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MONETARY POLICY AND HOUSING PRICES

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ABSTRACT

In this paper we study the determination of housing prices. We are particularly interested in how monetary policy affects housing prices.

First we derived the explanatory variables for housing prices from the utility maximisation framework. In this setting housing prices are determined by income, wealth, the user cost of housing, the demographic factor, and the supply of housing. In addition, our survey of the theoretical literature indicates that monetary policy affects housing prices through the user cost as well as through the liquidity of the households and through the changes in the valuation of alternative assets.

In the empirical part of the paper we ran regressions on data from the Helsinki area. Quarterly data from years 1973 -87 was used. Interest rate was found to be a significant explanatory variable in determining housing prices. Also net migration into Helsinki area and taxable wealth turned out to be of equal importance.

TIIVISTELMÄ

Tässä paperissa selvitetään asuntojen hintojen muodostumista. Erityisenä kiinnostuksen kohteena ovat rahapolitiikan vaikutukset asuntohintoihin.

Ensiksi johdettiin asuntojen hintoihin vaikuttavat muuttujat hyödyn maksimointi kehikon avulla. Selittäviksi muuttujiksi saatiin tulot, varallisuus, väestöpainetta kuvaava muuttuja ja asuntojen tarjonta. Teoreettisessa kirjallisuudessa rahapolitiikan katsotaan vaikuttavan asuntojen hintoihin asuntojen käyttökustannusten kautta. Lisäksi

vaikutuksia syntyy, sikäli kun rahapolitiikka vaikuttaa kotitalouksien likviditeettiin ja muiden rahoitusvaateiden arvoon.

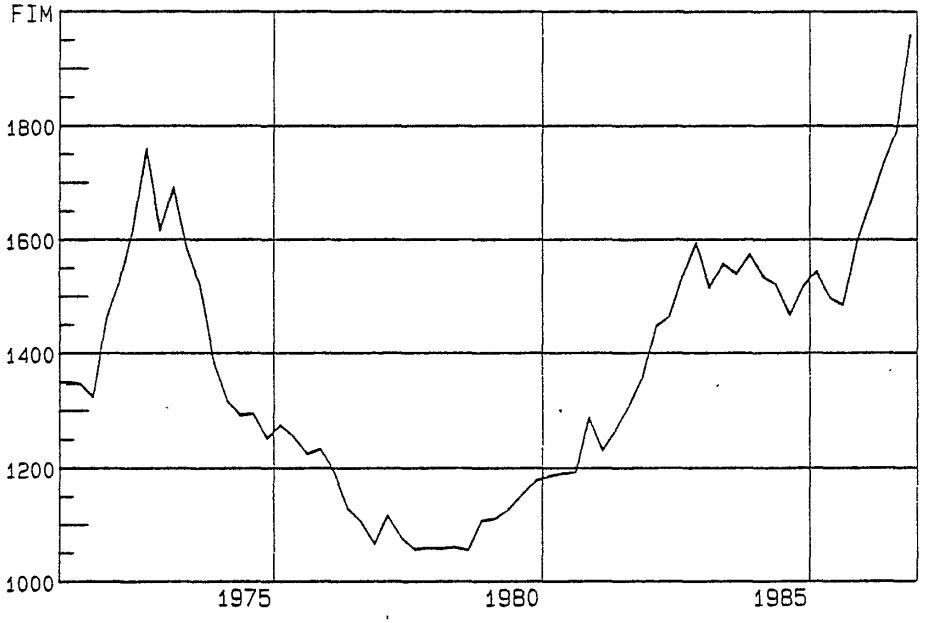
Empiirisessa osassa estimoimme asuntojen hintojen muodostumista Helsingin seudulla. Käytimme neljännesvuosiaineistoa vuosilta 1973-87. Korko osoittautui merkittäviksi selittäjäksi samoin kuin nettomuutto Helsingin seudulle ja verotettava varallisuus.

CONTENTS

1. INTRODUCTION

The real prices of housing in the Greater Helsinki area (the cities of Helsinki, Espoo, Vantaa and Kauniainen) have reached a new peak in recent years after having stayed relatively stable for some years as shown in Figure 1.

FIGURE 1
REAL HOUSING PRICES IN THE GREATER HELSINKI AREA, 1972 - 1987
(prices of old one-bedroom apartments deflated by the consumer's price index)



The same phenomenon but from a different point of view can be seen from Figure 2, which shows how many square meters could have been bought with the average annual disposable income in the Helsinki area. This ratio has been falling in 1987 after a slight increase in 1983-1986.[1]

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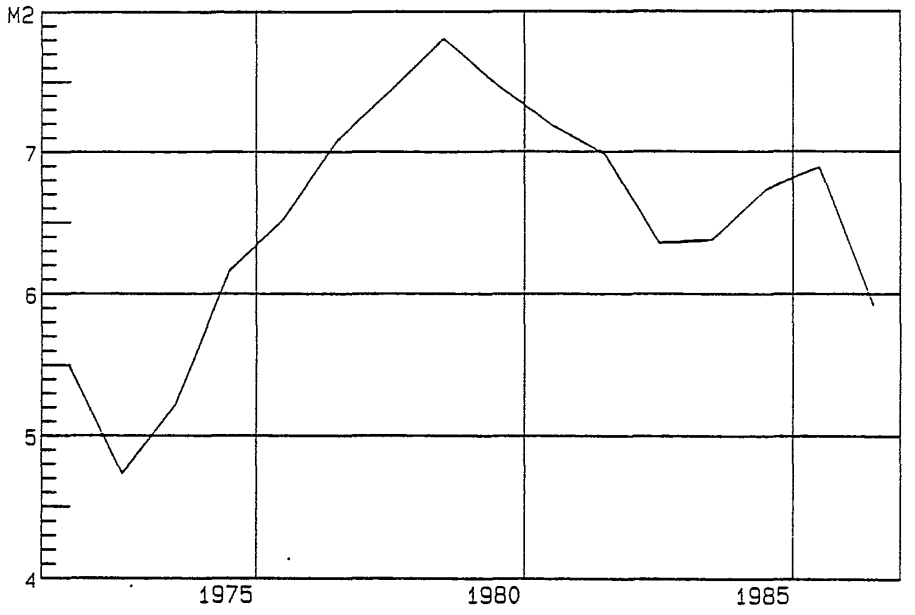
[1]Note that the level of the ratio is unrealistically low since we have divided the total disposable income by the total population rather than e.g. the number of households; the development of the ratio should nevertheless be accurate.

FIGURE 2
AVERAGE DISPOSABLE INCOME/PRICE OF HOUSING PER M2



These developments have lead to an increased interest in the determinants of housing prices. Several explanations have been offered, especially in view of the most recent price hike. For instance Rantala (1988) briefly discussed some possible explanations and concluded that the factors behind these developments have been the favorable development of disposable income and increased availability of credit. He also noted that the fall in the stock market prices last October has played a role, too, as speculators have now moved into the housing market.

In this paper we take a longer time perspective and focus particularly on the role of monetary policy in the determination of housing prices. We first study the determination of housing prices in a theoretical framework to get an idea of the variables that matter in the housing market. Against this background we then make a brief survey of the recent literature on how monetary policy is transmitted to housing prices. Finally, we present some estimation results on Finnish data up to 1987 and assess the relevance of different explanatory variables.

2. THE DETERMINANTS OF HOUSING PRICES AND THE ROLE OF MONETARY POLICY

The starting point for analyzing the determinants of housing prices is usually the demand for housing. As Salo (1984) points out, there are two possible approaches in modelling the demand for housing. If we want to look at housing as an investment from which capital gains are expected, we would want to use some type of portfolio approach. But if we take the demand for housing to arise from the consumption of housing services, we need to use utility maximisation just as in the derivation of any other type of consumption demand.

In the following, we first derive the variables affecting the housing demand from utility maximisation. Once the demand for housing is determined, we can obtain the price for housing by equating demand and supply. If the supply of housing is assumed to be fixed, at least in the short run, the demand determines the price and the demand equation can be transformed so that it yields the price.

In section 2.2 we then study the channels through which monetary policy is transmitted to housing prices.

2.1 Implications from utility maximisation

Salo has analyzed the representative household's demand for housing in a two-period utility maximisation framework. The household derives utility from consumption C and from housing H in both periods. Total utility can then be written as

$$(1) \quad \Omega = U(C_1) + V(H) + 1(1-\delta)\, U(C_2) + 1/(1+\delta)\, V(H)$$

where subscripts denote periods and δ = the rate of time preference. The household purchases the house consisting of H housing units in the first period, and finances the purchase by using initial wealth and taking out a loan. For simplicity it is assumed that the loan is paid back at the end of the second period, and that income accrues and consumption is paid for in the beginning of each period. The costs of housing are paid for at the end of each period.

The costs of housing in real after-tax terms are denoted by u_1 and u_2 in the first and in the second period, respectively. The household is able to deduct interest payments from taxable income, and its tax rate is denoted by γ. If a share b, $0 \leq b \leq 1$, of the purchase price is financed by debt, and if the nominal rate of interest is i (taken to be fixed), we can write the cost of housing for the first period as

$$u_1 = [(1-\gamma)ib]/[(1+r)(1+\pi)] \tag{2}$$

where π = the expected rate of inflation
r = the real rate of interest

This term represents the user cost of housing, i.e. the cost of having one unit of housing for one period.

The user cost of housing for the second period, again in real after-tax terms, is

$$u_2 \quad [(1-\gamma)ib + b - (1+\pi)^2]/[(1+r)(1+\pi)^2] \tag{3}$$

Note that b is added to the numerator to take into account the repayment of the loan. Similarly, $(1+\pi)^2$ is subtracted from the cost to represent the proceeds from selling the house at the end of period 2. It is thus assumed that the price of housing increases with the general rate of inflation.

For simplicity, the real rate of interest is assumed to equal the rate of time preference, i.e.

$$r = \delta \tag{4}$$

We are now able to write the budget constraint for the household as

$$(1-\gamma)[Y_1 - Y_2/(1+r)] - C_1 - C_2/(1+r) - KH = A/(1+r)^2 \tag{5}$$

where Y_1, Y_2 = income per period (initial wealth assumed to be included in Y_1)

$$K = P[(1-b) + u_1 + u_2/(1+r)]$$

P = unit purchase price of housing in real terms
A = financial wealth at the end of period 2

The household maximises its utility subject to the budget constraint. From this maximisation exercise we can derive the demand for housing which turns out to be dependent on income and wealth, the prices of housing in real terms, and on the user cost of housing. In reduced form:

$$(6) \qquad H^d = H^d(Y,W,P,u)$$

The above equation holds for the representative household. When we study the housing market in the aggregate, we must add some variable to capture the effects of the demographic factor (e.g. changes in the number of households).

An equation determining the prices of housing can be derived from the above analysis in the same way that Vihriälä and Skurnik (1985) have done. Assuming that the fraction of housing that is not effectively in the market is constant over time, we can equate the supply of housing with the observable housing stock. Furthermore, since construction takes time, we may take the housing stock to be fixed in the short run, e.g. within a quarter. We then have

$$(7) \qquad {}^sH = {}^dH\,(Y,W,P,u,N)$$

where N = the demographic factor

This can be transformed to

$$(8) \qquad P = P(Y,W,u,N,H^S)$$

We have now established that the housing prices are determined by income, wealth, the user cost of housing, the demographic factor and the supply of housing. In the following we study the ways in which monetary policy may be transmitted to housing prices.

2.2 The effects of monetary policy on housing prices

The effects of monetary policy on housing prices arise through the central bank influence on the nominal interest rate and on the actual and expected inflation rate. In this paper we do not consider the question to what extent the central bank is able to influence these variables. Instead we take this influence as given.

Monetary policy may affect housing prices through different channels. It may be transmitted through the user cost variable, or it may influence the liquidity of the household which in turn can change the household's desired consumption of housing services. If housing purchases are regarded as portfolio investments, the effects of monetary policy come also through changes in the valuation of alternative assets.

In the setting described above, the nominal rate of interest was taken to be fixed and the Fisher parity does not hold in the market for housing finance (i.e. the real rate of interest and expected inflation do not sum up to the nominal interest rate for housing loans). Monetary policy works through the user cost variable, and we can study the effects of an increase in the nominal interest rate and of an increase in the expected rate of inflation separately.

An increase in the nominal interest rate increases the user cost and reduces the demand for housing on this account. On the other hand, the income effects of an interest rate increase depend on the net wealth position of the household as well as on the level of terminal wealth, i.e. on the relative size of interest income with respect to interest payments. Salo concludes that under plausible assumptions the demand for housing is reduced as a result of an increase in the interest rate. Similarly, the effects of an increase in the inflation rate are not clear-cut and the net effect on the demand for housing remains ambiguous.

If we assume that the Fisher parity holds in the market for housing finance, the outcome is somewhat different. In this case the nominal

interest rate varies with inflation, so that in principle inflation does not affect the user cost of housing. However, if nominal interest payments are tax-deductible and capital gains are not taxed, higher inflation reduces the real user cost of housing (see e.g. Schwab 1983, Titman 1982). Defining the real after tax user cost of capital as

$$(9) \qquad u = [(r+\pi)(1-\gamma) - \pi]$$

we see that an increase in the expected rate of inflation reduces the user cost of housing. As a result, the demand for housing increases and prices go up.

The form of the mortgage contract may also create similar types of effects under the Fisher parity (see Manchester 1987). In the case of an adjustable rate contract unexpected inflation reduces the real interest rate, the demand for housing increases and real housing prices rise, even if there are no such tax-shelter effects as described above. These effects do not emerge, of course, if the contract is on a price-level-adjusted basis so that the real mortgage payments remain constant.

The above analysis was carried out with the assumption of a perfect capital market. Salo solves her model also under the assumption of an imperfect capital market, in which case consumers can borrow only for purchasing the house but not for consumption. The results remain basically the same; the differences lie in the time path of consumption which is now affected more by the timing of external shocks. Schwab (1982) argues along similar lines. Inflation may lead to a downward pressure on housing prices through liquidity constraints, which force the demand for housing down. This occurs when an increase in expected inflation raises the nominal interest rate. The present value of real payments remains constant, but inflation tilts the stream of real payments forward which may lead to cash flow problems for some homebuyers. The liquidity constrained consumers must then substitute among housing, present consumption, and future consumption, and the demand for housing will be reduced.

Thus inflation creates a welfare loss because the consumer cannot realize his preferred time path of consumption of goods and housing. Using a simulation model Schwab shows that this welfare loss is small if compared to the effects of a change in the real rate of interest. Again, this result does not emerge if the mortgages are adjusted to the price level.

We now turn to the implications that arise when we think of housing purchases as portfolio investments. It has been argued that inflation expectations make investment in housing more attractive than investment in financial assets (see e.g. Furstenberg 1985). This is because of the future capital gains that housing investment offers. The return on financial investment, on the contrary, is often reduced due to inflation. Fama and Schwert (1977) showed using U.S. data from 1953 to 1971 that only private residential investment was a complete hedge against both expected and unexpected inflation. Government bonds turned out to be complete hedges only against expected inflation, while the return on common stock was negatively related to expected inflation.

It should be noted, however, that this hedging motive in the demand for housing may not be all that important. Rantala (1986) develops a model in which housing is regarded not only as a consumer durable but also as portfolio investment. On the basis of this model he argues that if housing prices are positively correlated with the price of consumption, the consumption of housing services is reduced, which partly offsets the positive demand effect stemming from the hedging motive. Consequently, the hedging motive is less important as a determinant of housing demand than implied by standard portfolio theory.

Kearl and Mishkin (1977) point out that consumer durables, such as residential housing, are quite illiquid and may be less desirable as portfolio assets if the probability of encountering financial distress increases. Consequently, the balance sheet position of households plays an important role in the demand for consumer durables, and as monetary policy affects the balance sheet it also

affects the demand for durables. These effects may come from two channels.

Firstly, monetary policy affects the valuation of financial assets in the economy. Tight monetary policy leads to a fall in stock and bond prices, which in turn reduces the value of financial wealth. Consumers now have a higher probability of financial distress as their "reserves" (financial wealth) are lower, and they will reduce their demand for housing and other consumer durables.

Secondly, easy monetary policy in the past may have induced consumers to accumulate debt. This serves as a deterrent to the demand for housing as the increased debt holdings make consumers to desire more liquid assets.

In summary, we note that monetary policy is transmitted in several ways to housing prices. One channel is the user cost, which is affected by changes in the interest rate and/or in inflation. Monetary policy may also work through liquidity effects as we saw in the case of imperfect capital markets and through the valuation of alternative assets.

3 EMPIRICAL EXPERIMENTS ON FINNISH DATA

In the following some estimation results will be presented to explain the behaviour of housing prices in the Greater Helsinki area. We are particularly interested in the effects of monetary policy.

3.1 Explanatory variables

In section 2.1 we showed that the price of housing is determined by income, wealth, the user cost of housing, the housing stock and demographic factors (eq. (8)). In the operationalization of the explanatory variables we basically follow Vihriälä and Skurnik (1984). The details on data sources and on how the series were constructed are reported in the appendix so that here we just comment on the variables on a general level.

For the income variable we used disposable (after-tax) income. Taxable wealth is used as a proxy for total wealth as no other regional data on wealth is available. Both disposable income and wealth variables are transformed to per capita basis. Taxable wealth is only a very approximate measure for wealth as it underestimates the growth in asset value. We also experimented with a stock price index as a proxy for wealth, but it turned out not to be a significant explanatory variable.

The intuitively plausible indicator for the demographic variable N would be the number of households. Unfortunately no such data is available in an annual or quarterly time series form. Vihriälä and Skurnik used three different demographic variables (the total population, the percentage change in the total population and the net migration to the Helsinki area). The net migration was found to be the best explanatory variable. We chose to follow Vihriälä and Skurnik taking net migration for our demographic variable.

The operationalization of the housing stock variable was quite straight-forward and presented no particular problems.

As for the user cost variable the situation is more complicated. The treatment of the user cost differs in Salo from that in Vihriälä and Skurnik. Salo uses an explicitly calculated user cost variable in her estimations of the demand for housing, while Vihriälä and Skurnik argue that the purchase price is likely to dominate in the user cost formula and can therefore replace the user cost in the estimations. Again, we chose to follow Vihriälä and Skurnik and omitted the explicit treatment of the user cost.

Eq. (8) was derived under the assumption of a perfect capital market. This is clearly an unrealistic assumption with regard to the Finnish financial markets in the 1970's and early 1980's. During those years the administratively low level of nominal interest rates, high rates of inflation, and liberal rules of tax deductibility of interest payments resulted in very low levels of real after-tax interest rates and persistent excess demand for credit. In this situation credit had to be rationed by other means than the rate of interest and credit availability influenced decisions on housing purchases more than the price of credit. This reinforces the dominance of the purchase price in the user cost variable but also calls for an additional variable in the aggregate equation capturing the effects of credit availability. Following Vihriälä and Skurnik, and Salo we add the short term interest rate to the equation. For the years 1972 -81 this rate is the marginal rate for borrowing from the central bank which can be interpreted as an indicator of the tightness of the money market and consequently, of the availability of credit.

With the gradual deregulation of the financial markets the market interest rates increased in importance and have replaced other means of credit rationing. In terms of the housing market this has meant that the interest rate on housing loans has become a more relevant determinant of the user cost. It is not possible to pin down the start of this development to a single point in time, and we cannot therefore use a dummy to assess the importance of this. Instead, we continue our short term interest rate series with the market interest rates, data on which becomes available from 1982 onwards as the markets started functioning. The idea is that by doing this we obtain

a variable which reflects the current situation in the money market in any given point in time.

3.2 Estimations

The basic regression equation in nominal terms is the following (compare to equation 8)

$$PH = a + b\,YD + c\,W + d\,DEM + e\,R + f\,HS + P\ ,$$

where

PH = price of housing (per square meter)
YD = disposable income
W = taxable wealth
DEM= net migration
R = short term interest rate
HS = housing stock
P = consumer price index

All the variables are in the logarithmic form except for the interest rate. Nominal interest rates, incomes and wealth are transformed into 4-quarter moving averages. The interest rate is lagged by three quarters and net migration by four in all the regressions. Different lags on the income variable and on the interest rate variable were tried, but the results did not improve.

Besides the nominal interest rate (Rn) a real interest rate (Rr) was tried. The real interest rate was constructed by subtracting a year-on-year inflation rate from the transformed nominal interest rate. This is a fairly arbitrary method and it was used as there is no measure for inflationary expectations.

Regression using OLS is run first in nominal terms (equation 1 in Table 1). Signs of the coefficients seem to be right except for the consumer prices. However, there is a serious problem of multicollinearity. Correlations between income, wealth and consumer prices are around .99. Thus, the coefficients are not reliable. Autocorrelation is also significant as indicated by the DW-statistics, which makes the t-values biased upwards.

In regression (2) variables are made real by deflating prices, incomes and wealth by the consumer price index. Multicollinearity is now less severe but autocorrelation remains.

To avoid autocorrelation problems regressions were run in differenced form (equations (3) and (4)). Differencing indeed reduces autocorrelation significantly (some negative serial correlation remains) and removes multicollinearity. In spite of differencing the signs of income, wealth, net migration and interest rate remain correct. Regression in real differences (4) appears to give the best results. The coefficients are statistically significant except for the income variable and the housing stock. Moreover, the interest rate gains in explanatory power.

The effects of monetary policy emerge through the interest rate variable. The interest rate variable as it is constructed here is only a rough measure for the tightness of money market in any point of time. It is assumed that this one variable is able to reflect the effects of monetary policy under various degrees of regulation of housing markets and money markets in general.

TABLE 1
Regressions for housing prices 1973Q1 - 1987Q4

	Explanatory variables							
	YD	W	DEM	Rn	Rr	HS	P	constant
nominal								
(1a)	2.6	.41	.12	-.008		-3.6	-1.6	49
	(6.5)	(2.4)	(4.8)	(3.0)		(3.0)	(4.7)	(4.2)
	DW= .7	R2= .99						
(1b)	2.6	.25	.12		-.004	-2.3	-1.7	36
	(6.0)	(1.5)	(4.3)		(1.5)	(2.0)	(5.0)	(3.3)
	DW= .6	R2= .99						

real

(2a)	2.5	.30	.10	-.006		-1.8	24
	(6.2)	(2.1)	(4.1)	(2.8)		(8.0)	(12)
	DW= .6	R2= .89					
(2b)	2.5	.25	.12		-.002	-1.7	23
	(6.2)	(1.6)	(4.2)		(1.0)	(7.2)	(11)
	DW= .6	R2= .88					

nominal differences

(3a)	.72	.55	.08	-.005		1.6	-1.0
	(0.9)	(2.0)	(2.0)	(1.1)		(.6)	(1.0)
	DW= 2.4	R2= .11					
(3b)	.54	.58	.10		-.006	1.5	-0.8
	(0.9)	(2.1)	(2.4)		(2.0)	(0.6)	(0.9)
	DW= 2.4	R2= .13					

real differences

(4a)	.85	.51	.09	-.008	-.65	
	(1.1)	(2.0)	(2.3)	(2.0)	(0.7)	
	DW= 2.3	R2= .20				
(4b)	.76	.57	.10	-.006	-.72	
	(1.0)	(2.2)	(2.5)	(2.0)	(0.8)	
	DW= 2.3	R2= .20				

DW is Durbin-Watson -statistics for autocorrelation. R2 is the coefficient of determination corrected for degrees of freedom. A dummy for the third quarter of 1986 was used to capture the effects of the devaluation speculation. All variables are logaritmic except the interest rates.

The estimations indicate that the interest rate is a significant explanatory variable for housing prices. In the best performing regressions (equations 4a and 4b) it explains about a quarter of the total variance in housing prices that is explained by the independent variables and its explanatory power is of comparable magnitude to that of the wealth and the demographic variables. Using the real interest rate instead of the nominal one does not improve the results. However, in the difference specifications the real interest rate appears to behave better in the sense that the estimates of the interest rate elasticity of the housing prices differ less from one specification to the other.

The results on the importance of the interest rate are in line with previous results on Finnish data. Vihriälä and Skurnik (1984) obtained some significance for the nominal interest rate variable in explaining the housing prices in the Helsinki area. Our estimates for the interest rate elasticity are slightly higher than those in Vihriälä and Skurnik. Also Salo (1984) found that the marginal cost of central bank borrowing affected the demand for housing in the years 1962-80. Similar findings emerge from other studies, too. Using Danish data Blomgren-Hansen and Knosgaard (1978) found the interest rate to be of relevance in the determination of housing prices in Denmark and also Broadberry's (1987) empirical evidence from interwar Britain points to this direction.

4 CONCLUDING COMMENTS

In this paper we have studied the determination of housing prices and the transmission of monetary policy to housing prices.

First we analyzed the demand for housing in a utility maximisation framework and derived a reduced form equation for the determination of housing prices. They are shown to depend on income, wealth, the user cost of housing, demographic factors and the supply of housing.

We then turned to the transmission of monetary policy. There are several channels through which monetary policy may affect housing prices. One channel is the user cost, which is affected by changes in the interest rate and/or in inflation. An increase in the nominal interest rate increases the user cost and reduces the demand for and the prices of housing, if the loan contracts are fixed in nominal terms in some manner. But if the loan rate is free to change and the Fisher parity holds, the outcome is different. Assuming that interest payments are tax deductable and capital gains are not taxed, an increase in the nominal interest rate (reflecting higher expected inflation) actually reduces the user cost and thus leads to an increase in the housing prices.

Liquidity effects form another channel through which monetary policy may be transmitted. Consider the case in which the capital market does not function perfectly and some of the consumers are liquidity constrained. An increase in expected inflation drives up the nominal interest rate, and although the present value of real payments remains constant, the stream of real payments is tilted forward. As a result, liquidity constrained consumers may run into cash flow problems.

Monetary policy can also work through the valuation of financial wealth. Tight monetary policy tends to reduce stock and lond prices and consequently, the value of financial wealth is reduced. This in turn increases the probability of financial distress and leads to a reduction in the demand for illiguid assets, such as housing.

In the empirical part of the paper we present some tentative estimations on Finnish data of the role of monetary policy in determining housing prices in the Helsinki area. In our empirical framework monetary policy is thought to affect mainly through the short term interest rate which is taken to reflect credit availability but also, towards the end of the estimation period, the user cost. We have thus tried to take the relevant institutional settings into account.

The results of the estimations indicate that monetary policy do indeed affect housing prices, to the extent that the central bank can influence the interest rate. Furthermore, the nominal interest rate appears to be more significant than the real interest rate. The problems in meassuring the real interest rate may, however, be partly responsible for the result. Taxable wealth and net migration into the Helsinki area turned out to be equally significant explanatory variables. These results are compatible with previous studies on Finnish data.

DATA

Disposable income

Data on disposable income in the Greater Helsinki area for the years 1977-1985 was taken from the data base for regional information of the Central Statistical Office of Finland. It was calculated as the difference between gross income and taxes actually paid. The series was extended for the years 1972-1976 on the basis of data on disposable income in the cities of the administrative district of Uusimaa (in which the Greater Helsinki area is located), as no data on only the Greater Helsinki area was available. The observations for 1985-87 were obtained by using the percentage change in households' disposable income from the national income accounting statistics.

The annual time series was then transformed to a quarterly series by disaggregating the series so that the quarterly variations correspond to those in the index of general wage level.

Taxable wealth

The wealth variable for the years 1977-85 was taken from the data base for regional information. Data for the years 1972-76 had to be constructed from the more aggregated Incomes and Wealth Statistics of the Central Statistical Office. This was done by assuming that the taxable wealth of the Greater Helsinki area was in a stable relation to the taxable wealth of the district of Uusimaa (this relation was indeed constant, 87%, for the years 77-81). For the years 1986-87 no information was available. Thus, the series was continued by average growth rate of the taxable wealth. Taxable wealth in Finland includes real estate, vehicles, deposits on certain accounts on which the interest income is taxable and stocks. However, the taxable value of these items is lower than the market value. Quarterly series was constructed by linear interpolation.

Population

Population statistics were available in the data base for regional information from 1975 up to the third quarter of 1987. Data for the years 1972-74 was found in the publications of the Central Statistical Office, and the observation for the year 1987 was constructed by adding to the population in the third quarter of 1987 the average change in population from quarter to quarter. The annual series thus obtained was then transformed to a quarterly series by using linear interpolation.

Net migration into the Greater Helsinki area

Data for the years 1972-75 was taken from the population statistics, for the years 1976-86 from the data base for regional information, and for the year 1987 from the estimates of the Central Statistical Office. Quarterly series was created by linear interpolation.

Short term interest rate

Data was taken from the series of the Bank of Finland. For the period 72Q1 - 82M2 no short term market rate was existing, so the marginal rate for borrowing from the Central Bank borrowing was used instead.

Housing stock

The housing stock variable was constructed by using data on new housing units and on housing stock. Data on the housing stock was available for the years 1975, 1980 and 1985. We took the stock in 1975 as a starting point and added to it new housing units each year. The estimates of housing stock obtained in this way correspond well to the data on the actual stock in 1985: differences were of the order of 1 per cent. To extend the series backwards to cover the years 1972-74 we subtracted the amount of new housing units per year from the stock of 1975. The annual series was transformed into a quarterly series by using linear interpolation.

Price of housing

A monthly series of the prices of old one-bedroom apartments in the Greater Helsinki area was available in the data base of the Bank of Finland. This data has been obtained from Huoneistokeskus, the largest real estate firm in the Greater Helsinki area.

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