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Austrian Demography and Housing Demand: Is There a Connection

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Abstract. This paper analyses the role of demographic factors in the Austrian housing market. Linking demographic issues, in conjunction with the Austrian private housing finance, to the housing demand is the focus of the empirical model developed in this paper. We find statistical support that the demographic factors help to explain for housing demand. However, we emphasize that demographic factor such as the adult population with net migration effect is only one of the key variables which contributes in understanding the Austrian housing demand. Some of our other empirical findings indicate that the Austrian housing demand is inelastic to various economic factors is a concern for some housing policies.

keywords: housing demand, demography, migration, subsidies.

JEL codes: R21, R23, J11.

I. Introduction

The purpose of this paper is to analyse the role of demographic factors in the Austrian housing market. The effect of demographics in the U.S. housing market has been controversial and inconclusive. The work by Mankiw and Weil (1989) leads a group of researchers who supports the hypothesis that the demographic change has a strong effect in housing prices: There is a statistical support for the conclusion that the U.S. baby-boom cycles was a major source of the real housing prices increase in the amount of 20 percent during 1969–1989, and the real housing prices with sharply decline over the next 30 years till 2007.

On the other hand, there is a strong dissenting group of researchers who argues that the Mankiw and Weil's estimates and conclusions are the results of a mis-pecification and misinterpretation of their housing price equation (e.g., Hamilton, 1991; Hendershott, 1991; Green and Hendershott, 1996; Peek and Wilcox, 1991; Swan, 1995). These studies emphasize; first, "the negative time trend in the Mankiw and Weil's study, riot the age-demand relationship, is responsible for the

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large forecasted drop in real prices" (Green and Hendershott, 1996, p. 466). The main debate between these two groups has been the statistical interpretation of Mankiw and Weil's housing demand estimates.[1]

Although Mankiw and Weil's conclusion has been challenged and questioned in academic journals in the U.S., their approach has not been widely applied to other countries, except for Canada (Engelhard and Poterba, 1991) and Japan (Ohtake and Shintani, 1996). Consequently, we believe that linking housing demand to the size of adult population for Austrian housing market is a valid and useful exercise, especially when Austria faces ever changing adult population due to the European Union, the war in former Yugolavia, and the downing of the Iron Curtain. In this paper, we bring two new aspects in analysing the linkage. First, we include net migration effect on the linkage: Austria has experienced unusually rapid adult population growth on the account of migration starting from the late 1980s till the early 1990s. Second, we analyse whether the recent developments of private housing finance in Austria, in conjunction with age, can help to explain the linkage. Like many social welfare states in Europe, Austrian government plays a key role in the housing market. Large amount of subsidies in various forms (in construction, in rents, and in mortgage payments) lends interesting platform for analysing the effect of government role on the housing market.

We begin our analysis in the next section with some facts regarding the Austrian housing market. In Section III, we state some facts about the Austrian demography and present informal evidence suggesting that cyclical movements in housing prices are linked with the size of adult population in Austria. The boom and bust cycles in housing prices are positively correlated with the size of adult population.

Linking demographic issues, in conjunction with the Austrian private housing finance, to the housing demand is the focus of the empirical model developed in Section IV. We find statistical support that the demographic issues do help to explain for housing demand. We conchide that the adult population with net migration is a better statistical measure in explaining Austrian housing demand than the demographic measure proposed by Mankiw and Weil. Further, we emphasize the fact that the adult population with net migration effect is only one of the key variables which contributes in understauding housing demand: income, cost of housing finance, subsidy effect, and cost shifters such as unemployment rate need to be addressed when analysing Austrian housing demand. Section V concludes, and the data description is reported separately from the main text at the end of the paper.

II. Some Facts about the Austrian Housing Market

Traditionally there has been strong public intervention in the housing sector in Austria, justified by the idea of a right to the scarce good housing. The general housing policy measures are supposed to lower the construction and financing costs and also to provide cheap standard housing for lower income groups. For Austria,

the primary focus of the housing policy, however, has been on the housing quality management.

The expenditures are financed by a legally prescribed share of total direct tax revenue, the debt service for public loans, and sources drawn from the general budget. The subsidy system mainly focuses on the "object", namely the construction, renovation and upgrading of dwellings, by providing annuity grants and public loans at preferential rates and maturities. Eligibility for these subsidies is determined by household income, which has been self reported (no longer the case after the late 1990s). However, as the subsidy amounts are not indexed to life cycle incomes, this subsidy policy is mainly ineffective. Further, the government pays premiums on savings deposits in savings and loans associations ("Bausparkassen").[2] However, means tested allowances for housing expenditures play only a minor part.

Housing is further indirectly subsidized by a preferential tax treatment; since 1973, Austria has been following the consumption good principle, which implies that imputed income from owner occupied housing is not tax eligible. Rents are subject to a reduced excise tax rate. Irrespective of the consumer good principle, expenditures related to acquisition, like mortgage repayments, remain tax deductible. The rate on the purchase of property has consequently been reduced during the last decades. According to Lehuer (1992) foregone tax revenues amount to ATS 3.3 billion. In addition to these direct and indirect subsidies there is a complex system of rent regulation and tenant protection. The main set of regulations concerns tenant protection, rent levels and the landlady's responsibility to maintain dwellings. Rent control, however, mainly affects old dwellings.

Table I shows the relative importance of the different groups of developers for newly completed dwellings during the past twenty years for Austria; almost half of construction activities is carried out by private households for self use. Traditionally, these types of construction activities are not translated into market activities. That is, personal developings are almost never on the housing market for sale. The developers who are classified as "non-profit" and "other legal entities" could loosely be translated as the "co-ops" and other "socialized" firms. These developers mainly build apartments and other large communal buildings. For the rest of the provinces in Austria, the patterns for construction activities by different developers are similar to each other. However, for Vienna (with one fifth of Austrian population), the "non-profit" and "other legal entities" developers dominate the "private" developers. Consequently, the housing market in Vienna reflects the large part of the housing market in Austria.

An important feature of the Austrian market is the high share that detached family houses take in the total stock (see Table II). These are usually high quality dwellings, with a strong degree of diversification, adjusted for the specific personal needs of the tenant, who is in most cases also the developer. As mentioned previously, these types of dwellings are usually not for sale, consequently, the

Table I. Relative importance of developers

Year	1975	1980	1985	1990	1995
Private persons (percentage)	*50*	*60*	*56*	*62*	*45*
Non-profit (percentage)	*34*	*26*	*29*	*27*	*31*
Other legal entities (percentage)	*9*	*8*	*6*	*9*	*22*
Municipalities (percentage)	*7*	*6*	*9*	*2*	*2*

Table II. Share of detached family houses

	Vienna	Austria
Family houses	*7.6*	*48*
Condominiums	*92.4*	*52*
Total	*100*	*100*

provinces with high shares of detached family houses do not display a clear sign of a developed housing market.

One other noticeable features of Austrian housing market is the method of market clearing; the market is cleared by cueing of the applicants for subsidized and social housing. On the other hand there are vacant dwellings, mostly subsidized and/or developed by the municipalities with the aim to meet the excess demand (and recently, to stabilize excess supply), which are merely too expensive to be rented by lower income groups. Rent regulation causes high entry costs, because landladies often require keymoney to compensate for low rents (this practice is not only illegal but has also declined in importance over time). A further problem is the predominance of home ownership accompanied by a poor-performing private rental sector. This structure of the housing market with its entry (and moving) barriers causes labour immobility which may attribute to unemployment, although since the mid-nineties we observe a reversed mobility towards urban regions.[3] Thus there is a suboptimal allocation of different types of housing. For example, a widowed old person, living in a large rent-regulated downtown apartment, for whom it would be too costly to move to a dwelling more suitable to her living conditions. Furthermore the subsidy system seems to exhibit regressive effects.

III. Construction Activities, Prices, and Adult Population

The main series to be explained are the housing prices, investment, and adult population for Austria. Figure 1 shows the real detrended housing residential investment (including apartments) and real detrended housing prices from 1970 to

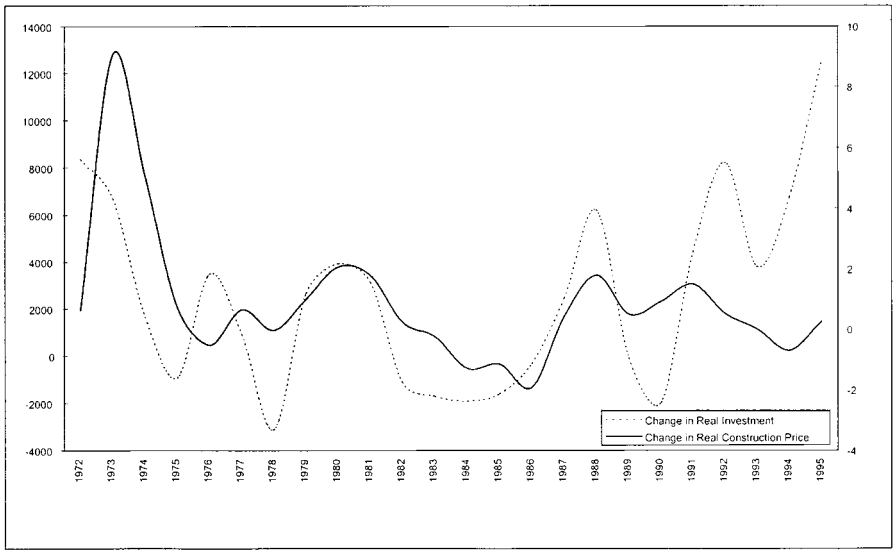

Figure 1. Time series of housing investment and price, 1970–1996.

1996 data in annualized form to exhibit the cyclical patterns most clearly. We take the construction investment deflator relative to the gross national product deflator as the proxy for the Austrian residential housing prices.[4] The cycles in prices take usually 3–4 years swing, suggesting a slow adjustment to economic conditions. The major peaks occurred at 1973, 1977, 1981, 1988, 1991 and 1995. The peak at 1981 needs to be discounted as there was a major change in the government regulation concerning the reporting of dwelling completion: the loophole in the new regulation allowed the households to artificially appreciate their reporting for the tax benefits in 1982. Furthermore, owners were keen to register completions because the regional governments offered premature sales of public mortgages at reduced rates. Over the sample period, the last two large peaks occurred in 1988 and 1991 followed by a sharp decline.

Visually comparing the detrended real housing price and housing investment series suggests that the price movements and construction activity are positively correlated, except for the earlier part of the series between 1972–1975. Apart from mis-timing of a few data points, this observation suggests a rising supply price of new houses. For the investment series, it took a huge boom in 1970–1972 followed by a sharp decline of equal magnitude in 1973–1975. The next episode for the boom and bust cycles are less prominent with cycles taking longer swings. A more substantial boom and bust occurred during the 1986–1995 with the activities peaking at 1988, 1992, and 1995. The peak-to-trough ratio of building activity in the last cycle of 1990–1993 is approximately little over 2: an expansion doubles the output of new homes and a contraction cuts it in half.

Figure 2. Live births in Austria, 1946–1996.

The other main series to be explained is demography changes. Figure 2 shows the number of births in the period 1946–1996. A clear baby boom and bust cycles can be observed: first baby boom occurred right after the World War II, and the last major baby boom occurred in late 1950s and peaked in 1962. The baby bust of the 1970s seems to be dramatic in comparison to the baby boom of the 1950s as the bust out-measures the boom 2 to 1. Further, after the baby bust in the 1970s, there are no significant baby booms in the magnitude of the 1950s.

One way to measure the magnitude of the baby boom is to look at the adult population, which is usually defined as the age group of 20 to 30 years old. Figure 3 graphs the adult population, live birth (25 years lag), and net migration from 1969 to 1995. A visual comparison of the adult population and the live birth (25 years lag) suggests that there is a positive co-movement between the two series upto 1987: the live birth (25 years lag) peaked in 1987, but the adult population is still rising and peaked in 1992. The miss-timing of the two series could be partly explained by the movement of the net migration. An increase in the adult population beyond 1987 could be attributed to the sharp rise in the net migration starting from 1987 to 1991. And a decline of equal magnitude for the net migration after 1991 along with the decline in the live birth (25 years lag) could explain the sharp decline in the adult population after 1992. Consequently, we think that it is the adult population (including the net migration) which is a better measure of consumer purchase power rather than the live birth (20 or 30 years lagged).

One of the main hypothesis to be tested in our paper is whether there is a direct link between the number of adult population over time and the housing prices. Fig-

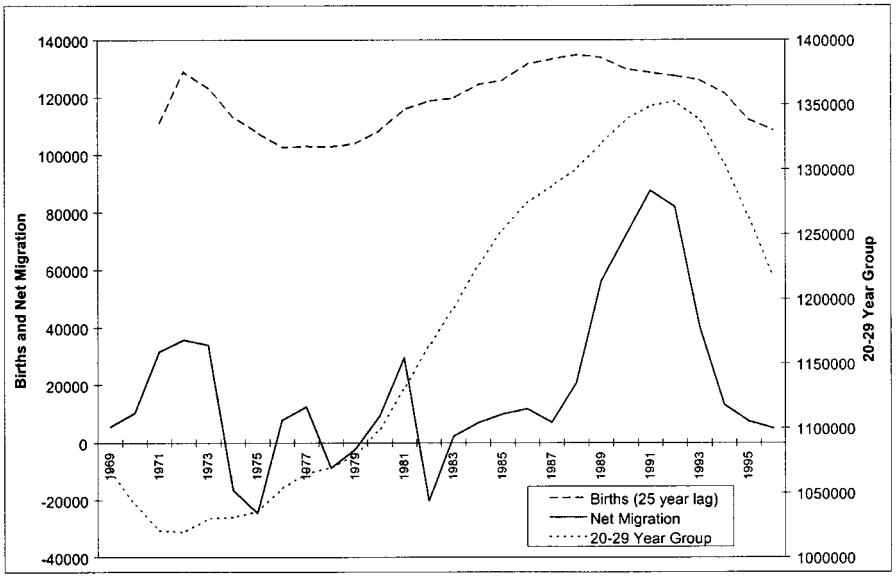

Figure 3. Adult population, live birth (25 years lag), and net migration in Austria, 1969–1995.

ure 4 graphs the real housing price and the adult population from 1970 to 1996. We look at the adult population because previous work (e.g., Mankiw and Weil) and our own assessment indicate that the late 30's age group spends the most amount for the housing expenditures. Figure 4 shows informal evidence that there is a positive relationship between the adult population and housing prices. The two series move, with a few minor mis-timing between 1988 and 1991, and peaking around 1992. Our main empirical task is to analyse and confirm statistically whether the adult population with net migration can be linked directly with the housing demand.

Figures 5 and 6, which graph prices versus net migration and live birth (25 years lagged) respectively, show that there seems to be no clear correlation between live births (lagged 25 years) with housing price for the periods after 1984; on the other hand, looking at the net migration with housing price, two series co-move after 1985 indicating indeed that one should look at the adult population (which includes net migration) instead of live birth for the analysis of demographic effects on housing demand.

IV. Estimates for Demand for Housing

1. DEMOGRAPHY AND HOUSING DEMAND

In this section, we take the dissenting view from Mankiw and Weil, and present their measure of housing demand as instead a measure of demography. Nevertheless, we believe in the importance of their measure of the age structure of

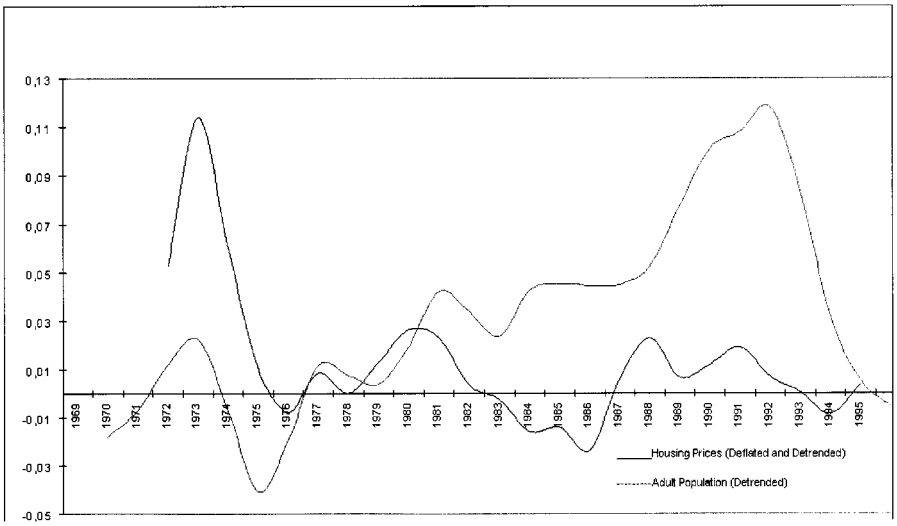

Figure 4. Housing prices and adult population, 1969–1996.

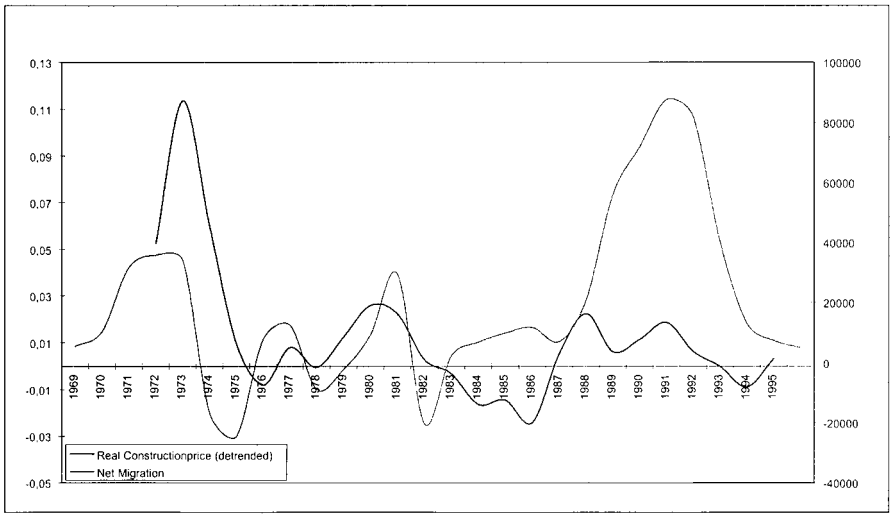

Figure 5. Housing prices and net migration, 1970–1996.

the population, especially the adult population, as one of the crucial explanatory variables for the housing demand.

Although the housing demand Equation (1) can be derived from the consumer's utility function, the approach here is to analyse the time-series model that captures the empirical linkage between housing demand and demography. Thus, the reduced form equation used in estimation is

$$H_t = \alpha_0 + \alpha_1 P_t + \alpha_2 Y_t + \alpha_3 D_{mwt} + \alpha \mathbf{X}_t + \epsilon_t, \tag{1}$$

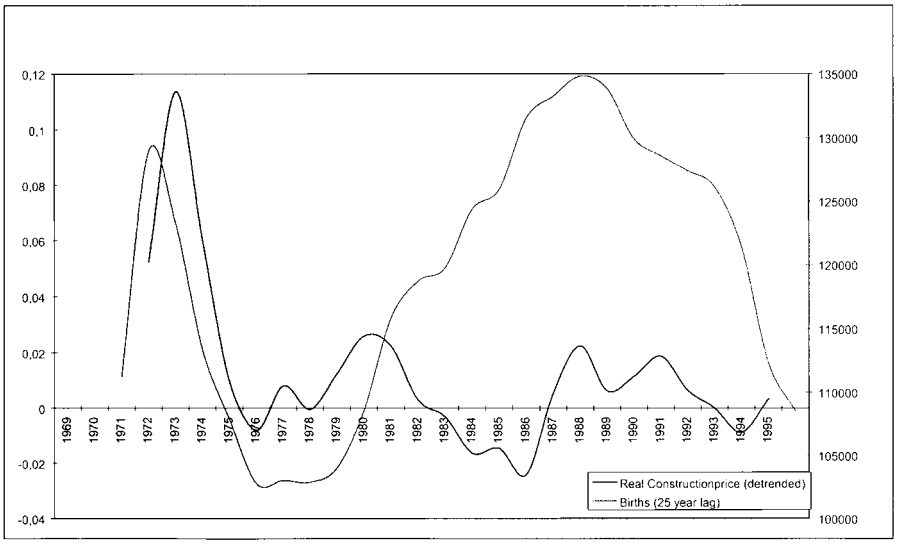

Figure 6. Housing prices and live birth (25 years lagged), 1970–1996.

where H_t is the net stock of residential capital (includes apartment building),[5] P_t

Table III. Mankiw–Weil's original crossectional estimates of housing demand by age

Age group	$a_i's$	Age group	$a_i's$
0–4	677.6	50–54	7892.8
5–9	312.2	55–79	7550.2
10–14	217.6	60–64	7632.2
15–19	1301	65–69	7209.2
20–24	5128.2	70–74	6936.6
25–29	7582.4	75–79	6769.4
30–34	8673.6	80–84	6200.8
35–39	9364.8	85–89	6347.2
40–44	9106.6	90–94	6845.4
45–49	8541.6	95–	4176.6

Table IV. Mankiw–Weil's crossectional estimates of housing demand by age for Austria

Age group	$a_i's$ (Mankiw–Weil)	$\tilde{a}_i's$ (Austria)
20–29	6355.3	3696.60
30–39	9019.2	4669.39
40–49	8824.1	3251.20
50–59	7775.36	2386.20
60–64	7632.2	1997.50
65–74	7072.9	1691.20
75–	4650	1243.71

Consequently, we constructed the Mankiw and Weil's housing demand variable, D_{mwt}, using their (Mankiw and Weil's Table A.l) estimates for $a_i's$ as well as the demand variable, D_t, using $\tilde{a}_i's$. Since our population data set is for each five-year age class running from 0–4 to 95-over, we take the average of $a_i's$ and $\tilde{a}_i's$ on each five year age class. Tables III and IV show the values for $a_i's$ and $\tilde{a}_i's$ that we use to construct D_{mwt} and D_t.

Table V reports the pair-wise regressions between D_{mwt}, D_t, adult population, and real housing stock (all represented in logarithms). The adult population includes the net migration effect. Consequently, we believe that for the housing demand analysis, the adult population is the correct measure of change in demography instead of the live births cycles. The basic message from Table V is that there is no statistical difference between Mankiw and Weil's measure of housing demand D_{mwt} (or D_t) and the measure of adult population.

Table V. Pairwise regressions of housing demand, capital stocks, population, and adult population, 1969–1996

	Dependent variable	Intercept	D_{tmw}	D_t	*Pop*	Adult *Pop*	R^2	D–W
1	D_{tmw}	5.060		0.826			0.997	0.149
		(0.224)		(0.011)				
2	D_{tmw}	−13.672			2.409		0.874	0.093
		(2.409)			(0.176)			
3	D_{tmw}	9.655				0.957	0.996	0.102
		(0.178)				(0.011)		
4	D_t	−6.026	1.207				0.996	0.148
		(0.334)	(0.014)					
5	D_t	−21.678			2.853		0.834	0.083
		(3.820)			(0.241)			
6	D_t	5.567				1.158	0.999	0.452
		(0.078)			(3.820)			
7	H	−52.379	2.719				0.902	0.068
		(4.226)	(0.172)					
8	H	−42.258		2.400			0.919	0.070
		(3.102)		(0.131)				
9	H	−81.667			6.052		0.666	0.065
		(12.935)			(0.816)			
10	H	−26.635				2.634	0.922	0.082
		(2.284)				(0.147)		

H = log of residential capital stock.
D_{mwt} = log of Mankiw–Weil demand (Mankiw–Weil coefficients).
D_t = log of Mankiw–Weil demand calculated with Austrian coefficients.
Pop = log of total population.
Adult *Pop* = log of population 20 and older.
R^2 = coefficient of determination, adjusted for degrees of freedom.
D–W = Durbin–Watson statistics.

The first three regressions of D_{mwt} on the total population and adult population lend partial evidence that population, especially adult population, can statistically explain the Mankiw and Weil's measure of housing demand. As expected, the adult population gives higher correlation (higher R^2) and adjusts faster in the age structure (higher Durbin–Watson) than the total population when the these variables are regressed on D_{mwt}. The next three regressions replicate the first three: whether we use Mankiw–Weils $a_i's$ or $\tilde{a}_i's$ using Austrian figures, the housing demand variables D_{mwt} and D_t produce qualitatively the same results.

The last four pairwise regressions are to lend partial statistical evidence that there is no statistical difference between D_{mwt} (or D_t) and the measure of adult

population. Since these regressions do not make allowance for other explanatory variables, however, one cannot conclude that the estimated coefficients of population variables (both total and adult) are evidence of a high elasticity of population growth per se on housing demand. What one can infer from regression 7 to 10 (except regression 9) is that the these regressions give almost identical results: the magnitude of the estimated coefficients, t-statistics, correlation coefficients, and Durbin–Watson values of these regressions mirror each other.

3. HOUSING DEMAND, POPULATION AND SUBSIDY EFFECTS

Before presenting our empirical results, we make a few remarks in regards to the estimates of the demand parameters. We face two serious limitations when estimating meaningful demand parameters from our data: one is a limitation of data, and the other is an imprecise measure of the capital stock. We have an annual data set of 25 years. Using the Instrumental Variable Method with five to seven explanatory variables, the usable data points are greatly reduced.

In order to estimate Equation (1), we require constructing a time series on stocks H_t using perpetual inventory methods.[8] But investment is such a small fraction of existing homes that the imputed stock series is too smooth and trend like to be informative about demand. Further, we do not take into account many subtle intertemporal issues in the housing market.

To be consistent with Mankiw and Weil, and other subsequent studies, we also choose to measure house prices by the ratio of the GNP residential construction deflator to the overall GNP deflator. Equation (1) is estimated using the Instrumental Variable Method since the price is endogenous. We use the known instruments (*à la* Swan, 1995) such as the current and lagged real construction costs (materials and other construction components), real construction wages and real short-term interest rates. For the demand cost shifters, we use the unemployment rate and the difference of the short – and long term interest rates. The regressions are estimated over the period from 1971 to 1995.

The regressions in Table VI attempt to explain the demand for the stock of houses. The first three regressions are to compare whether there is statistical and qualitative differences between the adult population ($Pop20$) and D_{mwt} (or D_t) in explaining the demand for housing. Both variables, $Pop20$ and D_{mwt} (or D_t), are statistically significant in their own regressions. The negative sign on the housing price coefficient, Pr, indicates that we are estimating the demand function. The cost shifters are also statistically significant in explaining for the housing demand, although the sign on the unemployment rate is positive: from economic theory, one would expect a negative sign on the unemployment rate. However, a positive coefficient lends a possible support for the interpretation that people build more houses (private) when they are laid off (or unemployed). Since these unemployed people have more "leisure" time, they contribute more to the "household production", namely building their own houses (assuming that this group of people have enough

Table VI. Housing demand regressions; instrumental variables method, 1969–1996

Dep.	Int.	GDPa	*Pop*20	D_{tmw}	D_t	Pr	U	$Rs - Rl$	Sub	D–W
H	−3.353	1.237		0.521		−0.465	0.049	−0.006		1.46
	(5.293)	(0.151)		(0.208)		(0.171)	(0.011)	(0.003)		
H	6.153	1.137	0.633			−0.377	0.022	−0.006		1.39
	(3.500)	(0.187)	(0.211)			(0.172)	(0.010)	(0.002)		
H	3.472	1.150			0.532	−0.393	0.023	−0.006		1.38
	(4.731)	(0.167)			(0.191)	(0.176)	(0.010)	(0.003)		
H	−11.109	0.946		1.122		−0.737	0.020		0.068	1.52
	(7.463)	(0.164)		(0.303)		(0.214)	(0.011)		(0.028)	
H	−4.127	0.773	1.308			−0.618	0.015		0.074	1.58
	(4.314)	(0.162)	(0.274)			(0.182)	(0.010)		(0.023)	
H	−8.810	0.815			−1.061	−0.605	0.018		0.066	1.42
	(5.992)	(0.173)			(0.251)	(4.731)	(0.010)		(0.024)	
H	−6.666	1.041		0.938		−0.653	0.021	−0.003	0.047	1.51
	(12.217)	(0.265)		(0.502)		(0.283)	(0.012)	(0.006)	(0.054)	
H	−4.982	0.740	1.364			−0.634	0.014	−0.001	0.079	1.61
	(7.388)	(0.279)	(0.478)			(0.226)	(0.011)	(0.005)	(0.047)	
H	−6.318	0.887			0.954	−0.565	0.019	−0.002	0.053	1.42
	(9.741)	(0.281)			(0.414)	(0.235)	(0.011)	(0.006)	(0.047)	

Standard errors in parentheses.
H = log of residential capital stock.
GDPa = log of real GDP per adult.
*Pop*20 = log of population 20 and older.
D = log of Markiw–Weil demand.
Pr = Residential Construction Price index deflated by GDP-deflator.
Sub = log of net present value of subsidies per adult.
R^2 = coefficient of determination, adjusted for degrees of freedom.
D–W = Durbin–Watson statistics.

initial capital). When taking the fact that for Austria private construction activity accounts for almost fifty percent of all construction activities into a consideration, the last remark is not trivial. The estimated coefficients for the real interest rate difference between short and long terms indicate that both nominal interest and inflation rates are statistically significant but has a small effect on explaining the housing demand. Indeed, with Austrian capital market being relatively imperfect, in terms of mortgage market and other banking aspects, small interest rate effects on housing demand is expected: a possible interpretation of high intergenerational private housing financing in Austria (Deutsch, 1997).

The income and price elasticities are in reasonable ranges. An income elasticity of 1.0 gives statistical evidence that housing has unitary income elasticity at all points: a one percent increase in money income results in a one percent increase in the total quantity demanded. The price elasticities of 0.465 and 0.377 indeed indicate that housing is an essential good and hence it is relatively insensitivity to the change in housing prices.[9] These regressions support the interpretation that D_t is a

measure of demography instead of housing demand. However, we also emphasize here that our empirical results support the importance of the age structure of the population, *ceteris paribus*.

The rest of regressions deals with the subsidy effect on housing demand. The subsidy variable is calculated using the net present value of money spent on subsidies in the relevant period. For the subsidized loans, the annual repayment using with an interest rate of 0.5 percent and a maturity of 47.5 years was calculated. Then the annual repayment was calculated using mortgage rates. Subsequently, we calculated the net present value of the difference of the annual payments over the whole 47.5 years. For the periods after 1985, we used a 1 percent interest rate and a maturity of 35 years to reflect the new law enacted in 1984. For the loans to replace personal capital injections a 10 year maturity was used with a 3 percent real interest rate, and the same procedure was applied. The renovation subsidies, annuity subsidies and construction subsidies were simply added, although some of them are repayable.

Regressions 3–6 look at the subsidy effects on housing demand when the cost of housing finance, which is captured by $Rs - Rl$, is ignored. These regressions imply that the demand schedule for housing varies directly with wealth per capita, demographic measures and subsidies. Again, the stock varies inversely with housing price but directly with unemployment. The message from these regressions is that the subsidy variable has significant and positive effect on housing demand.

In contrast to regressions 3–6, regressions 7–9 that include the cost of housing finance along with the subsidy variable lead to quite different implications for the subsidy effects on housing demand. Subsidy and interest rates difference variables are no longer statistically significant and have a weak effect on housing demand. The interest rate difference being statistically insignificant lend some empirical support that for Austria, the demand for housing is insensitive to the cost of housing finance. As Deutsch (1997) states, a large part of Austrian housing finance is done through bequest or direct inter-family cash transfers. Indeed, with Austrian capital market, especially the mortgage market, being imperfect and coupled with an easy access to other ways of financing, the demand and desire for housing being insensitive to both variables is, at least, understandable if not justifiable.

V. Summary and Remarks

We present a model that links demographic issues, in conjunction with the Austrian private housing finance, to the housing demand. We find statistical support that the demographic issues do help to explain for housing demand, *ceteris paribus*. Further, we emphasize the fact that the demography, especially the adult population that includes net migration effect, is only one of the key variables which contributes in understanding housing demand: other major factors that influence Austrian housing demand are the income, cost of housing finance, subsidy effect, and cost shifters such as unemployment rate.

Our estimates also reveal deficiencies of a housing demand model based on static, homogeneous capital and costless transaction market assumptions. To obtain and recover more precise and meaningful estimates of structural parameters, at least, we need a longer data series as well and a better understanding of the user cost and capital stocks. It remains to be studied in detail. Nonetheless, we provide some statistical evidence for the movement of future Austrian housing demand.

Data Appendix

- GNP: Gross National Product at current prices (SNA 68). Source: Austrian Institute of Economic Research (WIFO).
- GDP: Gross Domestic Product, current prices. Source: OECD Derived Series: General.
- DEFL: Implicit GDP Price Deflator. Source: OECD Derived Series: General.
- POP: Total Population in Austria. Population data in five year groups: data from census years (1961, 1971, 1981, 1991). Extrapolation of Census data for all years. Source: Austrian Central Statistical Office (ÖSTAT). See also Fassmann et al. (1996).
- POP20: Population 20 years and older. Source: see above.
- MWIndex: Calculated from Mankiw and Weil (1989) and Austrian population data: 5 year averages of Mankiw and Weil's estimated alphas, corresponding to the five year groups in Austrian population data, were taken an used to calculate the index for Austria.
- Investment: Series of Residential Investment in Austria. Calculated from financial data contained in Residential Construction Surveys. Source: Austrian Central Statistical Office (ÖSTAT).
- ResCCIV: Construction Cost Index for Residential Construction for Vienna. (Including special tax for Vienna underground -UBahn- construction) Source: Austrian Central Statistical Office (ÖSTAT).
- ResCCIA: Construction Cost Index for Residential Construction for Rest of Austria. (Excluding tax for underground construction.). Source: See ResCCIV.
- U: Austrian unemployment rate with respect to total labour force. Source: OECD, Main Economic Indicators: Basic Series.
- GVBond: Austrian Public Sector Bonds (>1 Year). Yields. Source: OECD, Main Economic Indicators: Basic Series.
- SRate: Interest rates for day to day money (call money). Source: Österreichische Kontrollbank.
- INF: Annual inflation rate. Source: Austrian Institute of Economic Research (WIFO).
- CCI: Overall Construction Cost Index. Source: Austrian Central Statistical Office (ÖSTAT).
- Mortgage: Mortgage Rates. Source: Raiffeisen Bank Österreich.

- Housing Expenditures: per square meter taken from Census data: it includes (a) regular fees for housing such as: rent (also for sublease) and repayments for ownership, and "usage fees" for dwellings constructed by corporate dwellings (b) operating costs and taxes, (c) fees for usage of fixtures (especially in cases of sublease), cost of heating and warm water. Source: Microcensus: Austrian Central Statistical Office (ÖSTAT).

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Notes

1. In steady state, it can be shown that housing service demand and population represent the same steady state growth process. We thank the referee for clarifying this point.
2. The Bausparkassen system works like the following; The potential borrower has to meet a savings target first. After that she is entitled to raise a loan of about the double amount. To make saving in this scheme more attractive the government offers premiums on interest and tax credits. For a more detailed discussion and a critical evaluation of the Bausparkassen system and other methods of housing subsidies see Lamel et al. (1986), Schmidinger et al. (1991, 1992a, b), Deutsch et al. (1993) and Deutsch (1995, 1997).
3. Oswald (1996) tries to link homeownership rates to unemployment using cross-section data from industrialized countries. However, his findings yet lack theoretical foundation.
4. For Austria, there is no such thing as "the market price" for housing nor the housing prices which are based on the hedonically adjusted houses of certain years characteristics as in the U.S. We have also tried with the housing expenditures series as a proxy for housing price. The results are not qualitatively different than the ratio of two deflators. The composition of the construction investment deflator is roughly 50% residential construction and the rest are commercial construction and structures (Tiefbau). The housing expenditure series is a composition of regular fees for housing: this includes the rent, repayments for ownership, "usage fees" for dwellings by construction firms, operating costs (e.g., cost of heating and water), taxes, and fees for usage of fixtures (e.g., furniture).
5. All the variables are expressed in logarithm for our empirical work, unless stated otherwise.
6. The demand measure based on population structure is calculated as in Mankiw and Weil:

$$D_{mwt} = \sum_i a_i N(i,t),$$

where the a_i are estimated coefficients of the average housing demand of persons in age group i using the census data, and the $N(i,t)$ are the number of individuals of age i in year t. The a_i be estimated by running the cross-sectional regression of

$$V_t = a_0 \sum_j Dummy0_j + a_1 \sum_j Dummy1_j + \cdots + a_{99} \sum_j Dummy99_j,$$

where V_t is the housing demand by a household which is measured by the value of the property for the unit in which the household resides, j denotes the jth member in the household, and *Dummy*0 = 1 if age = 0, *Dummy*1 = 1 if age = 1, etc.

7. The housing expenditures include (a) regular fees for housing such as: rent (also for sublease) and repayments for ownership, and "usage fees" for dwellings constructed by corporate dwellings, (b) operating costs and taxes, and (c) fees for usage of fixtures (especially in cases of sublease), cost of heating and warm water.
8. We use the capital stock that Czerny et al. (1990, 1992) have constructed.
9. A regression that includes both the *Pop*20 and D_t reduces the statistical significance of both variables, indicating that both variables are correlated and including 10th variables is redundant.

References

Deutsch, E., Riessland, B., and Schmidinger, J.(1993) 'Recent and Future Developments of Private Housing Finance in Austria', in B. Thruer and Cli. Whithead, eds., *Housing Finance in the 1990's*. The National Swedish Institute for Building Research.

Deutsch, Edwin (1995) 'Home Ownership Finance in Austria and Germany', *Real Estate Economics* **23**, 441–474.

Deutsch, Edwin (1997) 'Indicators of Housing Finance Related Intergenerational Wealth Transfers', *Real Estate Economics* **25**, 129–172.

Donner, Christian (1995) *Das Ende dei Wohnbauförderung: Versuch eines wohnpolitischen Gesamtsystems*, Vienna: Published by the author.

Czerny, Margarete (1990) 'Zur Neugestaltung der Wohnungspolitik in Österreich', in M. Czerny, G. Lehner, P. Mooslechner, N. Nemeth, G. Thury, M. Wüger, eds., Vienna: Austrian Institute of Economic Research.

Czerny, Margarete (1992) 'Gesamtnachfrage und Erneuerungpotential der Wohnungswirtschaft bis 2000', in M. Czerny, F. Hahn, A. Kodym, M. Wüger, eds., Vienna: Austrian Institute of Economic Research.

Engelhardt, Gary V. and Poterba, James M. (1991) 'House Prices and Demographic Change: Canadian Evidence', *Regional Science and Urban Economics* **21**, 539–546.

Fassmann, H., Kytir, J., and Münz, R. (1996) *Bevölkerungsprognosen für Österreich 1991-2021*. ÖROK-Schriftenreihe 126, Wien.

Green, Richard and Hendershott, Patric H. (1996) 'Age, Housing Demand, and Real House Prices', *Regional Science and Urban Economics* **26**, 465–480.

Hamilton, Bruce W. (1991) 'The Baby Boom, the Baby Bust, and the Housing Market: A Second Look', *Regional Science and Urban Economics* **21**, 547–552.

Hendershott, Patric H. (1991) 'Are Real House Prices Likely to Decline by 47 Percent', *Regional Science and Urban Economics* **21**, 553–563.

Lamel, J., Festa, C., Gisser, R., and Lackinger, O. (1986) *Prognose des Wohnungsbedarfes in Österreich bis 2000*, Linz: Traurier-Verlag.

Mankiw, N. Gregory and Weil, David N. (1989) 'The Baby Boom, the Baby Bust, and the Housing Market', *Regional Science and Urban Economics* **19**, 235–258.

Mankiw, N. Gregory and Weil, David N. (1995) 'The Baby Boom, the Baby Bust, and the Housing Market: A Reply to Our Critics', *Regional Science and Urban Economics* **25**, 573–579.

Ohtake, Fumio and Mototsugu Shintani, (1996) 'The Effect of Demographics on the Japaneses Housing Market', *Regional Science and Urban Economics* **26**, 189–200.

Schmidinger, J., Riessland, B., and Negrin, E. (1991) 'Überlegungen zur Wohnbaufinanzierung in Österreich', *Österreichisches Bankarchiv* **7**(91), 500–505.

Schmidinger, J., Riessland, B., and Negrin, E. (1992a) 'Überlegungen zur Neukonzeption der Wohnbauförderung und Wohnbaufinanzierung: Teil 1: Analyse des Wohnungsfinanzierungsmarktes', *Österreichisches Bankarchiv* **4**(92), 303–313.

Schmidinger, J., Riessland, B., and Negrin, E. (1992b) 'Über1egungen zur Neukonzeption der Wohubauförderung und Wohnbaufinanzierung: Teil 2: Lösungsvorschläge', *Österreichisches Bankarchiv* **6**(92), 543–551

Swan, Craig (1995) 'Demography and the Demand for Housing: A Reinterpretation of the Mankiw–Weil Demand Variable', *Regional Science and Urban Economics* **25**, 41–58.