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Are Housing Markets Decoupled? A Case Study of Residential Real Estate Affordability in Austria

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Real estate arguably forms the most important asset to most households and the basis for their wealth. Around this context a model has been set up testing the relative affordability of real estate for the median household in Austria and the consequences of lower borrowing costs between 2004 and 2013 by vintage year. In this paper the hypothesis that the significant decline in base interest rates is not sufficient to offset the relative affordability loss caused by declining net household incomes and the simultaneous increase of real estate prices. To test this hypothesis a model has been set up comparing two different Housing Affordability Indices – one including and one excluding financing effects, having been compared via a multi factor model. Based on this calculation the author finds decreased base interest rates to offset relative affordability losses by only approximately 50%, verifying the hypothesis. The paper therefore argues for a potential decoupling of the residential housing market in Austria.

Keywords: *Household Income, Taxation, Real Estate, Interest Rates, Debt Service, Austria, Housing Affordability*

JEL Classification: *M20, M21*

1. Introduction. Declining Real Estate Affordability a Global Phenomenon?

Real estate affordability is a vast field of research spanning from the late 18th century, documenting housing costs for worker to highly complex regression models capturing pricing and affordability trends in the recent years. What appears to be worthwhile examining, is that there seems to be a more global trend of depressed housing affordability, comparing the research done by Lin at al. (2014) for Taiwan, Radzimski (2014) for Poland or Kallakmaa-Kapsta and Kolbre (2013) examining the Estonian housing market, all pointing to declining real estate affordability. Despite the findings of three researchers do not constitute the existence of a global trend, the author's interest arose to examine the relationship between household income and real estate prices in Austria, to see if a comparable trend could be also found in this market. The paper therefore tries to develop a model that measures the affordability of real estate housing prices in Austria

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between 2004 and 2013 through a price-to-income measurement and further explore the impact of base interest rate changes on this affordability.

2. Literature Research – Theory and Empirical Background

2.1. Income Hypothesis – Life-cycle Permanent

Tracking income-consumption behaviour theory in social science ultimately leads to the income hypothesis by Keynes (1936), upon which the modern consumption theory, the life cycle permanent income theory, was built. The theory has been prominently tested by Hall (1978) and is still in use by highly regarded research institutions, such as OECD (2004) in their study on housing markets, wealth and the business cycle. But next to consumption functions in theory, actual spending behaviour – notably for housing expenditure – has been tracked since the 18th century.

2.2. Measuring Affordability in the Context of Real Estate - Expenditure to Income

Since the measurement of income is obviously one of the key criterions for assessing the affordability of real estate, we shall explore the findings of past researchers on the measurement of those. Herman Schwabe and Ernst Engel, identified as one of the forefathers of income to housing expenditure research by Stigler (1954), stated an inverse relationship between household income and expenditure for housing. Looking at the spending on rent to household income, a general increase on such spending might be argued over time. While the expenditure was between 5.3% and 4.3% in 1793 for English working families, it had increased to between 8.3% and 9.0% for Belgian workmen's families in 1853, as summarised by Stigler (1954). Despite it might be argued that this is an invalid conclusion on tendencies, Gilderbloom (1985) finds that professional landlords – in his research this group has been defined as those owning more than 50 rental units – apply a common rule of thumb of 25% of household income to housing costs, when assessing tenant quality.

Stone's (2006) finding that this value has been increased further from 25% up to the early 1980's to 30% thereafter. Gan and Hill (2009) find that a 28% cost-to-income ratio being applied by the National Association of Homebuilders in the US. Lin at al. (2014) compare the household's actual budget to purchase a home with the household's permanent income, creating a price-to-income ratio. Conceptually along this lines, despite considering a different format, Radzimski (2014) and Trojanek (2013) also take a housing price to household income ratio to measure the affordability of residential real estate – for their respective studies on Poland. Kallakmaa-Kapsta and Kolbre (2013) also use a household income-to-price ratio – not accounting for a household's spending behaviour – due the lack of data – while examining the Estonian residential real estate market.

We can therefore conclude that the approach to estimate the amount of spending on housing by the respective households might be criticised but even as the latest research shows – at least to the author's knowledge – there is no other approach than to simply ignore the factor of disposable income for housing or apply the rule of thumb that seems to be widely applied by real estate tracking indices and professional landlords.

Hulchanski (1995), reviewing the housing affordability in the context of housing expenditure to income ratios, identifies six sectors of usability for cost to income relationships and its' validity. Rejecting four out of the six areas examined, he finds it a "valid and reliable quantitative indicator in housing research and analysis, depending on the questions asked and the methods used". Despite these aspects, he argues that the "housing outlays" are rather a measurement of liquidity rather than of assets, and he, in principle, finds it a valuable tool to research on trends in the real estate market, measuring comparative positions within. On his liquidity argument the author disagrees since the liquidity is the key determinant of the asset acquisition both in the saving phase, when equity is accrued for the down payment at asset acquisition, and at the time of purchase when the liquidity defines the mortgage amount assumed by the lender to be serviceable by the respective household. Following this logic it actually remains the only relevant determinant for the mortgage lender during the "exploitation phase" when the mortgage granted needs to be served.

Around this context Gyourko and Linneman (1993) have been examining the relative affordability of home ownership in the US over a period of 30 years, between 1960 and 1989. They find that between 1960 and 1974, despite real home prices have increased, no affordability issued existed due to the strong real wage increase. Despite this might arguably have a more historical character due to the time lag, the author considers this a significant finding, since this seems to point into the direction that real home price increases may only be met by affordability during simultaneous strong wage increases.

The question to which extend (if at all) interest rates may offset reverse or rather diverging tendencies, shall be examined by this paper. Further Gyourko and Linneman (1993) observe that despite the then relative

low interest rate levels, a significant increase in house ownership was not recorded, pointing to the direction that low interest rates might not be sufficient to offset real wage declines (and consequently keep affordability stable). Following this logic one might argue that capital gains (or compound interest driven) may outperform labour income over time. Finding what the appropriate housing spending ratio versus the household income is, literature offers a narrow range of figures. Mortgage underwriter in the US as found by Stone (2006) typically apply a range from 25% to 35% depending on the household's other debt obligations. The range of 25% to 30% are figures widely found by empiric approaches to be applied in real life estimation to determine household's ability to serve household spending.

Kutty (2005), also researching cost-to-income ratios, found that lenders advise households not to increase debt service (i.e. interest and principal repayments) to no more than 30% of household income net of taxes, in average in line with the 25% to 35% findings of Stone (2006). Further Kutty (2005) argues that this seems to be in line with many HUD programs (the US Department of Housing and Urban Development – HUD), which assume housing cost burdens at the level of 30%. This is not an undisputed approach, for example, by Hulchanski (1995) correctly claiming that there is no scientific repeatability in simply observed ratios. Despite Hulchanski's claim (1995) that fixed ratios have rather the taste of "allowing" households to spend within certain band widths rather than to research the actual spending behaviour, the author would like to take on a different view on this matter. His claim that the percentage of household income spent on housing in Ontario according to the 1991 census shows no pattern and in no way supports the 25% to 30% range, seems only correct at a first glance. Taking a weighted average of the different spending brackets shown in Hulchanski's research (1995), assuming 19% for the lowest and 51% for the highest bracket - otherwise taking averages for all other brackets - a value of 27.78% can be computed (as done by the author), at least from this perspective, suggesting to be in line with the 25% to 30% range. Generally, however, Hulchanski (1995) agrees to the perspective that empirical found evidence does not create a scientific law (especially since this value has sharply increased over history comparing the findings of Stigler (1954), Gilderbloom (1985), Hulchanski (1995) and Stone (2006), nevertheless it seems - at least noteworthy - that the 25% - 35% range is in place and use for the past decades.

Reviewing the Australian real estate market, more concretely the housing market in Sydney, between 1996 and 2006, Gan and Hill (2009) find that there is a distinct difference between the *purchase affordability*, defined as the ability of a household to borrow sufficient funds for a housing purchase and the *repayment affordability*, reviewing the ability of a household to service its' debt obligation from the mortgage. For this reason the paper at hand combines the debt saving and the repayment phase to capture the full "investment cycle". Gan and Hill (2009) argue that purchase affordability, due to the loosening borrowing standards, has significantly increased over this period, pointing to an obvious cause-effect relationship between lending availability, interest rates and affordability, the key topic of this paper.

Arguing around this context, it could be claimed that the actual affordability is defined not as the disposable income but rather as the disposable income available for real estate investment (or purchase of such assets, more concretely). As discussed earlier, around this context. Stone (2006) finds that those levels have actually increased over time, arguing that the housing cost to income ratio has developed from 25% until the 1980s, to 30% since then. One of the reason for the increase of this ratio might be the high base interest rate environment found in the 1980s and the consequent need to accommodate for higher interest rate costs. Bourassa (1996) is also referring to the existence of a common measure of housing affordability as housing costs not exceeding 30% of the household's income. Quingley and Raphael (2004) note that the index produced by the National Association of Realtors (NAR) assumes a 25% disposable income margin of the median monthly household income to define real estate purchase power assuming a fixed rate loan applying current interest rates. Further, they note that the National Association of Home Builders (NAHB) compares a 28% disposable income margin of a median household with the affordability of dwellings sold for such a margin.

Given that the initial down payment (and the affordability to do so) is a significant criterion not only to credit worthiness and the subsequent ability to service debt, we shall give this factor a closer look. Chomsisengphet and Pennington-Cross (2006) finding around this context that the two factors mostly associated with borrowing costs, despite in the context of subprime lending, is credit history and down payment ability. Both factor arguably significantly determine housing affordability since they not only determine the risk margin above the reference rate but also the required down payment to take out the loan (and vice-versa). Phrasing this differently the potential borrower's affordability of real estate heavily depends on the interest (or risk) margin and the down payment requirement.

Around the context of down payments, Liu and Skully (2005) find that households purchasing houses with a down payment ration of less than 20% of the real estate purchase price are required to apply for a Lenders Mortgage Insurance (LMI) in Australia. In other words, in order to become applicable for real estate

borrowing, lending institutions seem to require a minimum down payment of 20% or otherwise require additional security against the lending, i.e. the insurance policy. Looking into literature the next equally important determinant of affordability is the average loan length or maturity of the loan provided to the real estate buyer. Gan and Hill (2009) for example took a dynamic approach by vintage years in their Affordability at Risk research, taking the 20 year maturity found by Bourassa (1996) for the period 1989/1990 in Australia, combining it with the OECD (2004) value found for 2004 of 25 years and the 2006 value of 30 years found by Brischetto and Rosewall (2007). This ranges seem to be in line with the findings of OECD (2004) for Austria, the research subject of this paper, where loan terms of 20 – 30 years are found to be typical. Loan to Value (LTV) ranges also seem to shift, Bourassa (1996) for example finds an LTV of 75%. Radzimski (2014) even finds even higher LTVs of 80-90% for the residential real estate market in Poland. While OECD (2004) records typical LTVs for Austria at 60% and a maximum of 80%.

Kutty (2005) further finds that homeownership with low or none – due to government assistance – down payment on housing purchases accumulate no or little wealth from real estate, i.e. not participating in the underlying wealth increase (mostly) found from real estate investment (even if done so primarily for housing purposes). This seems to be a significant finding, in the authors view, since this is not only showing a reduced affordability of real estate for low income households in the first place but potentially even a source of supressed relative wealth compared to high income households, since low income households would have to carry the same – if not more for the reason of higher repayment risk – financing, i.e. interest rate costs, but during the same period participate less in the value appreciation from the underlying asset. Phrasing this differently, the phenomenon found could be described as a negative spiral of compound interest rate working against low income households. The author therefore finds from the literature review that

i. using an income-to-spending ratio to estimate housing expenditures seems to be an accepted, despite of course not undisputed, approach;
ii. there seems to be limited impact of interest on the affordability;
iii. the driving factor of affordability deprivation may be lower incomes.

2.3. Measuring Affordability in the Context of Real Estate – Real Estate Prices

The other parameter to be reviewed in this context is the housing price index that was used in empirical research. Gan and Hill (2009) take the house prices in Sydney recorded by the Australian Property Monitors (APM), while trimming the top and bottom 0.5% arguing for a greater prevalence of the data entry there. Lin et al. (2014) using a housing demand survey to estimate housing prices. Using data from the Central Statistical Office of Poland (CSO) to estimate housing prices for the purpose of their study. Trojanek (2013) collected the asking prices for the biggest cities in the country of research – Poland – and calculated an index reflecting the average real prices per square meter per dwelling with a floor space of up to 150m^2. Kallakmaa-Kapsta and Kolbre (2013) measuring the real estate market by (i) residential buildings defined as at all or at least half being used for permanent residence and (ii) apartments. Kutty (2005), Gyourko and Linneman (1993) use the Census of Population and Housing and the American Housing Survey, published by the Bureau of the Concensus, which collects home prices reported by owners. Chomsisengphet and Pennington-Cross (2006) use the LoanPerformance ABS security data base of subprime loans to estimate the real estate market for their purpose. In other words estimating real estate prices ranges from self-collected and constructed indices to statistical resources. The research at hand combines research reports and statistical data base sourcing for the purpose of estimating housing prices.

3. Research Design, Methodology, and Targeted Analysis

3.1. Research Design and Method

The research design of this paper is set to understand first the impact of changes in net household incomes in comparison with the changes in real estate prices in Austria. Further it is the aim to then understand the impact of changes in the base interest rate or reference rate on the affordability of real estate in relation to the household income.

The research method chosen is a comparative research widely used in comparing real estate market impacts, such as proposed by Hulchanski (1995) for analysing trends. In more recent research Kallakmaa-Kapsta and Kolbre (2013), conducting a comparable analysis as done in this paper but for the Estonian real estate market. They calculate a Housing Affordability Index (HAI) comparing an average mortgage loan repayment based on the average purchase price of a dwelling to the average full time income. The research method proposed in this paper will go one step further, also accounting for tax and housing spending by household to calculate a Cash Flow Available for Debt Service per median household based on which a

maximum loan amount and consequently the affordability shall be calculated. Further this paper then will include the saving phase based on the median net income into the calculation to come up with a full life-cycle real estate measurement, based on which a HAI for median sample house hold in Austria shall be calculated, one taking financing effects into account, one not considering those impacts. As a next step a coefficient to measure the change in net household income and change in real estate prices versus the change in base interest rates shall be calculated for Austria for the period between 2004 and 2013.

4. Research Model

4.1. Comparative Model - Finding the Base Interest Rate Coefficient

Based on the research interest in the effect of base interest rate changes on the affordability of real estate in the Austrian market a basic hypothesis shall be found to be tested through a comparative model. The author argues: The change in base interest rates - and its' consequent effect on the borrowing amounts and costs - is not sufficient to off-set the change in post-tax median household income in relation to the price changes in the residential real estate market in Austria. The model pictured in Figure 1 shall test the above hypothesis and is split into four and three factors respectively, which are determined by the variables x_1 to x_{12} estimating: the household revenue, Factor 1, the household expenditure before housing costs, Factor 2, the financing parameters for a mortgage loan, Factor 3, and the price for a standardised real estate object, Factor 4. The factors 1-4 then further determine the down payment $X_{A/B}$ and loan amount Y_A in order to acquire such asset. Depending on the case with or without financing the loan amount X_A is or is not taken into account. Based on $X_{A/B}$ and Y_A it is then further translated into the Housing Affordability Indices (HAI), Z_A and Z_B, while $f(Z_A)= X_A + Y_A$, $f(Z_B)= X_B$ and further Z_A and Z_B are then put into relation to the household income and on that bases translated into rebased indices, which are used to calculate a coefficient β between both variables in order to measure its relative relationship over the testing period between 2004 and 2013.

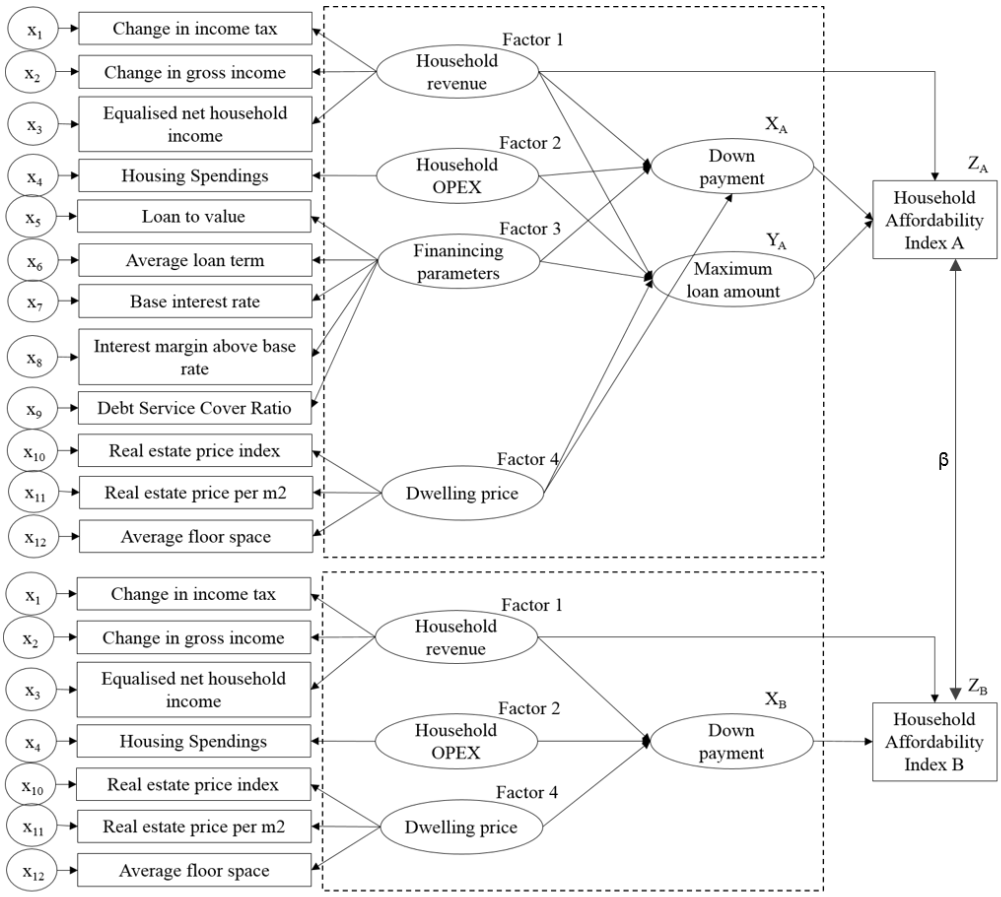

Figure 1. *Comparative model*
Source: Author's compilation
Legend for the comparative model:
x_1... x_{12} = latent exogenous variables (measurement variables), $X_{A/B}$, Y_A, $Z_{A/B}$ = dependent structural variables,
β = coefficient to measure the relative delta

5. Empirical Analysis

5.1. Factor 1: Household "Revenue" or Household Income

Household income or household "revenue" has been estimated by the input parameters x_1 to x_3, while x_1, the change in income tax, and x_2, the change in gross income, have been obtained from Statistics Austria and used to calculate a net income index rebased to the first year of the observation for the purpose of this paper, i.e. 2004. Further the equalised net median household income obtained by Statistics Austria for 2013 has been on the basis of that index recalculated back to 2004 on an annual basis, see Table 1.

Table 1. *Household Income*

	Year									
Trait	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Change in Income Tax	-	-0.90%	7.80%	7.90%	8.40%	-7.10%	3.90%	6.00%	7.00%	4.80%
Change in Gross Income	-	3.40%	4.70%	5.00%	5.20%	1.70%	2.50%	3.60%	4.30%	2.90%
Net Income Change post Tax	-	4.30%	-3.10%	-2.90%	-3.20%	8.80%	-1.40%	-2.40%	-2.70%	-1.90%
Net Income Index	100.00	104.30	101.07	98.14	95.00	103.36	101.91	99.46	96.78	94.94
Equalized Net Household Income	22,919	23,949	23,229	22,575	21,875	23,985	23,654	23,100	22,492	22,073

Source: Austrian Statistics, Author's calculation

5.2. Factor 2: Household "Operational Expenditure (OPEX)" or Household Spending Before Housing Expenditure

The household spending before housing expenditure has been defined as an inverse relationship, (1-n), of the input variable x_4, housing spending, which has been estimated in line with literature findings at 30%, see literature review Stone (2006) and others. Based on this, and taking the calculations from Factor 1 into consideration, a Cash Flow Available for Debt Service (CFADS) has been calculated for the median household by vintage year, see Table 2.

Table 2. *Household cash flow available for debt service (CFADS)*

	Year									
Trait	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Equalized Net Household Income	22,919	23,949	23,229	22,575	21,875	23,985	23,654	23,100	22,492	22,073
Net Spending before Housing Costs	-16,044	-16,764	-16,260	-15,802	- 15,312	-16,790	-16,558	-16,170	-15,745	-15,451
Household CFADS	6,876	7,185	6,969	6,772	6,562	7,196	7,096	6,930	6,748	6,622

Source: Author's calculation

Note: To estimate the households spending before housing costs, or defined as Operational Expenditure (OPEX) for the purpose, the author has used an estimate of 30%, see 5.2 Factor 2

5.3. Factor 3: Financing Parameters or the Mortgage Loan to Finance the Purchase

The mortgage loan has been defined by the input variables x_5 to x_9, where x_5, the loan to value (LTV) has been set at 0.8, the maximum value found for Austria in OECD (2004). The reason why the maximum value and not the typical values as found by this research of 0.6 has been used, is that it seemed more in line with the findings in other European countries by the same report all ranging between 0.75 and 0.8. A further reason why the author has been more "generous" on the LTV, is that the LTV in the model only functions as a plug to determine the maximum lending, while the actual loan amount is calculated using x_9, a Debt Service

Cover Ratio (DSCR), which was set at 1.2x the Household CFADS, to determine the maximum loan amount, i.e. both the DSCR and the LTV are set equally for all vintage years and therefore have no direct impact on the relative measurement of the indices to be calculated. Stated differently, the maximum loan amount was estimated using the estimated household's cash flow – and arguably ability – to service the loan 1.2x leaving some cushion for unexpected payments by the household. Input variable x_6, the average loan term has been set at 25 years, the average of the loan term found by OECD (2004) and in line with the findings in other European countries in this research, as can be found in the theoretical background section of this paper. The interest rate for the loan has been calculated by combining x_7 – the base interest rate – and x_8 – the interest margin above base rate. As a base rate, x_7, the European Interbank Offer Rate (EURIBOR) has been used, recalculating average monthly base rates from the data provider Euribor Rates to annual values, see Table 3. A summary of the loan calculation by vintage year can be found in Table 4.

Table 3. *European interbank offer rate monthly data recalculated to annual values*

	Year									
Trait	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
January	2.28%	2.34%	2.86%	4.03%	4.73%	3.03%	1.25%	1.50%	1.94%	0.54%
February	2.25%	2.29%	2.90%	4.08%	4.33%	2.26%	1.23%	1.66%	1.75%	0.62%
March	2.09%	2.34%	2.99%	4.08%	4.38%	2.03%	1.22%	1.77%	1.60%	0.55%
April	1.98%	2.34%	3.25%	4.19%	4.74%	1.80%	1.21%	2.01%	1.41%	0.54%
May	2.23%	2.20%	3.31%	4.30%	4.95%	1.72%	1.24%	2.14%	1.30%	0.51%
June	2.33%	2.14%	3.37%	4.47%	5.10%	1.63%	1.26%	2.14%	1.23%	0.48%
July	2.39%	2.09%	3.51%	4.52%	5.42%	1.50%	1.32%	2.17%	1.21%	0.53%
August	2.35%	2.22%	3.54%	4.52%	5.36%	1.35%	1.42%	2.18%	0.94%	0.53%
September	2.28%	2.20%	3.64%	4.78%	5.33%	1.30%	1.41%	2.09%	0.80%	0.55%
October	2.37%	2.33%	3.75%	4.72%	5.51%	1.24%	1.46%	2.09%	0.69%	0.54%
November	2.30%	2.55%	3.83%	4.63%	4.85%	1.24%	1.54%	2.11%	0.62%	0.53%
December	2.28%	2.76%	3.85%	4.71%	3.92%	1.24%	1.53%	2.03%	0.57%	0.50%
EURIBOR Average	**2.26%**	**2.32%**	**3.40%**	**4.42%**	**4.88%**	**1.69%**	**1.34%**	**1.99%**	**1.17%**	**0.54%**

Source: Data provider EURIBOR Rates, Author's calculation

Table 4. *Maximum loan amount*

	Year									
Trait	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Household CFADS	6,876	7,185	6,969	6,772	6,562	7,196	7,096	6,930	6,748	6,622
Debt service cover ratio	1.20x	1.20x	1.20x	1.20x	1.20x	1.20x	1.20x	1.20x	1.20x	1.20x
Maximum debt service	5,730	5,987	5,807	5,644	5,469	5,996	5,914	5,775	5,623	5,518
Average EURIBOR	2.26%	2.32%	3.40%	4.42%	4.88%	1.69%	1.34%	1.99%	1.17%	0.54%
Loan margin above base rate	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Average interest rate	3.76%	3.82%	4.90%	5.92%	6.38%	3.19%	2.84%	3.49%	2.67%	2.04%
Maximum Loan Amount	**91,825**	**95,372**	**82,675**	**72,702**	**67,433**	**102,211**	**104,824**	**95,274**	**101,612**	**107,280**

Source: OECD (2004), Data provider EURIBOR Rates, Author's calculation

5.4. Factor 4: Dwelling Price or Cost of a Home

The cost of a home has been estimated by the input variables x_{10} to x_{12}, where the real estate price index published by the Austrian National Bank since 2000 – x_{10} – has been rebased to 2004 figures to calculate the annual change in real estate prices in Austria, x_{10} has then been used to recalculate the average housing price per square meter for each vintage year, based on the value found by the Deloitte Real Estate Index (2014) for the year 2013, in the model the input parameter x_{11} – being the average transaction price of the new dwelling. The so found price per square meter has then been applied to the average floor space x_{12}. The average floor space for each vintage year was recalculated by a Compound Annual Growth Rate (CAGR), based in the observation of Statistics Austria in 2001 and 2011. A summary of the calculation of Factor 4, cost of a home, can be found in Table 5.

Table 5. *Dwelling price*

	Year									
Trait	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Real Estate Price index (based 2000)	99.70	104.70	109.00	114.10	115.40	119.80	127.30	132.70	149.10	156.00
Change in Real Estate prices		5.00%	4.30%	5.10%	1.30%	4.40%	7.50%	5.40%	16.40%	6.90%
Real Estate Index rebased 2004	100.00	105.00	109.52	115.10	116.60	121.73	130.86	137.92	160.54	171.62
Average price per sqm Austria	1,331	1.401	1,464	1,542	1,563	1,635	1,767	1,868	2,234	2,400
Average floor space	91.28	91.58	91.88	92.18	92.49	92.79	93.09	93.4	93.71	94.01
Dwelling price	121,469	128,282	134,486	142,178	144,523	151,671	164,506	174,467	209,375	225,628
Dwelling price change	-	5.61%	4.84%	5.72%	1.65%	4.95%	8.46%	6.06%	20.01%	7.76%
Dwelling price index	100	106	111	117	119	125	135	144	172	186

Source: Austrian National Bank, Deloitte (2014), Author's calculation

5.5. X_A and Y_A: The life cycle of the real estate purchase

X_A: In the model the down payment to acquire the asset (and take out the mortgage) is assumed as an inverse function to the actual leverage of the asset or LTV, calculated based on the DSCR, or simply said functions as a plug to bridge the delta between the purchase price per dwelling and the maximum loan amount allowed under Factor 3, the financing parameters, with the limiting values of Factor 1, the household revenue, and Factor 2, the household OPEX. Further the down payment is then expressed into years by comparing the respective vintage year's net household income and the calculated down payment.

Y_A: Payback time is equal to the input parameter x_7, assumed to be 25 years.

5.6. Z_A: Household Affordability Index A

The household Affordability Index A is calculated by adding the values under X_A and Y_A for each vintage year, rebasing the values to 100 in 2004 producing an index. A calculation summary for X_A, Y_A and Z_A can be found in Table 6.

Table 6. *House Affordability Index – A*

Trait	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Dwelling price	121,469	128,282	134,486	142,178	144,523	151,671	164,506	174,467	209,375	225,628

Debt										
Maximum Loan Amount	91,825	95,372	82,675	72,702	67,433	102,211	104,824	95,274	101,612	107,280
LTV	0.76x	0.74x	0.61x	0.51x	0.47x	0.67x	0.64x	0.55x	0.49x	0.48x
Equity										
Down payment	29,645	32,910	51,811	69,476	77,090	49,460	59,682	79,193	107,763	118,348
Household CFADS	6,876	7,185	6,969	6,772	6,562	7,196	7,096	6,930	6,748	6,622
Saving years for down payment	4	5	7	10	12	7	8	11	16	18
Loan term	25	25	25	25	25	25	25	25	25	25
Total life-cycle	29	30	32	35	37	32	33	36	41	43
Change in life-cycle	-	0.92%	9.65%	8.71%	4.22%	-13.26%	4.82%	9.03%	12.47%	4.64%
House Affordability Index - A	100	101	111	120	125	109	114	124	140	146

Source: Author's calculation

5.7. X_B: The life cycle of the real estate purchase

X_B: Since under X_B no financing is assumed, the equity down payment equals to the purchase price and is divided by the Household's CFADS.

5.8. Z_B: Household Affordability Index B

The household Affordability Index B is calculated by rebasing the values calculated under X_B to 100 in 2004 producing an index, in analogy to Z_A. A calculation summary for X_B, and Z_B can be found in Table 7.

Table 7. *House Affordability Index – B*

	Year									
Trait	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Dwelling price	121,469	128,282	134,486	142,178	144,523	151,671	164,506	174,467	209,375	225,628
Equity										
Down payment	121,469	128,282	134,486	142,178	144,523	151,671	164,506	174,467	209,375	225,628
Household CFADS	6,876	7,185	6,969	6,772	6,562	7,196	7,096	6,930	6,748	6,622
Saving years for down payment	18	18	19	21	22	21	23	25	31	34
Total life-cycle	18	18	19	21	22	21	23	25	31	34
Change in life-cycle	-	1.07%	8.09%	8.79%	4.90%	-4.29%	9.98%	8.60%	23.25%	9.81%
House Affordability Index - B	100	101	109	119	125	119	131	143	176	193

Source: Author's calculation

5.9. Z_B: Coefficient ß to Determine the Impact of Financing to Offset House Purchase Affordability

Finally the Coefficient ß is calculate to determine the ability to offset the increase in housing prices by the use of financing by comparing the values in HAI-A and HAI-B in the last vintage year. To arrive at ß the value of the HAI-A and -B respectively in the last year of review, 2013, has been reduced by 100, the ideal line of the HAI, indicating that the affordability remains stable in comparison to the initial year, and compared to each other in order to calculate the relative impact of financing on the affordability. An overview can be found in Table 8.

Table 8. *Coefficient ß – HAI-A vs. HAI-B vs. Dwelling price index*

	Year									
Trait	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
House Affordability Index - A	100	101	111	120	125	109	114	124	140	146
House Affordability Index - B	100	101	109	119	125	119	131	143	176	193
Dwelling price index	100	106	111	117	119	125	135	144	172	186
Offset Coefficient HAI A&B		**49.82%**								

Source: Author's calculation

6. Discussion, Limitation and Conclusion

While the prices for dwellings in Austria increased by 86% according to the model's output, the author finds the non-financed house affordability be even further deteriorated by 93%, which arguably is due to the significant decrease of post-tax wages in Austria during this time period. The simulated financing impact during this period was only able to offset the increase in housing prices by less than 50%, the hypothesis taken at the beginning of the research, that the decrease in base interest rates was insufficient to offset the simultaneous increase in real estate prices at post-tax falling household income, is therefore confirmed.

Limitations in the research could be found around the financing assumption, more concretely the margin above base interest rate and the fixing of the Debt Service Cover Ratio. Further the impact of different actual disposable income for housing purposes, rather than the fixed rate applied in the research, would have significant impact on the affordability indices calculated. Nevertheless the author believes that a base tendency can be observed and concluded even from the data and input short comings. Going forward additional research along the same lines should be conducted for other markets to evaluate if this is a local or more global phenomenon, potentially pointing into the direction of other and/ or additional asset inflation drivers.

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