial savings. The 'saving disaster', i.e. small or in some periods even negative saving rates, experienced in early 2000's, to a certain extent, is the other side of the 'saving miracle' of early and mid 90's when households rearranged their wealth portfolio from real assets to financial assets implying decreasing house prices and high saving rate.

JEL: E00, E21, E31, H31.
Keywords: household wealth, housing subsidy scheme, house price.

Összefoglaló

A háztartások vagyonával kapcsolatos események fontos figyelmet kapnak az elemzők, a döntéshozók és természetesen a háztartások életében. E kiemelt szerep ellenére az elmúlt tíz évben nem készült szisztematikus áttekintés a magyar háztartások vagyonelemeiről. A tanulmány ezt a hiányosságot igyekszik bepótolni. Városi legendák és anekdotikus evidenciák helyett a tanulmány formális becslésekkel és módszerekkel elemzi a háztartások vagyonában a 90-es évek közepétől napjainkig lezajlott változásokat, illetve köti össze ezeket gazdasági eseményekkel. Mindemellett a lakosság teljes vagyonának meghatározásához becslést adunk a lakásárakról, lakásvagyon szintjéről és a tartós fogyasztási cikkek állományáról is. Nemzetközi összehasonlítás és formális tesztek szerint a magyar háztartások pénzügyi vagyona meglehetősen alacsony, míg ingatlanvagyonuk kiemelkedően magas. Ez a megállapítás magyarázatot ad arra, hogy a kormányzati lakástámogatási rendszernek miért volt sokkal erőteljesebben hatása volt a lakásárakra, mint a lakásállományra. Ebből következően pedig a 2000-es évek elején tapasztalt rendkívül alacsony lakossági megtakarítás, a „megtakarítási katasztrófa" részben a 90-es évek elején tapasztalt „megtakarítási csoda" másik oldala, azaz a vagyonelemek közötti ismételt átrendeződés eredménye.

1. Introduction

Citation of households' wealth is a recurring subject in several areas of our lives. Politicians, policy makers, analysts and, of course, households themselves are concerned about their wealth positions. While politicians worry about their electors' standard of living, analysts keen on understanding and predicting how certain shocks affect the households' wealth and hence their behavior. Founded on a common conjecture, namely the households' wealth is a substantial part of a nation's wealth, the eager interest is comprehensible. Theoretically oriented research and models are also fond of employing housing or durable consumption stock in utility function. Aoki et al. (2004) provide a microeconomic foundation of how housing wealth affect consumption expenditure via risk premium of households' loan. Another interesting examination of households' wealth is the paper of Bruce et al. (2004) in which they investigate the relation between economic and subjective well-being. According to their results, consumption, income and wealth all together alter the satisfaction level of households. This result rationalizes the appearance of housing and financial wealth in utility function, for instance money-in-the-utility approach in the literature of monetary theory.

Being the foundation of theoretical works and practical analysis, households' wealth data and related stylized facts are essential. Cardoso and da Cunha (2005) conduct a detailed research about the wealth portfolio of Portuguese households. Similar exercise can be found in Aron and Muellbauer (2006a) for South Africa, Niemeläinen et al. (2006) for Finland or O. Berge et al. (2006) for Norway.

Contrary to this distinguished attention, little effort has been made to conduct thorough evaluation of Hungarian households' wealth and its structure for the last decade. Zsoldos (1997) provided a systematic examination for the period 1980 to 1996 but since then no study dealt with the entire wealth position. Owing to the lack of studies in Hungary, several legends and conjectures have been stated about the severe decline in financial savings rate, the housing wealth level, the effect of housing subsidy scheme and EU accession on house price level.

Under the auspices of 'the plural of anecdote is not evidence' axiom, the aim of this study is to assess the development of wealth elements and connect them to economic events. In order to attain this goal, this paper also presents the wealth levels as the by-product of our analysis. Due to the fact that housing wealth is expected to be the largest part of households' wealth, we pay special attention to housing subsidy scheme initiated by Hungarian government.

The rest of the study is organized as follows. Section II collects stylized facts and evaluates the structural changes with the aid of formal econometric tests. In order to assess the current wealth level of households, subsequent section compares several countries' wealth level and estimates the expected steady state wealth levels. Using a small theoretical model introduced in Section IV, succeeding part simulates this model and connects the impulse responses to the facts and economic events. Finally, Section V concludes. Appendix displays the estimation details of housing wealth and the stock of consumer durables, provides formal proof of how income growth affects steady state wealth ratios and finally displays the estimation of model parameters.

2. Households' wealth and structural breaks

Hungarian households have been affected by several events and shocks for the last ten years. One of them was the increasing disposable income. By the end of 1990s, households became less credit constraint hence more and more families were able and willing to take out consumer credits and repay the monthly installments.

Parallel with increasing disposable income, the late 1990s comprised other two substantial effects: the Russian financial crisis and the beginning of intensive government housing subsidy. The latter one has undergone several changes since its launch. Due to the permanent adjustment of governmental support system it is not feasible to list all the modification, hence, we outline only the major changes.

Between 1995 and 1999 households were eligible to apply for social subsidy in which the support of new house constructions depended on the number of children and, on the other hand, interest-subsidy up to 2.8 million Hungarian Forint (hereafter HUF) loan value in the case of new house construction and 0.6 million HUF in other cases. In January 1999, the ceiling of loan value increased from 0.6 million to 1.2 million HUF. In February 2000, subsidy scheme was extended to reconstruction and second-hand housing market. Loan-ceiling increased to 30 million HUF. In the same year, government introduced an additional interest subsidy up to 10 million HUF in August. The maximum duration of subvention was 10 years. In 2001, the so-called 'half social subsidy' was established, which was the half of the financial support of the 'normal' social subsidy[1]. In March 2002, government increased the maximum duration of subvention to 20 years.

By 2003, due to the enormous raise in new housing loan, it became evident the subsidy scheme was not sustainable. In 2004, tightening measures primarily attempted to cut the budget expenditures on interest rate subsidies on new housing loans. Given the lower subsidies for the new loans, banks' profit margins declined, parallel with the significant increase in the interest burden of households. Furthermore, the changes to the subsidy scheme gave rise to two new features: mortgage rates became partly linked to market rates, and the difference between subsidies for new and existing housing widened from 1 to around 4 percentage points. The loan-ceiling has been reduced to 15 million HUF in the case of new construction and 5 million HUF in the case of second-hand housing market.

The latest major revision of housing subsidy scheme took place in February 2005. On one hand, the eligibility has been limited to young married couples and single-parent families. On the other hand, the loan-ceilings have been further differentiated. It is 15 million if the property is situated in Budapest or other capital of counties and 12 million in the case of any other location. Meanwhile the loan-ceiling in second-hand housing market became 12 million if the property is situated in Budapest or other capital of counties and 8 million in the case of any other location.

Along with tightening housing subsidy scheme, another effect also made conditions more unfavorable. In the early 2000s, the yield curve showed a steep negative slope, reflecting investors' confidence in the profitability of the convergence play strategy in the Hungarian government bond market. However, as concerns about the external and internal disequilibrium of the Hungarian economy increased in 2003, the long segment of the yield curve started to increase significantly, putting an end to the yield convergence that characterized long yields in the previous years.

2.1. STYLIZED FACTS

The most noticeable phenomenon in connection with financial wealth position is that the ratio of net financial wealth to income is practically constant since 2000 (see the upper-left panel of Figure 1). As for the financial assets, in the beginning of regime change, i. e. 1990, the typical deposit type was the jar in the cupboard and approximately 40 percent of net financial wealth was held in cash. By the beginning of 2000 this ratio dropped under 10 percent. Due to the fear of hyperinflation in mid 90's the FX denominated deposit became a favorite saving form, which, after the consolidation of inflation expectations, gradually decreased to 5 percentages. By the mid 90's Hungarian households began to employ more sophisticated savings

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[1] The 'social subsidy' is based on the number of children, namely, households entitled for 0.2, 1.2 and 2.2 million HUF per one, two and three children respectively. Any additional child increased the financial support by 0.2 million HUF.

forms, such as stocks and mutual funds. As for the quoted stocks, households abandoned stock exchange because of falling stock prices triggered by Russian financial crisis. Even after substantial soaring of stock market prices in the last few years Hungarian households disregarded quoted shares as a savings variant (see the upper-right panel of Figure 1).

Even though the financial asset/income ratio continues to increase along the same trend, it has been offset by the households' liabilities that expanded at higher pace. In the first phase, around 1998, the increasing income eased the liquidity constraint and made the HUF-denominated consumption loan available. This was followed by foreign exchange (hereafter FX) denominated consumption loan since 2000 (see the lower-left panel of Figure 1). At the same time governmental housing subsidy scheme began to stimulate the HUF-denominated housing loan. The tightening of housing subvention shifted the housing loan origination to foreign exchange-denominated mortgage (see the lower-right panel of Figure 1).

Chart 1

### Financial wealth and its elements
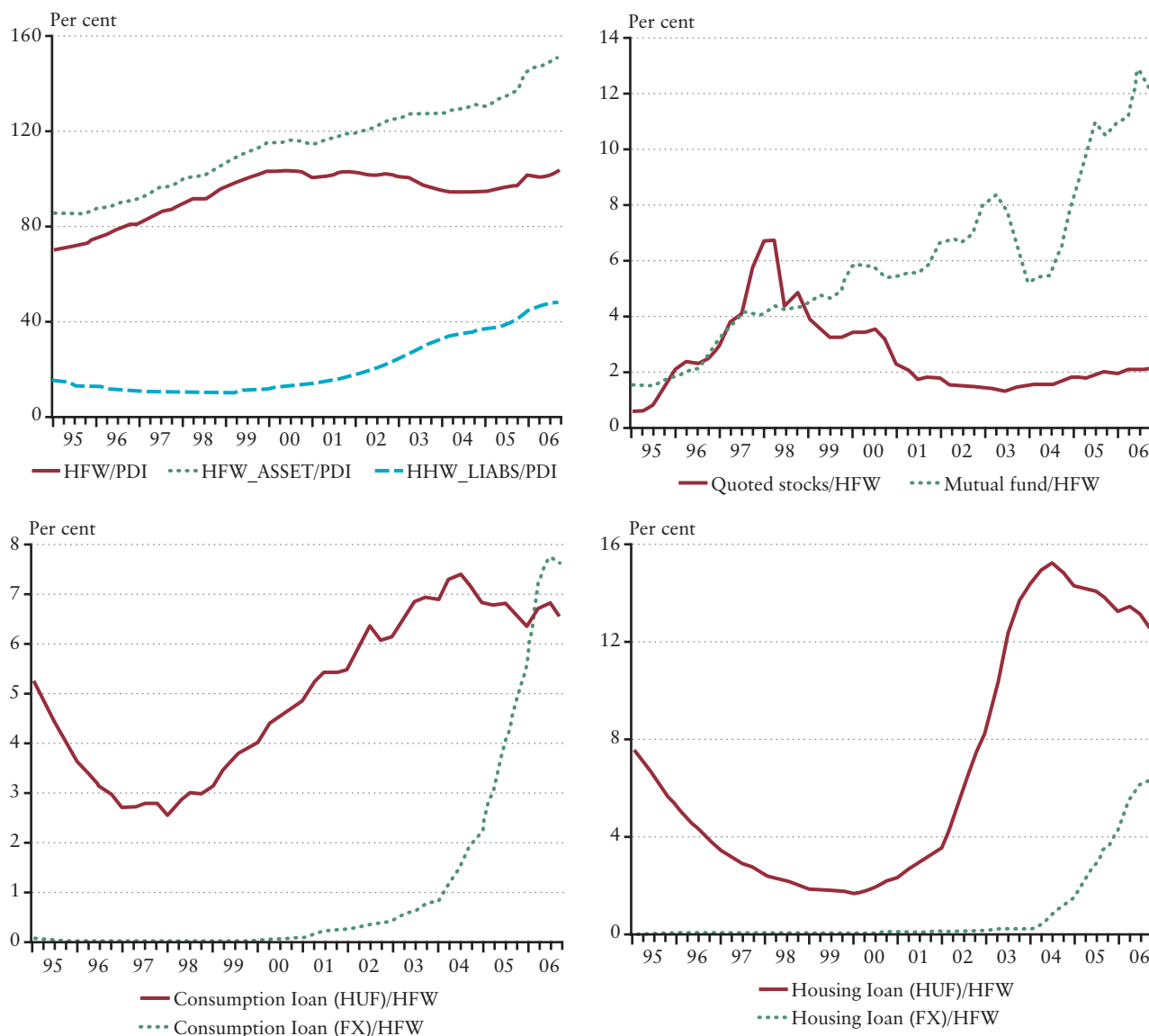
Where HFW and PDI denote the households' financial wealth and annual personal disposable income in current price. HUF and FX indicate the HUF and foreign exchange-denomination.

Not surprisingly, our estimated housing wealth[2] is significantly higher than financial wealth. To be precise, households' housing wealth is more than three times bigger than their financial wealth. Comparing our results with Zsoldos (1997) estimation for housing wealth in early 90's it is apparent that our estimation is considerably higher. While Zsoldos' approximation is 8000 billion HUF at 1996 price, our figure is nearly 18,500 billion HUF in the end of 1996. This discrepancy is attributed to the different house price data. While Zsoldos used the selling price of local government owned flats, our estimation is based on the market price of every sold real estate. Knowing that the local government owned flats were sold to tenants, the selling prices were set in line with social concerns, therefore, these prices were much less than the actual market value. Besides the different data sources, Zsoldos' estimation ends at the end of 1996 and our price data are less reliable before 1997, which renders the comparison difficult. Nevertheless, the decreasing pattern of real housing wealth in early and mid 90's is presented in both estimations implying same underlying market movements.

According to the upper-left panel of Figure 2 there was a considerable increase in house prices from 1999 to 2004, which was the period when soaring disposable income accompanied by the most intensive period of government housing subsidy

Chart 2

Housing wealth, its decomposition and ratio to annual personal disposable income
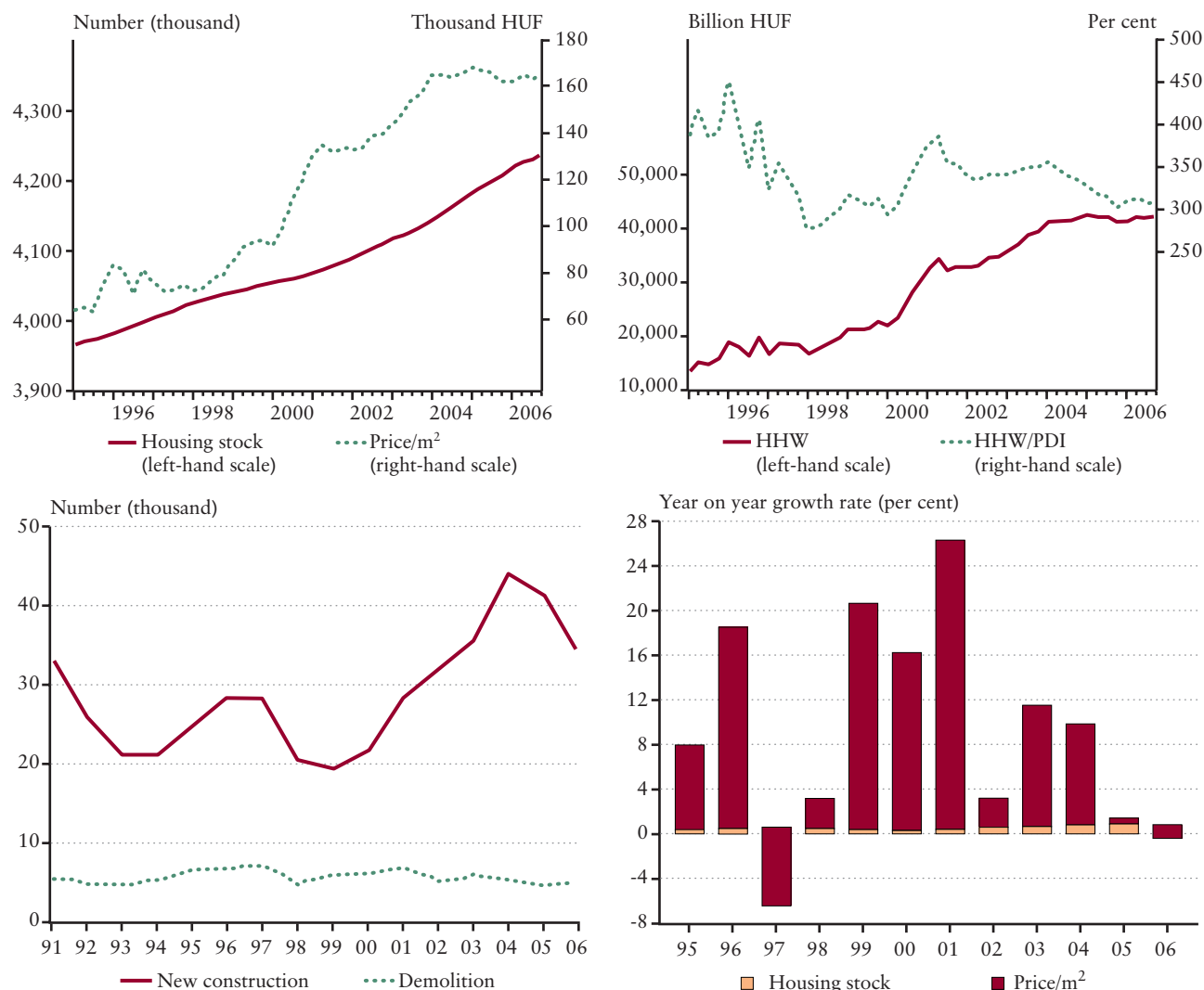
Note: HHW and PDI denote the housing wealth and personal disposable income in current price. The values of new dwelling construction and demolition are annual data.

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[2] Albeit Hungarian Statistical Office (HCSO) published estimation about non-financial assets of private sectors, it is in not suitable for our purpose. First, the estimation procedure is not documented, therefore, it is not possible to detect the discrepancies between other acknowledge estimations, such as the capital stock of Pula (2003), and HCSO statistics. Second, the HCSO's data comprise extremely short time period, 2000-2005, which would disable us to conduct a proper analysis. Consequently, we apply our own housing wealth estimation (for estimation details see Section A. 1. 1).

scheme. Since housing stock can adjust sluggishly, the peak in the housing wealth to income ratio around 2000 (see the upper-right panel of Figure 2) clearly indicates that the house prices grew much faster pace than income. The dominance of housing prices is noticeably detected when we decompose the growth of housing wealth. As the lower-right panel of Figure 2 reveals that the house price changes were primarily responsible of housing wealth changes until 2004. After this period, dwelling prices are practically constant.

The intentions of housing subsidy schemes are generally twofold: provide higher chance for households to obtain housing service by increasing housing supply and/or facilitate quality change. It is crucial to understand which indicators are appropriate to measure the achievement of different goals and do not use them interchangeably. If the aim is to ensure better chance to obtain housing service then we should examine the housing stock that is facing the housing demand. On the contrary, if we tend to facilitate quality change then the relation of new dwelling construction and demolition are the appropriate figure. As for the first goal concern, based on the 'eyeballing' of upper-left panel of Figure 2, we cannot decide whether the dynamics housing supply, i.e. housing stock, has change significantly in the last ten years. As for the quality change concern, lower-left panel of Figure 2 displays no changes in the demolition of existing housing stock, therefore, the higher activity in dwelling construction cannot be attributed to quality change. Nevertheless, note that the higher construction volume does not imply significant change in housing stock necessarily since the number of new construction is minuscule relative to housing stock.

It is also worth elaborating on the distributions of square meter price and housing wealth within a year. According to the left panel of Figure 3 more than one fourth of housing stock is in the relatively low 100-150 thousand forints square meter price range. Skewness is more apparent when one looks at the distribution of housing wealth (see right panel of Figure 3).[3]

Chart 3

Histograms of average house price per square meter and housing wealth (2005)
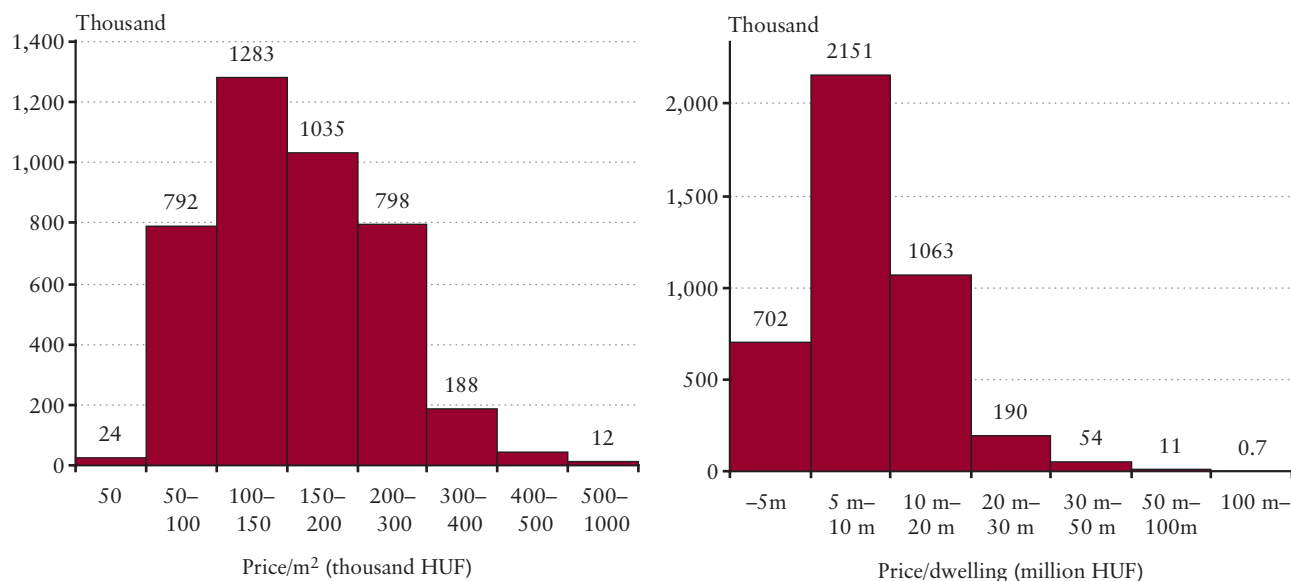

Another information content of HCSO database, which can reveal interesting aspect of Hungarian housing market, is the number of transactions within regions. In 2005, there were 46.9 thousand sales in second-hand housing market, 38 percent of which took place in Budapest. Comparing the transactions to the housing stocks, the most vivid housing markets were Fejer county, Budapest and Békés county where 2.2, 2.1 and 1.7 percent of housing stocks have been sold respectively. Nograd, Borsod-Abaúj-Zemplen and surprisingly Pest county (obviously excluding Budapest) are at the other end of the line where nearly zero, 0.3 and 0.4 percent of housing stocks have been sold respectively. The large difference between transaction data in Budapest and Pest county implies that the common assumption, namely there is a significant flow from the capital to its agglomeration, at least in 2005[4], is not supported by housing market transaction data.

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[3] This phenomenon has a particular interest in the recent debate of introducing housing property tax in which a certain dwelling-value might emerge as the limit of tax exemption (for detailed elaboration see Kiss and Vadas, 2007).

[4] Nevertheless the same large discrepancy remains true in the whole sample period.

Dealing with house prices it is worth examining another urban legend – the EU accession of Hungary boosted/will boost Hungarian house price, which is widespread even among professionals. Assuming any effect of EU accession on house prices in a small village somewhere far away from any industrial or touristical locations is clearly ludicrous. Therefore, the finer version of the concept concerns the house prices in the capital of Hungary, Budapest. Figure 4 unambiguously confirms that EU accession in May 2004 indicated by a vertical line in the figure has any effect on house price. House prices and income are decreases by the pace since the beginning of 2003 in Budapest. The same pattern can be observed across Hungary.

Chart 4

Growth rate of house price, income and the ratio of house price to annual income in Budapest

Relative house price/m² · · · · · Real income per capita
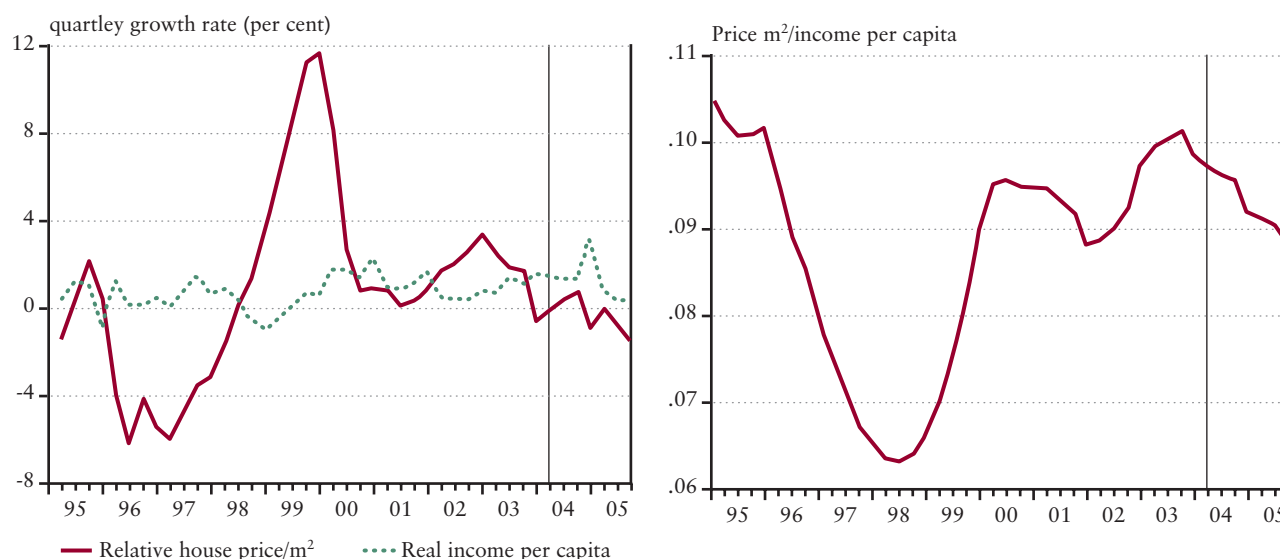
2.2. DETECTION OF STRUCTURAL CHANGES

Preceding part described the main attributes of households' wealth element in Hungary. In this section, we apply more formal approach to identify the major changes and, whenever it is possible, assign them to the above-listed economic events.

Several tests have been proposed to test structural breaks, for instance, Wu (2004), Juhl and Xiao (2005), and Wu and Zhao (2006) among others. Bai and Perron (1996, 2003) suggest a set of tests that provides appropriate methodology to examine the presence, the number and the locations of structural breaks. In order to obtain answers to the above-described question we invoke two tests among the Bai-Perron tests: the double maximum test[5] and the no structural break versus l break points test, which helps to identify the number of breaks and their location.

An important aspect of testing procedure is to assess the possible number of break points. General concern about structural break test is that the numerous break points may result too short time intervals. The design of Bai-Perron test ensures that the two break points cannot be too close to each other by terminating the increase of the number of breaks.

Another relevant note is that special care should be given when these test statistics are used to evaluate whether the wealth allocation of households is stable or not. If the share of a wealth element is continuously changing along a linear trend then the above-described tests indicate no structural change. To put it differently, the rejection of no structural breaks in favor of structural breaks is a clear indication of altered wealth allocation. Contrary, the acceptance of null hypothesis of no structural break could imply both stable wealth share and linearly increasing or decreasing proportion. Consequently, 'eyeballing' remains a crucial part of our analysis.

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[5] Double maximum test can be applied when the main interest is the existence of structural breaks regardless of their number and the locations. More formally, double maximum method tests the null hypotheses of no structural break against an unknown number of breaks. There exist unweighted and weighted double maximum test in which the individual F tests are weighted to obtain equal marginal p-values across of the number of break points. In the succeeding empirical analysis, we are going to use the weighted version of double maximum test denoted by WDmax.

Table 1

Structural breaks of wealth elements

	WDmax	Number of breaks F(*l* | *l*=0) at			Locations of breakpoints
		10%	5%	1%	
Income	break(s)	5	5	5	1996 Q3, 1998 Q1, 2000 Q2, 2002 Q2, 2004 Q1
Financial wealth/income	break(s)	3-5	3-5	3-5	1996 Q2,1997 Q3, 1999 Q2, 2000 Q4, 2003 Q2
Consumption loan (HUF)	break(s)	4-5	4-5	4-5	1992 Q1, 1995 Q3, 1998 Q1, 2000 Q3, 2003 Q1
Mortgage loan (HUF)	break(s)	2,4-5	2,4-5	2,4-5	1993 Q1, 1995 Q2, 1997 Q3, 2000 Q4, 2003 Q1
Housing stock	no break	0	0	0	-
House prices	break(s)	2-5	2-5	2-5	1996 Q3, 1999 Q1, 2000 Q3, 2002 Q2, 2003 Q4
Housing wealth	break(s)	1-5	1-5	1-5	1996 Q3, 1999 Q1, 2000 Q3, 2002 Q2, 2003 Q4
House prices /current income	break(s)	1-5	1-5	1-5	1996 Q2, 1997 Q4, 2000 Q2, 2001 Q4, 2004 Q2
House prices /perm. income[1]	break(s)	1-5	1-5	1-5	1996 Q3, 1998 Q3, 2000 Q2, 2002 Q1, 2003 Q4
Housing wealth /total wealth	break(s)	1-5	1-5	1-5	1996 Q2, 1997 Q4, 2000 Q3, 2002 Q4, 2004 Q2

[1] *Permanent income is approximated by the consumption expenditure.*

Even without any formal test, it is apparent that the trend of financial wealth per income ratio broke around 2000. As it was outlined in the stylized facts, this phenomenon is owing to the expansion of households' liabilities. Structural break tests strengthen this notion (see Table 1). The major breaks of financial wealth/income correspond to the extension of HUF denominated consumption loan, started around the first quarter of 1998, the significant increase in HUF-denominated mortgage loan started around 2000 and the expansion of FX-denominated consumption loan and housing credit since the first quarter of 2003.

The main house price increase between 1998 and 2003 is underpinned by the estimated location of structural breaks. Besides, we found a structural break around the third quarter of 2000, which can refer to the extension of subsidy scheme to second-hand housing market. Albeit the estimated structural break locations can be straightforwardly assign to the changes in housing subsidy system, they could be the effect of other demand shifters, i.e. income and financial market environment.

Chart 5

Demand shifters of housing demand: income and interest rate of housing loan
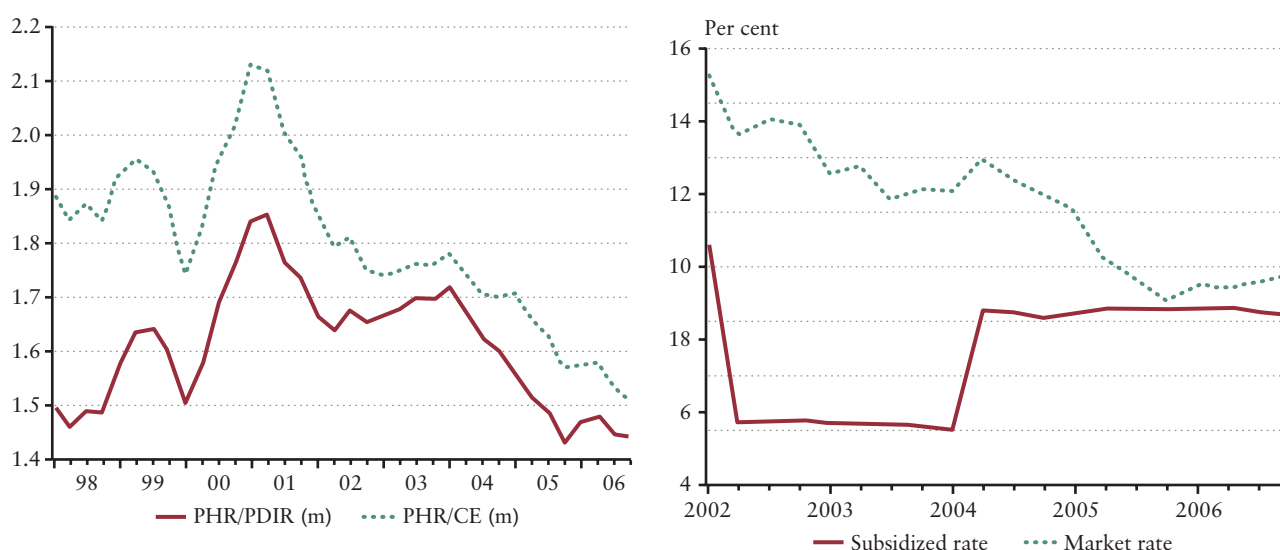
Note: PHR, PDIR(m) and CE(m) denote the relative house price per square meter, real monthly disposable income and real monthly consumption expenditure.

It is apparent that the increasing income could also induce soaring house prices. However, both current and permanent income can influence housing demand. As for current income, the stylized fact section indicated that the house prices might grew faster than income. In order to obtain more precise result, we examined the ratio of house prices to income (see the panel of Figure 5). Since tests essentially indicate the same breakpoints for house prices and the house price per income ratio, we can conclude that soaring disposable income is not sufficient to explain the significant increase in house prices. As for permanent income or income expectation, we apply a common assumption, namely, consumption expenditure is set in line with income expectation, hence the increase in the ratio of consumption to current income indicates soaring income expectation. According to this assumption, permanent income increased evenly from 1998 to 2003 and remained around that level. On the one hand, house prices also increased considerably between 1998 and 2003 implying that increasing income expectation also influenced house prices. On the other hand, house prices display higher volatility, which is easily connected to the elements of subsidy scheme (see left of Figure 5). Besides, house prices have declined since 2003 meanwhile the income expectation remained at high level. Applying formal tests, we obtain essentially the same breakpoints again. Consequently, it seem increasing permanent income also played part in house price increase, however, the main variation from 1998 to 2003 and the decline since 2003 cannot be explain by the permanent income component.

Turning to the financial market circumstances (see right panel of Figure 5), it is apparent that the financial market environment cannot explain the path of house prices. In contrast to long segment of yield curve, the market rate of housing loan did not increase. However, the subsidized rate jumped in the beginning of 2004 along with the reduction of loan-ceiling.

As for housing stock, tests are not able to detect any structural change[6]. Given that housing wealth is the multiplication of housing stock and house prices it is apparent to observe the same structural breaks in housing wealth as in house prices. In the following parts, we put these finding into international perspective and attempt to find explanation for them.

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[6] One might argue that the housing stock time series has low variance, therefore, structural break tests are not able to detect the changes. Albeit this statement has no theoretical foundation, in order to check the robustness of our results, we simulate a time series with the characteristics of housing stock and, in the middle of the sample new housing starts has been increased by 10 percent, which is equivalent to 0.1 percent change in housing stock growth rate. Tests were able to detect the presence and location of break.

3. International comparison and steady state wealth ratios

Previous section revealed the wealth level of Hungarian households, however, it is unexplored so far whether Hungarian wealth level is high, low or is expected to soar or decline in the future. There are two frequent approaches to conduct empirical evaluation on this issue: cross-country comparison and econometric methods.

The use of cross-country data reveals the relative wealth position of different counties, which might identify whether a country's wealth elements are far from the international experience. Table 2 displays the related values of G7 countries and Hungary. In addition, we also display Portugal since it is generally considered as the most similar country to Hungary.[7]

Table 2

International comparison of households' wealth (2003)

as a percentage of disposable income							
Net financial wealth		**Housing wealth**		**Durable goods[1]**		**Total wealth**	
Country	**Ratio**	**Country**	**Ratio**	**Country**	**Ratio**	**Country**	**Ratio**
Japan	369	Italy	477	Japan	158.7	Italy	903
USA	294	UK	381	Italy	142.6	Japan	744
Italy	283	**Hungary**	**346**	UK	72.4	UK	703
UK	249	France	318	Canada	71.0	France	585
France	233	Germany	268	Germany	70.0	USA	540
Canada	226	Portugal	226	USA	61.2	Canada	519
Germany	169	Canada	222	**Hungary[2]**	**60**	Germany	507
Portugal	155	Japan	216	France	33.7	**Hungary**	**504**
Hungary	**98**	USA	184.0				

financial wealth elements as a percentage of net financial wealth							
Shares & Equitiy[3]		**Mutual funds**		**Loans**		**Mortgage**	
Country	**Ratio**	**Country**	**Ratio**	**Country**	**Ratio**	**Country**	**Ratio**
USA	38.0	Italy	17.0	Portugal	73.1	Germany	43.3
France	25.9	Germany	12.0	Germany	66.4	UK	41.0
Portugal	21.0	France	10.0	UK	55.6	Canada	32.2
Italy	18.0	USA	10.0	USA	39.9	USA	28.4
UK	11.0	Portugal	9.0	Japan	36.4	Portugal	28.2
Germany	10.0	**Hungary**	**7.6**	Canada	36.1	France	24.9
Japan	9.0	Canada	6.3	France	32.7	Japan	16.8
Hungary	**7.3**	UK	5.0	**Hungary**	**28.0**	Italy	11.5
Canada	6.9	Japan	2.0	Italy	18.0	**Hungary**	**11.3**

Sources: Annex to OECD's Economic Outlook (December 2005), Cardoso and Cunha (2005), Eurostat, Magyar Nemzeti Bank, Statistic Canada and own calculations.

[1] For estimation details see Section A. 1. 2.

[2] Based on expertise judgment.

[3] Excluding mutual funds.

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[7] As for general aspect, in addition to geo- and demographical similarities, Portugal is the closest EU member country to Hungary in Human Development Index ranking (Portugal is 28th while Hungary is 35th on the list, for more details see Human Development Report 2006). As for specifics, the popularity of FX denominated loans indicates that Hungary will likely not follow a moderate path; the dynamics observed in Hungary probably mirror the dynamics observed in Portugal, where mortgage loans rose to almost 50 per cent of GDP in the last 10 years.

As for net financial wealth concern, Kirsanova and Sefton (2007) showed the importance of institutional environment, for instance pension system, in connection with saving behavior. Since Hungarian institutional environment is likely to be closer to German system than Anglo-Saxon system[8] we can conclude that the ratio of financial wealth is expected to increase in the future, however, it is not likely to increase rapidly and reach the UK or US level. As for the elements of financial wealth concerns, it is worthy to outline that the share of mutual funds, liabilities and mortgage loans have increased significantly since 2003. These ratios soared to 12, 46 and 19 percent respectively by the end of 2006, consequently, attained at internationally standard share relative to net financial wealth. However, since the ratio of net financial wealth to income has not increased, the proportions of these wealth elements relative to income are still low.

Contrary to net financial wealth, housing wealth seems to be high relative to other countries. The level of housing wealth became more extraordinary if we consider the ratio of housing wealth to financial wealth, which is 3.5 in Hungary, meanwhile the next closest value is 1.6 in Italy. Assuming that the financial wealth ratio converges to the German level and housing wealth stays still, Hungarian housing per financial wealth ratio still remains to be the highest. This relative wealthiness could have a serious implication on how housing wealth react to different shocks.

The other and more formal empirical approach to examine the equilibrium wealth level is the application of econometric methods. Generally, to detect significant deviation from steady state wealth ratio, this approach applies error-correction model (ECM) between financial wealth and households' income. The equilibrium is attained when the error correction part is zero. Consequently, this method seeks the wealth level that makes the long-run part equal zero at a certain income level.[9]

Nevertheless, this direct methodology leaves out an important factor, namely, the ECMs are dynamic models, hence, extracting the long-run part as static equation rules out additional information. It can be shown that not only the level of income but also its growth rate determines the steady state consumption/income and wealth/income ratios (for details see Section A. 2). More formally, the steady-state wealth/income ratio is negative function of the income growth rate.

In order to be able to calculate steady state wealth ratios we apply the Quarterly Projection Model of MNB (Benk et al, 2006) parameters for consumption function defined in equation (A-1). Table 3 displays the solution to the steady state wealth rate based on equation (A-10).

In line with the international comparison, Table 3 also indicates that the recent financial wealth level of Hungarian households is still relatively low. Based on the range of estimations, the ratio of financial wealth to income is likely to converge to the Portugal or German values, which is around 1.5, which is in line with the assumption of institutional similarities.

Table 3

Structural breaks of wealth elements[10]

g	Financial wealth only in cons. equation				Financial and housing wealth in cons. equation			
	HFW/PDI	NFS/PDI	HHW/PDI	HI/PDI	HFW/PDI	NFS/PDI	HHW/PDI	HI/PDI
1	136	1.4	108	1.1	205	2.0	162	1.6
2	126	2.5	197	2.0	148	2.9	231	2.3
3	117	3.5	271	2.7	121	3.6	280	2.8
4	110	4.3	335	3.4	104	4.1	318	3.2

Results are in percentage points. g, NFS and HI denote the annualized growth rate of income, net financial savings and housing investment respectively.

[8] The importance of redistribution in social welfare expenditures, which has significant effect on saving behavior, is more emphasized in Germany and Hungary than in Anglo-Saxon countries. For instance, Queisser and Whitehouse (2006) provide detailed comparison of pension systems.

[9] Justification of such an approach could come from ECM-type consumption functions. Incorporating financial wealth in consumption function is widespread, see for instance Muellbauer and Lattimore (1995), Fagan et al. (2001) among others. After housing market booms in some countries it became inevitable that financial wealth is not sufficient to explain the wealth effect on consumption. As a result, many macro models and analysis, such as Girouard and Blöndal (2001), Case et al. (2005) and Paiella (2007), incorporate housing wealth into consumption function. Under the assumption of long-run homogeneity the ECM-type consumption ensures stable consumption/income and wealth/income ratios. Therefore, this direct estimation between wealth and income seemingly provides appropriate results.

[10] Gauss program for computing steady state ratios is downloadable from www.vadasg.extra.hu/codes.html.

Another important implication is in connection with the financial savings rate (NFS/PDI). This estimation underpins the suggestion of Zsoldos (1997), namely the so-called saving miracle in the early and mid '90s, i.e. 15% or higher financial saving rate, was merely induced by the reallocation between housing and financial wealth. Consequently, unless another significant shock occurs, it is unlikely to experience such a high financial savings rate again.

Contrary to the financial wealth, where every equilibrium wealth ratio is higher than the actual one, the current share of housing wealth is not evidently below the equilibrium level. Again, the importance of this result is essential when we evaluating how housing market and housing wealth react to different shocks.

4. A simple model of housing market

The above outlined empirical tests help to identify whether data reveal any significant changes or patterns that we expect based on intuitions. If so, it is worth checking whether there is any theoretical explanation for these results. If not, it is essential to find theoretical underpinnings why our expectations are not detectable in the data. Since housing wealth of Hungarian households is considerable and structural break tests indicated several breakpoints around the housing subsidy scheme, the following part establishes a modeling framework in which the housing market plays central role, therefore, empirical findings can be put into economics perspective.

As Hungarian housing market was mainly influenced by the governmental subsidy scheme, Poterba (1984) model, which is designed to analyze such subsidies, is an appropriate baseline framework. Two basic equations are the no-arbitrage condition, i.e. the return on real and financial assets are equal, and the transition equation of housing stock *(HS)*:

$$\Delta PH_{r,t+1} = (r_t + \delta)PH_{r,t} + \tau_t - R(HS_t) \tag{1}$$

$$HS_{t+1} = (1-\delta)HS_t + \Psi(PH_{r,t}) \tag{2}$$

where PH_r, τ and δ denote the real or relative house price, the tax on housing and the depreciation of housing stock. Since Hungarian housing subsidy scheme supports households by the use of interest rate subsidy, we denote this subsidy by *rs*.

In addition, two points are worthy of note. First, this setup pays no attention to the effects of housing market on the other aspects of households' decision problems. House prices also affect consumption expenditure, see for instance Shiller (2004), Carroll et al. (2006), and hence financial savings. Second, the assumption of the model is that $\Psi(.)$, i.e. housing investment function, is increasing in its only argument, i.e. house price.

Note that these omitted factors can be taken into account by the extension of $\Psi(.)$ function. There are two channels through which house price influences the start of new construction. The one is the above-mentioned substitution effect between housing and consumption. Apparently, higher house price induces shift toward consumption, therefore, reduces the gross savings, which is the sum of financial saving and dwelling investment. The other channel is how the return on housing, which is influenced by house price, affects the households' portfolio allocation between financial saving and dwelling investment. The higher the change in house price the more excess return can be realized on real assets, therefore, dwelling investment becomes more attractive. Based on this line of reasoning the model can be reformulated the following way:

$$\Delta PH_{r,t+1} = (r_t + \delta)PH_{r,t} - rs_t - R(HS_t) \tag{1'}$$

$$HS_{t+1} = (1-\delta)HS_t + \eta(g_{PH,t}, r)(PDI_{r,t} - C_t)/PH_{r,t} \tag{2'}$$

where g_{PH} denotes the growth rate of house prices. Evidently, the transition equation of financial wealth (HFW_r) is:

$$HFW_{r,t+1} = (1+r)HFW_{r,t} + \left[1 - \eta(g_{PH,t}, r)\right](PDI_{r,t} - C_t) \tag{3}$$

In order to close the model, one should note that the housing wealth, as it has consumption value through housing service, enters in utility function. The use of wealth elements in utility function is also underpinned by Bruce et al. (2004) estimation. Assuming CES utility function we obtain $U(C,HS) = (C^{(\sigma-1)/\sigma} + HS^{(\sigma-1)/\sigma})^{\sigma/(\sigma-1)}$, where C and σ denote the consumption expenditure and the elasticity of substitution, consequently:

$$\ln\left(\frac{C_t}{HS_t}\right) = \sigma \ln\left(PH_{r,t}\right) \tag{4}$$

Note that $\partial\eta/PH_r > 0$, as in Vadas (2004), implies $\Psi' > 0$ and $\sigma = 0$ reduces the extended model to the original Poterba model.

5. Theoretical description of wealth development

To verify the empirical results and stylized facts we estimate the parameters of the above described theoretical framework on Hungarian data (see the estimation details in Section A. 3) and simulate the effect of housing subsidy scheme. Nevertheless, two modeling details have to be established. First, the governmental subsidy scheme, as it was outlined, has altered continuously. Setting that number of shocks would render the evaluation of impulse responses cumbersome. Since the most significant effect on housing market was the extension of subsidy scheme to the second-hand housing market in 2000, besides this was the year when the mortgage loan began to soar, the model is shock by a permanent decrease in mortgage rate started at 2000 Q1. Second, in order to gain practical use of the model, the impulse response functions and the data have to be comparable. As there is only one observation for real data, it is challenging to generate 'real' data without shocks, i.e. baseline data of house prices, housing stock, consumption and financial wealth.

As for house prices, the main factor in inverse demand function is the housing stock, mortgage rate, disposable income and population. Two out of four demand shifters, namely personal disposable income and population, are assumed to be unaffected by housing subsidy scheme[11] Since house price can react to any shocks immediately, the effect of housing stock and mortgage rate can be filled out by keeping the ratio of house price to disposable income times population constant at its 2000 Q1 level. To put it differently we assume that if the subsidy scheme had not been introduced every fluctuation in house prices would have been caused by the variations of disposable income and population. Consequently, any change in house price/income×population relative to its value in 2000 Q1 is resulted by the subsidy scheme that alters the housing stock and mortgage rate.

Since the housing stock adjusts sluggishly the above trick cannot be applied to the housing stock. A possible way to generate baseline 'fact' would be to set up an empirical equation in which the right hand side variables contains income, population etc. and generate forecast with unaltered mortgage rate. Unfortunately, in this approach we implicitly reformulate the model; therefore, instead of baseline 'fact' we obtain the baseline of the model. Consequently, only univariate methods are applicable so the most common approach, HP filter, is invoked. The apparent caveat of HP filter is that it overestimates trend values when the sample ends in positive cyclical phase. To control this phenomenon we estimate a simple linear time trend up to 1999 Q4 and generate out-of-sample forecast. Obviously, the forecasted trend values are seriously underestimated as the substantial increase in income growth since 2000 is completely omitted. Nevertheless, the two cyclical components depict reasonably same pattern hence we use the HP filtered values.

Although the consumption expenditure, due to habit formation, may not adjust as fast as house prices do, however, similar approach is justifiable. The main demand shifters of aggregate consumption are real income, financial and housing wealth. Among these factors only income is unaltered by housing subsidy scheme, therefore, any change in the ratio of consumption to income relative to its value in 2000:q1 is considered as the effect of subsidy scheme on consumption.

Finally, the baseline 'fact' of financial wealth has to be identified. Fortunately, as the lower-right panel of Figure 1 clearly reveals, the stagnation of financial wealth/income is owing to the extension of housing loan. So we assume that households' saving behavior remain the same as it was before 2000 and the ratio of financial wealth to income converges to the Portugal value, i.e. 150 percentage. This convergence path implies 126 percent financial wealth per income ratio at the end of 2006.

With the 'fact' baseline in hand the 'fact' impulse response can be computed. The impulse response of the model is based on 5 percentage point permanent decrease in mortgage loan rate, which is a reasonable proxy for the difference between unsupported and supported interest rate of housing loan.

Throughout the simulation exercise, we compare the 'facts' and two model results: in which there is no substitution between consumption and housing *(σ =0)* that is the Poterba (1984) model and in which *σ* = 0.18. Both 'facts' and simulated house prices display a clear pattern of overshooting. Obviously, in the case of no substitution effect, all government subsidy remains in housing market inducing more dwelling investment and hence higher housing stock, which in turn, reduces the housing

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[11] High owner-occupancy rate in Hungary implies minuscule income from rental fees hence house price fluctuation alters the disposable income marginally.

price in faster pace. The moderate response of housing stock is owing to several factors. First, the initial level of housing wealth was high in Hungary, therefore, stimulating a variable that is not below its steady state level is likely to generate moderate effect only. Second, housing stock, hence housing supply, is entirely inelastic in short-run, consequently the immediate effect of higher demand generated by housing subsidy scheme is the soaring house prices merely. Furthermore housing stock adjust slowly, therefore, even such a considerable price increase induces feeble response in housing stock in medium-run. Even though that generous subsidy scheme had been maintained, the long-run increase in housing stock would have been 1 percent higher only[12]. The convergence to the new equilibrium level would have taken 41 years while the half-life is 9 years. Accompanying this slow adjustment with the tightening of subsidy scheme at the end of 2003, which is clearly recognizable in 'fact' house prices, it is not surprising why empirical test did not reveal any significant increase in housing stock. Concisely, housing subsidy scheme has its major effect on house prices rather than housing stock.

Housing subsidy scheme definitely influenced both consumption and financial saving decisions. As for consumption, the original Poterba does not suggest anything about consumption, however, it would be unreasonable to assume complete independence. Therefore, consumption is allowed to response to wealth effect but we exclude substitution effect. Evidently,

Chart 6

Simulation results

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[12] There is marginal difference in simulation runs in long-run. The discrepancy between the new housing stock levels is within 0.1 percent.

more considerable consumption response is observed when both effects are presented. Although, housing subsidy scheme had a significant effect on consumption expenditure it is not enough by itself to explain the consumption boom in Hungary. One of the omitted factors is the households' perception about their current situations. The considerable upsurge of disposable income in early 2000 probably increased households' willingness to consume more out of their income and wealth. The high propensity to consume out of wealth is underpinned by simulation results. Even in the presence of substitution effect, the simulated financial wealth rates are higher than the 'facts' indicating that the optimistic attitude of households[13] encourage them to take out loans to finance further increase in consumption.

Based on these results we can conclude that the 'saving disaster', i.e. near to zero or even negative financial saving rate, experienced in early 2000's, to a certain extend, is the other side of the 'savings miracle' of early 90's. While in the early 90's households rearranged their wealth from housing to financial wealth implying decreasing real house prices and housing wealth, from 2000 the increasing demand for housing and soaring house prices, via housing loan, vanished financial savings. Unfortunately, this reallocation did not induce higher housing stock partly because the initial housing wealth was high hence the primary effect was increasing house prices and partly because it would have required extremely long time to reach the new, otherwise marginally higher, equilibrium level.

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[13] Households confidence index reached its all-time high value in 2002.

6. Summary

The aim of this study was to conduct thorough evaluation of the entire wealth of Hungarian households and to challenge the urban legend about households' wealth by evaluating its development in connection with economic events. In order to do so, the stocks of housing and consumer durables are also presented. According to our approximations, the housing wealth in 2005 is slightly more than three times as high as annual income, meanwhile the durable consumption good wealth is approximately 60 percentage of the annual income. Putting these together with financial wealth the total wealth of Hungarian households is roughly five times as high as annual income. Since the housing wealth is at least three times bigger than the next wealth element, which is the financial wealth, the overall pattern of households' wealth is determined by housing wealth.

Based on the implied equilibrium ratios of ECM form consumption function, it seems the recent wealth level of Hungarian households is still relatively low; as the steady state ratio is around 150 percentage of annual personal income, which is close to German or Portuguese levels. Contrary, the current share of housing wealth is not evidently below the equilibrium level.

Even though the financial asset/income ratio continues to increase along the same trend the households' liabilities have expanded at higher pace since 2000 implying that the ratio of net financial wealth to income remained at the same level since then. It is apparent that the 'saving disaster', to a certain extent, is the other side of the 'savings miracle' of early 90's. The governmental housing subsidy scheme increased demand for housing and induced mainly soaring house prices, which, via housing loan, vanished financial savings. Nevertheless, our empirical results and model simulation indicate marginal effect on housing stock, which is owing to several factors. First, the initial level of housing wealth was high in Hungary, therefore, stimulating a variable that is not below its steady state level is likely to generate moderate effect only. Second, housing stock adjusts slowly. Even a considerable price increase induces feeble response in housing stock in short-run. Convergence to the new equilibrium level, in which the housing stock would have been 1 percent higher only, would have taken 41 years. Accompanying this slow adjustment with the tightening of subsidy scheme at the end of 2003 it is not surprising why we cannot detect any significant increase in housing stock.

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A. Appendix

A.1. ESTIMATION OF HOUSEHOLDS' WEALTH

One of the primary goals of this study is to provide estimation for financial wealth, housing wealth and the stock of durable consumption goods of Hungarian households. Fortunately, as we mentioned above the financial wealth of households is accessible. On the contrary neither housing nor durable consumption stock is available. The following part provides estimations for these wealth elements. Obviously, these approximations could be suitable for any theoretical or empirical analysis, however, cannot be considered as official statistics.

A.1.1. Housing wealth estimation

Since there is no official data for housing wealth it has to be estimated based on the available data. In theory, this estimation is a sole matter of multiplication:

$$HHW_t = HS_t \cdot \overline{A}_t \cdot \overline{PH}_t$$

where HHW, HS, $\overline{A}$ and $\overline{PH}$ denote households' housing wealth, number of apartments, i.e. housing stock, average apartment size and average price per square meter. The challenging issue is to obtain these data.

As for the housing stock, the initial point is the censuses of number of flats and houses in Hungary. Theses surveys were conducted by Hungarian Central Statistical Office (HCSO) in 1990 and 2003. Using the quarterly statistic of finished constructions and demolitions of dwellings the missing stock data between and after these dates can be computed. Fortunately, the average apartment size is also published by HCSO.

As for average price per square meter, it is difficult to obtain applicable price. HCSO publishes a yearbook on house prices starting from 1997; however, this contains square meter prices only for those streets where at least three real estates have been sold. These data are based on the official record of Hungarian Duties Office. Since only the county-level housing stocks are available, average house price time series has to be created. Using the unprocessed HCSO data the necessary aggregation can be done in two steps. First, erroneous records have to be filtered out. We consider a record valid if the size of the flat is between 20 and 600 square meter *and* its price is between 1 and 600 million HUF *and* the square meter price is between 50 thousand and 1 million HUF. Note that all of the three conditions used simultaneously can identify the problematic records. Second, average house prices are calculated by rescaling the county level transactions with the counties' housing stocks.

A.1.2. The stock of consumer durables

There are two statistics at our disposal that can be exploited to estimate the stock of consumer durables: the current expenditure on durable consumption goods and the number of durable goods per 100-household. Although the latter one could seem promising, data such as there are 50 cars in 100 households is rather insufficient because we have to find average price to every durable branch for all periods. Consequently, we apply a perpetual investment method as in the Hungarian capital stock estimation of Pula (2003), however, we assume that the duration of consumer durables follows a Weibull distribution. Therefore, the stock of these goods is determined by the expenditure on durables multiplied by the survivor function:

$$HDW_t = \sum_{s=0}^{S} C_{D,t-s} \exp\left[-\left(s/\lambda\right)^k\right]$$

where C_D, k, λ and S denote the spending on durable consumption, the shape and scale parameters of Weibull distribution and the scrapping age respectively. Spending on durable consumption is available from 1995 to 2004. Fortunately, the ratio of durable goods expenditure to the entire consumption is reasonably stable. It stays between 14 and 15 percent until 2001

and increases up to 17 percent by 2004. Consequently, we assume 14-percentage share before 1995 and 17-percentage share after 2004. Although PIM requires long time series, due to the poorer quality and comparability problem of statistics before the regime change, we start our sample from 1991.

The average service life and the first-year depreciation assumptions pin down the shape and scale parameters. As vehicles represent the major part of consumer durables the assumption on their average age is essential. Fortunately, HCSO data are available showing that the average age of vehicles was 10.31 in 2006. With assumptions on the other parts[14], the estimated average age of durables is 9.15 year. Knowing that the mean value of Weibull distribution is $\lambda \, \Gamma \, (1+1/k)$, where Γ is the gamma function, the scale parameter can be defined by $\lambda = 9.15/\Gamma(1+1/k)$. To define the shape we calibrate the first year depreciation to 20 percent based on expertise information. At first glance, it may seem too high, however, the first year depreciation of vehicles, depending on their types, can be even 30-50 percent. As a result $k=0.739$ and $\lambda=7.584$.

As for scraping age, there is no standard statistic to be applied. The only technical data that can be used is again related to cars. Based on general technical specifications the scrapping age of cars, in average, is around 15 years[15]. Assigning scrapping ages to every other durable branch the average scrapping age becomes 13.8 year. In the time of scrapping, the value of durable goods is less than 20 percent of the original value.

Using the above-defined parameters the estimated stock of consumer durables is 8617 and 9363 billion HUF in 2005 and 2006 respectively, which is between 64 and 69 percentage of annual disposable income. In order to obtain an approximate cross-check estimation the number of durable goods per 100-household can be applied by assigning average price to every durable branch. Using expertise price estimations the stock is in line with the PIM method.

Table 4

Estimated wealth of Hungarian households

Year	House price/m² (thousand HUF)	Wealth (billion HUF)			Wealth (% of personal income)		
		Financial	Housing	Durables	Financial	Housing	Durables
1991	54.1	853	12,775		47	701	
1992	57.3	1,300	13,622		60	634	
1993	57.8	1,672	13,799		68	559	
1994	62.3	2,070	14,926		70	505	
1995[1]	67.0	2,652	14,644		71	394	
1996	79.0	3,519	18,114		78	400	
1997	73.5	4,536	17,887		84	333	
1998	75.5	5,744	17,989		91	286	
1999	90.9	6,898	21,554		100	311	
2000	105.3	8,126	25,457		103	323	
2001	132.6	9,175	33,102		102	366	
2002	136.1	10,205	33,862		102	338	
2003	150.9	10,757	37,793		98	346	
2004	164.6	11,451	41,545		95	344	
2005	165.5	12,854	42,148	8,617	96	314	64
2006	163.6	13,821	41,983	9,363	102	309	69

[1] *The dynamics of house price and housing wealth estimation before 1995 is based on Zsoldos (1997) in which the house prices were proxied by the market value of apartments sold by local governments. Data are in current price.*

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[14] Refrigerator: 5 years, microwave oven: 5 years, washing machine: 8 years, TV: 5 years, CD-DVD player: 2 years, camcorder: 4 years, PC: 2 years and mobile phone: 2 years.

[15] Car engines are generally running at 250-300 thousand kilometers. The average use of cars is 15 thousand kilometers per year, which implies 15 service lifetime.

A.2. CONNECTION BETWEEN INCOME GROWTH AND EQUILIBRIUM WEALTH RATIOS

There are several approaches how to model households' behavior. Muellbauer and Lattimore (1995) provide a straightforward connection between theoretical and empirical consumption function. Aron and Muellbauer (2006b) argue for the separation of wealth element and several other control variables that are generally omitted from consumption function. However, due to the available sample span, the number of control variables has to be limited hence the applicable consumption function is the following

$$\Delta \ln C_t = -\beta_1(\ln C_{t-1} - \alpha_0 - \alpha_1 \ln PDI_{r,t-1} - \alpha_2 \ln HFW_{r,t-1} - \alpha_3 \ln HHW_{r,t-1})$$
$$+ \beta_2 \Delta \ln C_{t-1} + \beta_3 \Delta \ln PDI_{r,t} \tag{A-1}$$

where C, PDI_r, HFW_r and HHW_r denote the consumption, personal disposable income, households' financial and housing wealth in constant price respectively. The two intertemporal budget constraints are the same as in equation (2') and equation (3).[16]

$$HFW_{r,t} = (1+r)HFW_{r,t-1} + (1-\eta_{t-1})(PDI_{r,t-1} - C_{t-1}) \tag{A-2}$$

$$HHW_{r,t} = (1+g_{ph,t})\left[(1-\delta)HHW_{r,t-1} + \eta_{t-1}(PDI_{r,t-1} - C_{t-1})\right] \tag{A-3}$$

where $\eta_t = \eta(g_t, r_t)$ denotes housing investment/gross savings[17], consequently, $1-\eta_t$ denotes the ratio of financial savings to gross savings, therefore $0 < \eta < 1$. gph and denote the growth rate of house price and the amortization rate respectively. Let g denote the long-run growth rate of potential GDP. As the labor income share is constant in long-run, g also defines the growth rate of personal disposable income, hence $PDI = (1+g)PDI_{r,t-1}$. Expressing C_t from equation (A-1) and dividing by $PDI_{r,t}$ we obtain

$$\frac{C_t}{PDI_{r,t}} = e^{\beta_1\alpha_0}(1+g)^{\beta_3} \frac{\left(\dfrac{C_{t-1}}{PDI_{r,t-1}}\right)^{1-\beta_1+\beta_2}\left(\dfrac{HFW_{r,t-1}}{PDI_{r,t-1}}\right)^{\beta_1\alpha_2}\left(\dfrac{HHW_{r,t-1}}{PDI_{r,t-1}}\right)^{\beta_1\alpha_3}}{\left(\dfrac{C_{t-2}}{PDI_{r,t-1}}\right)^{\beta_2}} \frac{PDI_{r,t-1}^{\beta_1\alpha_1+1-\beta_1+\beta_2+\beta_1\alpha_2+\beta_1\alpha_3}}{PDI_{r,t}PDI_{r,t-2}^{\beta_2}} \tag{A-4}$$

Let $\gamma_t = C_t/PDI_{r,t}$, $\omega_{f,t} = HFW_{r,t}/PDI_{r,t}$ and $\omega_{h,t} = HHW_{r,t}/PDI_{r,t}$[18], use that, and suppose that $\exists \gamma = \lim_{t \to \infty} \gamma_t$, $\exists \omega_f = \lim_{t \to \infty} \omega_{f,t}$ and $\exists \omega_h = \lim_{t \to \infty} \omega_{h,t}$, then we get from equation (A-4) that

$$\gamma = e^{\beta_1\alpha_0}(1+g)^{\beta_2+\beta_3-1+\beta_1(\alpha_1+\alpha_2+\alpha_3-1)}\gamma^{1-\beta_1}\omega_f^{\beta_1\alpha_2}\omega_h^{\beta_1\alpha_3} \tag{A-5}$$

Due to the long run homogeneity we may restrict $\alpha_1 + \alpha_2 + \alpha_3 = 1$ and based on Vadas (2004) we impose $\beta_2 + \beta_3 = 1$. In this case equation (A-5) simplifies to the following form:

$$\gamma = e^{\alpha_0}\omega_f^{\alpha_2}\omega_h^{\alpha_3} \tag{A-6}$$

Now turn to the intertemporal budget constraint of financial wealth, the equation (A-2) can be rearranged:

$$\frac{HFW_t}{Y_t} = \frac{1}{1+g}\left[(1+r)\frac{HFW_{t-1}}{Y_{t-1}} + (1-\eta_{t-1})\left(1 - \frac{C_{t-1}}{Y_{t-1}}\right)\right]$$

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[16] Note that equation (A-3) and equation (2') are equivalent since $HHW_{r,t} = PH_{r,t}HS_t$ and $1+g_{ph,t} = PH_{r,t}/PH_{r,t-1}$.

[17] Gross savings (financial savings plus housing investment) is the difference between income and consumption.

[18] One should note the difference between ω and generally displayed HFW/PDI_r ratio. ω means the ratio of the stock of financial wealth to income no matter whether they are annual or quarterly data. Meanwhile, the ratio of wealth to income is generally considered as a ratio of wealth to the annualized income.

With γ_t and $\omega_{f,t}$ as above we have:

$$\omega_{f,t} = \frac{1}{1+g}\left[(1+r)\omega_{f,t-1} + (1-\eta_{t-1})(1-\gamma_{t-1})\right]$$

In addition to $\exists \gamma = \lim_{t\to\infty} \gamma_t$ and $\exists \omega_f = \lim_{t\to\infty} \omega_{f,t}$ suppose that $\exists \eta_h = \lim_{t\to\infty} \eta_{h,t}$, thus we get

$$\gamma = 1 - \frac{g-r}{1-\eta}\omega_f \qquad \text{(A-7)}$$

Before applying the same procedure to the budget constraint of housing wealth (equation (A-3)), based on Kiss and Vadas (2007), we assume that $g_{ph}=g$. As a result we obtain

$$\gamma = 1 - \frac{\delta}{\eta}\omega_h \qquad \text{(A-8)}$$

From equation (A-7) and (A-8) it is apparent that

$$\frac{\omega_f}{\omega_h} = \frac{1-\eta}{\eta}\frac{\delta}{g-r}$$

Consequently, $\omega_h = \omega_f \eta(g-r)/((1-\eta)\delta)$ hence equation (A-6) has the following form

$$\gamma = e^{\alpha_0}\left(\frac{\eta}{1-\eta}\right)^{\alpha_3}\left(\frac{g-r}{\delta}\right)^{\alpha_3}\omega_f^{\alpha_2+\alpha_3} \qquad \text{(A-9)}$$

Combining equation (A-7) and (A-9) yields

$$1 - \frac{g-r}{1-\eta}\omega_f = e^{\alpha_0}\left(\frac{\eta}{1-\eta}\right)^{\alpha_3}\left(\frac{g-r}{\delta}\right)^{\alpha_3}\omega_f^{\alpha_2+\alpha_3} \qquad \text{(A-10)}$$

Note that if there is no housing wealth in consumption function ($\alpha_3=0$) the problem is simplified to $1-(g-r)/(1-\eta)\omega_f = e^{\alpha_0}w_f^{\alpha_2}$ and all the following results remain true.

To find the relation between ω_f and g rewrite equation (A-10) as

$$F(g,\omega_f) = e^{\alpha_0}\left(\frac{\eta}{1-\eta}\right)^{\alpha_3}\left(\frac{g-r}{\delta}\right)^{\alpha_3}\omega_f^{\alpha_2+\alpha_3} + \frac{g-r}{1-\eta}\omega_f - 1 = 0$$

Let $\omega_f=f(g)$, then we get $F(g,f(g))=0$. Differentiating with respect to g and expressing $f'(g)$ yields

$$f'(g) = -\frac{\partial F/\partial g}{\partial F/\partial \omega}$$

It is apparent that the first derive of $f(g)$ is negative, which means that ω_f is decreasing function of g, if $\partial F/\partial g$ and $\partial F/\gamma$ have the same sign.

$$\frac{\partial F}{\partial g} = e^{\alpha_0}\alpha_3\left(\frac{1}{\delta}\right)^{\alpha_3}\left(\frac{(1-g)(g-r)}{1-\eta}\right)^{\alpha_3-1}\left(\frac{\eta(1-\eta)+\eta'_g(g-r)}{(1-\eta)^2}\right)\omega_f^{\alpha_2+\alpha_3} + \frac{(1-\eta)+\eta'_g(g-r)}{(1-\eta)^2}\omega_f$$

To define the sign of this expression we invoke the result of Vadas (2004), namely η (.) is increasing in the excess return on dwelling investment, implying $\eta'_g = \partial\eta(g,r)/\partial g > 0$ and $\eta'_r = \partial\eta(g,r)/\partial g < 0$. These results are also reinforced by our estimation presented in the next section. Since $\eta'_g > 0$ it is apparent that $\partial F/\partial g > 0$.

$$\frac{\partial F}{\partial \omega} = (g-r)/(1-\eta) + e^{\alpha_0}\left[\eta/(1-\eta)\right]^{\alpha_3}\left[(g-r)/\delta\right]^{\alpha_3}(\alpha_2 + \alpha_3)\,\omega_f^{\alpha_2+\alpha_3-1} > 0$$

therefore $f'(g) < 0$, hence ω_f is decreasing function of g.

As for the ratio of two wealth elements concerns, the steady state ratio of housing wealth is also increasing relative to financial wealth as g is increasing, since $\partial(\omega_f/\omega_b)/\partial g = (-\eta'\delta(g-r)-(1-\eta)\delta\eta/\eta(g-r))^2 < 0$.

Worthy of note is how interest rate affect steady state wealth rate. It is intuitively apparent that it has opposite effects. As the interest rate increases, the attractiveness of dwelling investment relative to financial savings decreases implying ω_f is increasing function of g. Formally:

$$\frac{\partial F}{\partial r} = -e^{\alpha_0}\alpha_3\left(\frac{1}{\delta}\right)^{\alpha_3}\left(\frac{(1-g)(g-r)}{1-\eta}\right)^{\alpha_3-1}\left(\frac{\eta(1-\eta)-\eta'_r(g-r)}{(1-\eta)^2}\right)\omega_f^{\alpha_2+\alpha_3} - \frac{1-\eta-\eta'_r(g-r)}{(1-\eta)^2}\omega_f < 0$$

which yields $f'_g > 0$. As for the ratio of financial wealth to housing wealth, $\partial(\omega_f/\omega_b)/\partial_r = ((1-\eta)\delta\eta-\eta'_r\delta(g-r))/\eta(g-r))^2 > 0$, hence the steady state ratio of financial wealth is increasing relative to housing wealth as r is increasing.

There are two important caveats that should be outlined. First, growth rate has to be higher than the interest rate, otherwise the saving rate would have to be negative in order to obtain stable wealth ratios. Second, growth and interest rate are treated as exogenously given. The effect of interest rate on potential GDP growth and hence personal disposable income, however, is far beyond of the scope of the paper.

A.3. ESTIMATION OF MODEL PARAMETERS

The following part outlines the estimation procedure of the model parameters described in Section 4. As for house price equation, we follow the specification of Cameron at al (2006) in which the housing price is obtained as the inverse demand function where the demand for housing is equated to the housing supply (HS, i.e. the number of dwellings). Since the demand function comprises real disposable income (PDI_r), real house price (PH_r), interest rate (r), population (POP) and other demand shifters (d) the house price equation has the following form:

$$\ln(PH_r / POP) = \phi_1 \ln(HS / POP) + \phi_2 \ln r + \phi_3 \ln(PDI_r / POP) + \boldsymbol{\varphi}\mathbf{d} \tag{A-11}$$

The evolution of housing stock is described by the equation (2') in which the start of new house construction is a highly non-linear function of economic factors. Since our data set comprises roughly ten years the estimation of such a complex non-linear function would not be reasonable. Instead of that, we use the following linear model:

$$\ln(I / POP) = \theta_1 \ln(PH_r / POP) + \theta_2 \ln(C / POP) + \theta_3 \ln(PDI_r / POP)$$

Finally, the elasticity of substitution is estimated by the use of equation (4).

$$\ln\left(\frac{C_t}{HS_t}\right) = \sigma \ln\left(PH_{r,t}\right)$$

Table 5

Estimated parameters

Variable	Description	IV	Estimated value	Standard error
ϕ_1	elasticity of house price to housing stock	yes	-8.6	4.71
ϕ_2	semi elasticity of house price to interest rate	yes	-1.8 a	-
θ_1	elasticity of new construction to house price	yes	0.88	0.191
σ	elasticity substitution between cons. and housing	yes	0.18	0.073
δ	depreciation rate (quarterly)	no	0.0023	0.0068

[1] *PMG estimation of Kiss and Vadas (2007).*

Instead of estimating the semi elasticity of house price to interest rate I use the pooled mean group estimation of Kiss and Vadas (2007) as their panel data set comprises broader information content. Nevertheless, equation (A-11) yields $\hat{\phi}_2 = -1.12$ with standard error 0.85 implying that setting ϕ_2 to Kiss and Vadas estimation is an acceptable restriction. Unfortunately, similar panel data cannot be constructed for all our variables, therefore, the rest of the parameter estimation is based on time series only. The results are displayed in Table 5.

Nevertheless, it is worthy of test whether $\partial\eta/\partial p > 0$, which is equivalent to Poterba $\partial\Psi/\partial p > 0$ assumption ignoring the substitution between consumption and housing. An appropriate functional form is $exp(\pi_1 + \pi_2(g_{ph} - r))/[\ 1 + exp(\pi_1 + \pi_2(g_{ph} - r))]$. Estimation yields $\hat{\pi}_2 = 3.2$ with 2.05 standard error, therefore $\partial\eta/\partial PH > 0$ and $\partial\eta/\partial r < 0$ assumptions are applicable.