Housing Prices, Bank Lending, and Monetary Policy

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September 2000

Paper to be presented at the *Financial Structure, Bank Behaviour and Monetary Policy in the EMU* Conference, October 5-6, 2000, Groningen.

Abstract

In order to gain more insight into the relationship between housing prices and mortgage lending, we estimate models for both the Dutch housing and the mortgage market. The empirical analysis presented in this paper offers support for the hypothesis that in the Netherlands housing prices and mortgage lending are interdependent. According to our model, housing prices were influenced by changes in bank lending criteria during the estimation period, even when we control for variables such as disposable household income, mortgage interest rate, demographic developments and the housing stock. Mortgage lending was found to be dependent on housing prices as well as disposable income. Our analysis further suggests that in the short run housing prices can deviate substantially from their long-run equilibrium value.

JEL-codes: D45, E32, E51, G12, G21, R21

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1. Introduction

A dependency of households on bank credit points in the direction of a credit channel in which bank lending influences real economic activity through changing housing prices. External shocks, like rapid deregulation or a change in monetary policy, will influence banks' lending conditions and therefore the severity of households' credit constraints. An expansionary monetary policy, and the accompanying lower interest rates, can for instance lead to higher collateral values. This will enable households to attract more credit and even to cash part of the surplus value of their house, since higher collateral values make the problem of asymmetric information less critical to banks. Expectations about continuing housing price rises may induce banks to relax their lending standards even further, thereby leading to a self-perpetuating process of increasing property values and higher credit. Such periods of rising property prices and higher credit granting are not only of consequence for monetary policy, but also have important implications for supervisory policies, as both households and banks become more vulnerable to a fall in housing prices. Lower property values will again bring to the fore the problem of asymmetric information, as banks will no longer rely mainly on (excess) collateral, but are forced to focus again on the expected repayment capacity of their clients. A squeeze of the credit supply may be the result.

In this paper, we shall examine the currently soaring Dutch housing prices and the accompanying rapid credit expansion. To put this case into perspective we will briefly revisit two earlier and quite similar European cases of rapidly rising housing prices and the associated role of bank loans: the Nordic banking crisis, and the boom and bust on the UK housing market. In paragraph 2 we first pay attention to some important theoretical notions. Then, in paragraph 3, we briefly discuss both the Nordic case and the UK case in a descriptive manner. Paragraph 4 presents some general information with regard to the modelling of housing prices, followed by an empirical analysis on the relationship between housing prices and credit-availability in the Netherlands in paragraph 5. Finally, paragraph 6 concludes.

2. Housing prices, bank credit and consumption

When a household buys a house, it will typically be dependent on a financial institution like a bank from which it can borrow a substantial portion of the needed funds. Most households will not be able to raise money from other sources: banks are "special" to them. However, when granting loans, banks will be faced with asymmetric information: they only have limited insight into the financial prospects and moral rectitude of potential borrowers. To reduce these informational shortcomings, banks will screen households before granting credit, hoping that in doing so they will be able to avoid the worst risks. Additionally, they will demand households to pledge collateral, usually in the form of the house that is to be financed (mortgage loan). The pledging of collateral significantly reduces moral hazard behaviour, since households know that if they are unable to meet their redemption and interest payments, the bank will be entitled to sell the house and use the proceeds to reclaim its funds.

The so-called balance sheet channel, which is part of the credit view of monetary transmission, describes how changing interest rates can influence the credit supply of banks by affecting the net worth of both firms and households.[1] A higher interest rate, for instance, can decrease the net worth of households, since households' real debt burden will increase and housing prices (collateral value) will come down.[2] Furthermore, the higher interest rate will also increase interest payments. Together, these effects may aggravate the consequences of asymmetric information, ultimately leading to a reduction in the supply of credit to households.[3] External shocks, like a change in monetary policy, can thus start a process in which changing housing prices influence the credit supply by banks. In turn, these changes in credit availability may influence housing prices. Additionally, an increase in interbank competition (for example due to deregulation) can lead banks to focus on gaining market share rather than profit maximisation. During such adjustment processes, overshooting of credit markets is a well-known phenomenon in

[1] Bernanke & Gertler, 1995. In the remainder of this paper we will focus on households.

[2] A household's net worth is to a large extent made up of the housing value minus its outstanding mortgage debt (also termed surplus value).

[3] Besides the balance sheet channel, the credit view also highlights the so-called bank lending channel, which stresses the importance of the adaptation of banks' balance sheets in reaction to a shift in monetary policy. Both the bank

which the pricing of risk is inadequate. Expected increases in collateral values will also lead to a decline in the perceived risk (Herring and Wachter, 1999). Banks may even start to display disaster myopia behaviour: the probability of low-frequency shocks like a real estate crash is underestimated, especially when the time period since the last real estate collapse gets longer (Guttentag and Herring, 1984).

Periods of rapid credit expansion may not only influence housing prices but also macroeconomic variables like consumption and inflation. Firstly, higher housing prices can lead to wealth effects: house-owning households will start to feel wealthier because of the increased housing prices and will therefore spend a higher proportion of their income on consumption (decreasing propensity to save). Secondly, some households will start to cash part of their surplus value by taking out new mortgage credit. This so-called withdrawn equity can then be consumed. However, such periods of credit and housing booms can end abruptly when a certain trigger, e.g. a tightening of monetary policy, reverses this vicious circle. Lower collateral values and increasing uncertainty may then prompt banks to shrink their credit supply, thereby (further) depressing housing prices: the disaster myopia turns into disaster magnification (Herring and Wachter, 1999). Wealth effects and equity withdrawal will start to work in the opposite direction, resulting in lower consumption. Ultimately, economic activity will be slowed down by means of the same channels that were preponderant during the preceding boom period.

3. The macroeconomic importance of housing and mortgages: two European cases

During the 1980s and 1990s a number of European countries were hit by financial instability relating (at least in part) to housing and mortgage markets, namely the United Kingdom and three Scandinavian countries. While each boom-bust cycle had its own peculiar features, they nonetheless shared some remarkable similarities. All four countries experienced a period of rapid financial deregulation in the 1980s, prior to the boom.[4] Before deregulation, credit rationing had led to substantial excess demand for

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lending channel and the balance sheet channel stress the way in which monetary policy influences the *supply* of bank credit, while the traditional money view focuses on the *demand* for bank credit.

[4] In 1980 the Bank of England discontinued the Supplementary Special Deposits Scheme which had required banks to place a certain amount of interest-free deposits with the central bank. In 1981 the Bank also abolished the Reserve

credit (Miles, 1992; Callen and Lomax, 1990; Drees and Pazarbasioglu, 1998). In the UK this was the result of an informal cartel of building societies that ruled the mortgage market. In Scandinavia, banks were effectively sheltered from competition from other domestic and foreign financial institutions, which allowed them to be highly selective in choosing credit risks. After deregulation of the financial markets, both the amount of mortgage credit and the (real) mortgage interest rate rose in these countries, reflecting the excess demand that had been present for many years. Adding to this effect, which basically reflected the achievement of a new equilibrium, was an additional increase in credit demand, pushing up real mortgages rates even further. This credit demand was induced by very optimistic expectations of households. In the UK an increasing interest for new products like small and second mortgages also played a role, while in Scandinavia demand for credit was enhanced by a generous tax deductibility of interest expenses.

The resulting rapid build-up of household debt was accompanied by a spectacular increase in housing prices. Apparently, the growing value of collateral subsequently made the problems associated with informational asymmetries (seemingly) less serious to banks, which prompted them to extend even more credit. Furthermore, fierce competition on the mortgage market led to an erosion of the quality standards used: banks started to use higher loan-to-value ratio's. Meanwhile, the combination of rising housing prices and less strict credit constraints resulted in a boost of consumption, as consumers (partly) cashed in the surplus value of their house.

By the late 1980s or early 1990s the whole process reversed. Monetary tightening increased interest payments of households, compounded in Scandinavia by the abolition of the tax deductibility of interest expenses. Households' net worth decreased or even turned negative because of the sharp reduction in housing prices. Furthermore, many

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Asset ratio, a liquidity requirement. In addition, in 1983 the Building Societies' Association decided to no longer recommend rates to be charged on mortgages and started to allow building societies to borrow increasingly from the money markets, whereas they were previously restricted to lend on their customers' deposits only (Sargent, 1991, and Muellbauer and Murphy, 1997). In Norway, supplementary reserve requirements were abolished in 1984, while interest rate declarations were removed in 1985. Important deregulation measures in Sweden included the abandoning of the system of liquidity ratios for banks in 1983 and lifting the ceilings on bank lending and restrictions on bank lending

households were confronted with lower than expected incomes. Households began to consolidate their financial positions by cutting back on consumption. As a result, the economies plunged into a deep recession. In addition to this initial demand shock the Scandinavian countries, particularly Finland, suffered from a collapse of the trade with the former countries of the USSR (Vihriälä, 1997). Personal bankruptcies rose, putting bank's balance sheets under pressure. In Scandinavia, the financial problems in the private sector (including the corporate sector) reached such a level that a full banking crisis ensued.

From these two cases it is evident that housing and mortgage markets play a crucial role in financial stability, in the sense that problems may spill over into the real economy. In the remainder of this paper we will concentrate on the Netherlands, where the present situation with regard to housing prices, mortgage lending and consumption appears to resemble the upward cycle in the UK and Scandinavia in the 1980s to a certain degree. Our main focus will be the relation between housing prices and mortgage lending. However, before setting up a model, we will first discuss the different ways in which housing prices in general, and the role played by mortgage credit in particular, have been modelled in previous research.

4. Modelling of housing prices and mortgage credit

There exists a large body of both theoretical and empirical literature describing housing prices. Traditional models of housing prices consist of a stock-flow model in which markets clear quickly and prices adjust to equate the demand for housing with the existing stock. Prices are directly derived from a demand and supply function.[5] However, these models, like the stock-adjustment framework developed by Muth (1960), lack a satisfactory micro foundation. An important strand of literature therefore started to view houses as an investment asset that provides the owner with a stream of housing services.[6]

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rates in 1985. In Finland, amongst other measures, restrictions on average lending rates were abolished in 1986 (Drees and Pazarbasioglu, 1998).

5 With housing supply assumed fixed (infinitely inelastic) in the short run, a housing price equation was often constructed by inverting the demand function (see for instance Hendry, 1984).

6 See for this so-called asset market approach Breedon and Joyce (1993), Holly and Jones (1997), Brown et al. (1997), Barot and Takala (1998) and the seminal paper by Poterba (1984).

The fundamental value of a house can then be seen as the present discounted value of the real (expected) housing services the house will provide over time. In this literature, models generally describe a representative household that solves an intertemporal optimisation problem involving two goods: housing services and a composite consumption good, which are both part of the utility function. Apart from housing there is one other non-housing asset. The household maximises utility over time, taking into account its budget constraint and some technical constraints, describing the evolution of the stock of housing and non-housing assets. By doing so, it ensures that the marginal rate of substitution between housing services and the flow of utility from consumption (u_h/u_c) will equate both the real user cost of housing and the real rental price of housing in capital market equilibrium (R_t):

$$(1) \qquad \frac{u_h}{u_c} = \left[(1-t)i - p_h^e + d \right] rp_h = R_t$$

The variables included in the real user costs of housing term are the interest rate (i), the marginal rate of income tax (t), the expected real capital gains on housing (p_h^e), the rate of depreciation (d) and the real housing price (rp_h).[7] It is the real housing price which must now bring about capital market equilibrium. The real rental price (R_t), which equals the amount of money that has to be given to a household to compensate for the loss of one "housing unit", is unobservable: it is proxied by the demand for and supply of housing services. Therefore, the real rental price will be a function of real income (ry), the housing stock (H) and demographic variables ($DEMO$)[8]:

$$(2) \qquad R_t = f(ry, H, DEMO)$$

By substituting out for R_t in (1) we can now express the real housing price in terms of real income, demographic variables, housing stock and the user cost of housing

[7] See also Barot and Takala (1998), p. 12. The real user cost of housing includes an expected price term and is therefore endogenous. In empirical testing the expected capital gains on housing are often proxied by lags in housing price appreciation (Muellbauer and Murphy, 1997).

[8] Breedon and Joyce (1993) for instance, in the tradition of the Bank of England's model of the early 1990s, represent demography by the proportion of the population aged 25-29, a prime house buying group.

(logarithmic notation). Note that when we assume the existing housing stock fixed in the short-term, the resulting model of housing prices is simply an inverted demand function and is close to the traditional reduced form specification that can be derived from equating particular housing demand and supply schedules and solving for housing prices (Pain and Westaway, 1997). Usually, housing price models include the ratio between some measure of demography and the housing stock, which we represent for the moment as ln(*DEMO/H*). Thus, the housing price is related to (excess) demand rather than demand for or supply of housing per se.

$$(3) \qquad \ln rp_h = f\left(\ln ry, \ln\left(\frac{DEMO}{H}\right), \ln\left\{(1-t)i - p_h^e + d\right\}\right)$$

Note that in the discussion until now, no theoretical reason has been given for including a mortgage credit variable in equation (3). This means that thus far it has implicitly been assumed that there are no credit market constraints, meaning that only the market price, i.e. the mortgage interest rate, is relevant to households.[9] The mortgage interest rate is already included in (3) as an element of the user costs of housing. However, it is very likely that not only the *price* but also the *volume* of the mortgage market will be of interest to house buyers. After all, as was pointed out in the paragraph 2, households can generally not borrow as much as they desire at the prevailing mortgage rate. Therefore, one can test for the importance of credit rationing[10] as a result of information asymmetries by including a mortgage variable. Hendry (1984) and Hakfoort and Matysiak (1997) use, for instance, the outstanding mortgage stock as a proxy for mortgage rationing, while Muellbauer and Murphy (1997) proxy changes in mortgage lending by the rate of acceleration of the log mortgage stock. Other credit rationing variables that are often used include loan-to-value ratio's for first time buyers (Dicks, 1990, and Pain and Westaway, 1997) and the difference between an appropriate interbank rate and the average mortgage rate (Pain and Westaway, 1997). For the time being we will label the different mortgage variables "ln(*MOR*)":

9 Demand influences are assumed to be completely reflected in the mortgage interest rate.

10 Stiglitz and Weiss (1981). Meen (1990) shows that the existence of credit market constraints implies that the user costs of housing increase with the ratio of the shadow price of the rationing constraint to the marginal utility of the

$$(4) \qquad \ln rp_h = f\left(\ln ry, \ln\left(\frac{DEMO}{H}\right), \ln\left\{(1-t)i - p_h^e + d\right\}, \ln MOR\right)$$

Both Muellbauer and Murphy (1997) and Hendry (1984) recognise that households do not possess all relevant knowledge of the mortgage and housing market and all the variables that influence it. The rational expectations assumption might therefore be too strong. On the one hand it can be expected that households will have at least some information about these markets, housing being one of the biggest expenditures in their life. On the other hand, however, the very fact that most households buy a house only once or twice in their lifetime adds to the doubtfulness with regard to the quality of their decision making process. Therefore, "sensible" (Hendry, 1984) or "semi-rational" (Muellbauer and Murphy, 1997) expectations are often assumed, which means that these expectations are neither persistently wrong nor fully efficient. Available sources of information can for instance be interest rates, the volume of mortgage lending and also lagged values of housing prices. DiPasquale and Wheaton (1994) note that the housing market has a somewhat predictable cycle with positive serial correlation: housing prices do not follow a random walk but exhibit significant serial correlation. This implies that not only the supply side of the housing market adjusts gradually, due to the housing stock being fixed in the short term, but also the demand side.[11] Such a gradual price adjustment process holds when households develop expectations by looking backward at historic prices. Case and Shiller (1988) show for instance that extrapolating behaviour (backward looking expectations) is common in housing markets. During booms home buyers expect further housing price rises and are worried about not being able to buy a house in the future market.[12] [13]

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composite good. However, this quantity is unmeasurable, and therefore excess demand is often proxied by measures such as the stock of mortgages outstanding.

11 DiPasquale and Wheaton assume the following price adjustment mechanism, in which P^* is the hypothetical equilibrium price and τ is the (quarterly) percentage rate at which actual prices converge to this equilibrium price:

$$?P = t\{P^* - P\}$$

12 Levin and Wright (1997) proxy expectations of future changes in real housing prices by past changes in real housing prices and conclude that that housing price movements are systematically related to historical housing price movements which they interpret as being caused by speculation. Extrapolating behaviour seems to be confirmed by the results of a recent survey held by De Nederlandsche Bank (2000), which shows that 57% of all Dutch households with a mortgage loan think that the fundamental value of their house is less than the current market value, when 60% of this population

5. An empirical investigation into the Dutch housing and mortgage markets

5.1 Introduction

In recent years the Dutch mortgage market has displayed very high rates of growth, with annual increases of 15% or more.[14] On average, banks' portfolios of mortgage lending doubled in the period between end-1993 and mid-1999. At the same time, housing prices have shown a remarkable increase of 80% between 1990 and 1998. The combination of rapidly increasing housing prices and the relatively high level of outstanding mortgage debt as a percentage of GDP means that the financial risks for Dutch households have increased significantly. This is especially so because mortgage loans have to some extent been used for consumption and the purchase of securities, thereby stimulating both consumption and the bull stock market. Important causes for the simultaneous increase in housing prices and mortgage lending have been the strong economic growth and low interest rates. These have ensured that households' borrowing capacity has increased significantly. Besides these temporary factors, more structural causes were also very important, notably demographic developments, tax legislation (deductibility of interest expenses), central government policy on spatial planning, as well as changes in banks' acceptance policies.[15] All these aspects have influenced and reinforced each other, thereby stimulating the rapid growth in mortgage credit and housing prices.

5.2 Modelling of the housing and mortgage markets

In order to gain more insight into the relation between housing prices and mortgage lending in the Netherlands, we explicitly model both housing prices and mortgage

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at the same time thinks that housing prices will increase further. Additionally, 49% of the population thinks that the mortgage interest rate will rise further as well.

13 Note that slow market clearing can also be consistent with housing demand based on fully rational, forward looking forecasts. After all, when the exogenous variables to the market move systematically, or if the structure of the market is so that only gradual adjustments to the stock are possible, then even rationally forecasted prices can be highly correlated over time (DiPasquale and Wheaton, 1994, p.7).

14 De Nederlandsche Bank (2000^{II}).

15 During late 1980s and early 1990s, banks started to include second and temporary incomes in determining borrowing capacity thereby increasing the permissible mortgage debt service/income ratio (the maximum proportion of gross income that may be spent on housing costs). They also increased the amount of credit granted per unit of collateral.

lending. This allows us to assess the impact of mortgage lending on the housing price, as well as the reverse relationship.

5.2.1 Housing prices

Based on our earlier discussion we expect that in the long run housing prices are closely related to variables such as income and mortgage interest rates. However, in the short run deviations from this long-run equilibrium may occur due to backward-looking expectations and an inelastic housing supply. An Error Correction Model (ECM) framework would seem a well-suited tool to model this, since it combines information about the short-term dynamics (formulated in first differences) and the adjustment process towards the long-run relationship (in terms of levels). Our model is determined in two steps, according to the Engle-Granger procedure. First, we estimate a long-term equation, the cointegrating regression, relating the level of the housing price to a number of variables including income and interest rates. Next we determine a short-term equation in terms of first differences, including an error correction term consisting of the lagged residuals of the estimated long-term equation. A possible long-term equation is:

$$(5) \qquad \ln(rp_h)_t = c + b\,\ln(ry)_t + f\,\ln(ry^e)_t + j\,(ri_{eff})_t + g\,\ln\left(\frac{DEMO}{H}\right)_t + h\,\ln(MOR)_t + e_t$$

In this equation the dependent variable is the log of the real housing price (rp_h). The housing price is dependent on, first of all, real per capita income (ry). In as far as agents are forward-looking expected real per capita income will also play a role. We have chosen to proxy real expected income (ry^e) by a consumer confidence indicator referring to the expected financial situation over the next twelve months (*FINSIT*) because this may also be interpreted in a broader fashion to include wealth (data on household wealth are hard to come by for the Netherlands). A third independent variable is the real effective mortgage rate (ri_{eff}), which is corrected for the marginal income tax rate. Our preferred demographic variable to measure against the housing stock is the number of households (*HOUSEH*). We experiment with two mortgage related variables (*MOR*): total real mortgage lending (i.e. the real change in mortgage stock, *rm*) and the ratio of double-income households to all households (*DIH*). This latter variable may serve as a direct measure of changes in credit rationing. Although banks formally started to take

second incomes (fully) into account in the first half of the 1990's, research by DNB (2000[II]) indicated that in practice most banks started to include second incomes in their credit decisions some years earlier. Since the timing of these changes in informal bank lending is not known exactly, we experimented with various dummy variables to determine indirectly in what year this break in banks' behaviour began to have a significant effect on housing prices. Testing results suggested this to be 1990. Therefore, we included a dummy (*DUMMY90*) in our model setting ln(*DIH*) zero before 1990.

Short-term dynamics in the housing price are modelled by relating the change in the log real housing price to the first differences of the right-hand variables of the long-term equation. The maximum number of lags is four, lagged variables with insignificant coefficients being left out of the final estimated equation:

$$\Delta \ln(rp_h)_t = c + \sum_{g=1}^{4} r_g \Delta \ln(rp_h)_{t-g} + \sum_{i=1}^{4} b_i \Delta \ln(ry)_{t-i} + \sum_{j=1}^{4} f_j \Delta \ln(ry^e)_{t-j} + \sum_{m=1}^{4} j_m \Delta(ri_{eff})_{t-m} + \sum_{k=1}^{4} g_k \Delta \ln\left(\frac{DEMO}{H}\right)_{t-k} + \sum_{n=1}^{4} h \Delta \ln(MOR)_{t-n} + ke_{t-1} + n_t \quad (6)$$

In addition, the lagged change in the real housing price itself and an error-correction term consisting of the lagged residuals of the estimated long-term equation (ε_{t-1}) are included.

5.2.2 Mortgage lending

In order to investigate the role of housing prices in mortgage lending, a separate model for mortgage lending is set up. The housing price may enter mortgage lending both as a demand and a supply factor. Housing prices, together with income and the mortgage rate, determine how much credit households wish to take out. At the same time, banks' decisions regarding mortgage applications may also be influenced by housing prices, which form an indicator of the collateral value of a house. Credit may be rationed. In the Netherlands, the mortgage debt service/income ratio, which is the maximum proportion of current gross income that may be spent on housing costs, plays a dominant role in the supply decision, more so than the loan-to-value ratio which is not officially limited. This suggests that the double-income household dummy should also be included in this model, as a measure of changes in credit rationing by banks. Since changes in the determinants

of mortgage lending (income, mortgage rates, housing price etc) may be expected to have immediate effect rather than to set off a lengthy adjustment process, a single-equation model would seem more appropriate than an ECM. On the basis of the above considerations a model of mortgage lending might look as follows:

$$\Delta \ln(rm)_t = a + \sum_{g=1}^{4} w_g \Delta \ln(rm)_{t-g} + \sum_{i=0}^{4} q_i \Delta \ln(rp_h)_{t-i} + \sum_{j=0}^{4} c_j \Delta \ln(ry)_{t-j}$$

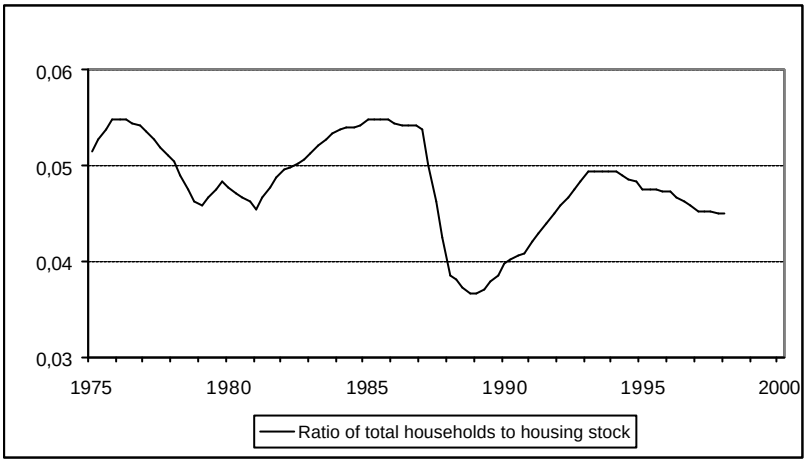
$$(7) \qquad + \sum_{k=0}^{4} l_k \Delta \ln(ri_{eff})_{t-k} + \sum_{m=0}^{4} tDUMMY90 \Delta \ln(DIH)_{t-m} + e_t$$

The dependent variable in this equation is real mortgage lending (*rm*). (Lagged) forms of the real housing price (rp_h), real income (*ry*), the real effective mortgage rate (ri_{eff}) as well as real mortgage lending have been included. The equation is framed in first differences to cope with the fact that most time series used contain unit roots (see below).

5.2 The data

In general, quarterly data for the period 1977:Q2-1998:Q1 have been used (1977:Q2 - 1999:Q4 in case of the mortgage lending model). The appendix gives a more detailed description of the data and their sources. The time series used were analysed to determine the presence of unit roots. Most variables (real housing price, real per capita income, expected financial situation, real effective mortgage rate of interest, and share of double-income households) were found to be I(1). Only real mortgage lending was found to be I(2). However, from an economic rather than a statistical viewpoint one would expect real mortgage lending to be integrated to the same order as the real housing price. Therefore, real mortgage lending is treated as if it were I(1). Finally, the ratio of households to the housing stock ln(*HOUSEH/H*) proved I(0). This suggests that in the long-run this variable ought not play a role in the determination of housing prices. However, the variation in the log ratio of households to the housing stock suggests that this long run situation is not actually reached (Figure 1).

Figure 1 Ratio of households to housing stock (logarithm)



Since we are in effect concerned with a medium long period we decided to include this variable in the long term equation for the housing price, despite it being integrated to the order of zero. Multicollinearity problems are not expected: no correlation between independent variables exceeds 0.7, which as a rule of thumb may be taken as a cut-off level (Table 1).[16]

Table 1 Correlation matrix

	?ln(rp_h)	?ln(rm)	?ln(ry)	?ln(FINSIT)	?ri_{eff}	?ln(DIH)	?ln(HOUSEH/H)
?ln(rp_h)	1.00	0.30	0.28	0.16	0.34	0.14	-0.14
?ln(rm)		1.00	0.44	0.02	0.12	-0.01	-0.39
?ln(ry)			1.00	0.26	0.29	0.08	-0.05
?ln(FINSIT)				1.00	0.13	-0.14	0.00
?ri_{eff}					1.00	-0.15	0.08
?ln(DIH)						1.00	0.21
?ln(HOUSEH/H)							1.00

5.3 Empirical results

Our preferred specification is shown in Table 2. When estimating the long-term equation for the housing price we found that of the two mortgage variables the index of double-income households yields the best results. When included into the estimation together with real income, the coefficient on total real mortgage lending proved to have the wrong sign (negative). The high correlation between the log levels of real income and real

mortgage lending as well as between the first differences in logs (0.93 and 0.44, respectively) is probably the cause of this. However, when mortgage lending was proxied by the index of double-income households, this variable turned out to have a significant and positive influence on housing prices, even when the real income variable was included as well. To us, this suggests that mortgage lending influences housing prices mainly as a supply factor, with demand for mortgages adjusting to more fundamental factors that co-determine the housing price, such as income and the mortgage rate.

Table 2 Estimated Error Correction Model of the Housing Price 1977:Q2-1998:Q1

$$\Delta \ln(rp_h) = -0.04 + 0.2\,\Delta\ln(rp_h)_{-1} + 0.2\,\Delta\ln(rp_h)_{-2} + 1.7\,\Delta\ln(ry)_{-1} - 1.1\,\Delta ri_{eff}$$
$$(7.1)\quad (1.8)\qquad (2.7)\qquad (3.7)\qquad (2.0)$$

$$- 0.06\,[2.1\ln(ry) + 0.7\ln(FINSIT) - 10.9\,ri_{eff} + 4.6\ln(HOUSEH/H)$$
$$(2.7)\quad (4.1)\qquad (4.9)\qquad (11.3)\qquad (1.5)$$

$$+ 0.2\,DUMMY90\ln(DIH) - 19.7]$$
$$(3.6)\qquad (3.9)$$

N = 84
$R_{adj}^2 = 0.53$
prob. LM (4 lags) = 0.06
prob. White = 0.08
ADF residuals (4 lags) = -3.66 (1% critical value = -2.58)

Explanatory note: The model is shown without seasonal dummies (absolute t-values in brackets). N = number of observations, R_{adj}^2 = adjusted multiple correlation coefficient, prob. LM = probability of Breusch-Godfrey test on serial correlation in residuals, prob. White = probability of White heteroscedasticity test, ADF = augmented Dickey-Fuller unit root test.

The lagged residuals of the long-term cointegrating regression, written out fully between the large brackets in terms of the fundamental variables, proved stationary, supporting the notion that the real housing price is indeed cointegrated with the other variables included in the long-term equation such as real income and the real interest rate. Most long-term

16 Test results including lagged independent variables (not shown here) also suggest that there is no significant multicollinearity.

coefficients are significant at the 1% level, although the significance level is likely to be overestimated due to serial correlation. Only the ratio of households to the housing stock turns out to be substantially less significant. However, because of theoretical considerations we decided to keep this variable in our estimation.[17]

All the coefficients have the expected sign and the adjusted R^2 equals 0.53 for the total ECM equation (0.66 for the long-term equation taken separately). The error correction term in the equation is significantly negative, indicating that in the long run the housing price moves in line with its fundamentals. However, the adjustment process takes a considerable time: each quarter only about 6% of the deviation from the long-term value is corrected.[18] Since the model is estimated in logs, the long-term coefficients (between large brackets) can be interpreted as long-run elasticities or, in the case of the mortgage rate, semi-elasticities. The outcomes show than an increase of 1% in real disposable income will result in a 2.1% increase in the real housing price. Similarly, a 1% increase in the index measuring financial expectations, the double income households dummy or the ratio of households to total housing stock yields an increase in the real housing price of 0.7%, 0.2%, and 4.6%, respectively. Finally, a rise of 1%-point of the real effective mortgage interest rate induces a decrease of the real housing price of 11%.[19] Of the various long-term variables only real income and the real effective mortgage rate appear to have a significant influence on housing prices in the short run as well. Additionally, the lagged real house price provides some more short-term dynamics, indicating a "sticky" pricing process.

Mortgage lending appears predominantly dependent on previous developments in mortgage lending itself and on (lagged) housing prices and real income (Table 3). The adjusted R^2 shows that our equation explains 88% of the variation in the amount of

[17] Removing this variable would only have a very small impact on both the magnitude of the coefficients of the remaining variables and their significance.

[18] This comes down to an adjustment process of approximately four years.

[19] However, it should be kept in mind that the real effective mortgage rate equals the nominal interest rate corrected for the fiscal deductibility of interest expenses and subsequently lowered by the inflation. In most years the correction simply implied dividing the nominal interest rate by 2, as the marginal tax rate for the average Dutch household was 50%. This means that a 1%-point increase in the real effective mortgage rate roughly corresponds to a 2%-point increase in the nominal mortgage rate, implying that a 1%-point increase in the *nominal* interest rate would lead to a long-run reduction in real housing prices by approximately 5%.

mortgage lending, which is satisfactory. The results show that, when for each variable the different significant lags are added up, a higher rate of growth in real housing prices or incomes leads to higher growth of mortgage lending. Oddly, supposedly fundamental factors such as the mortgage rate or the double-income household dummy turned out insignificant.[20] We take this as an indication of the complexity of modelling the mortgage lending process (rather than the possibility that factors such as the mortgage rate are truly insignificant).

Table 3 OLS estimation of mortgage lending 1977:Q2-1999:Q4

$$\Delta \ln(rm) = 0.00 + 0.4\ \Delta\ln(rm)_{-1} + 0.5\ \Delta\ln(rm)_{-2} + 0.1\ \Delta\ln(rp_h) + 0.1\ \Delta\ln(rp_h)_{-2}$$
(1.8) (4.6) (5.7) (3.3) (2.6)

$$- 0.1\ \Delta\ln(rp_h)_{-4} + 0.5\ \Delta\ln(ry) - 0.5\ \Delta\ln(ry)_{-2} + 0.3\ \Delta\ln(ry)_{-4}$$
(2.1) (3.9) (3.9) (3.0)

N = 91
$R_{adj}^2 = 0.88$
prob. LM (4 lags) = 0.74
prob. White = 0.41

Explanatory note: The model is shown without seasonal dummies (absolute t-values in brackets). N = number of observations, R_{adj}^2 = adjusted multiple correlation coefficient, prob. LM = probability of Breusch-Godfrey test on serial correlation in residuals, prob. White = probability of White heteroscedasticity test.

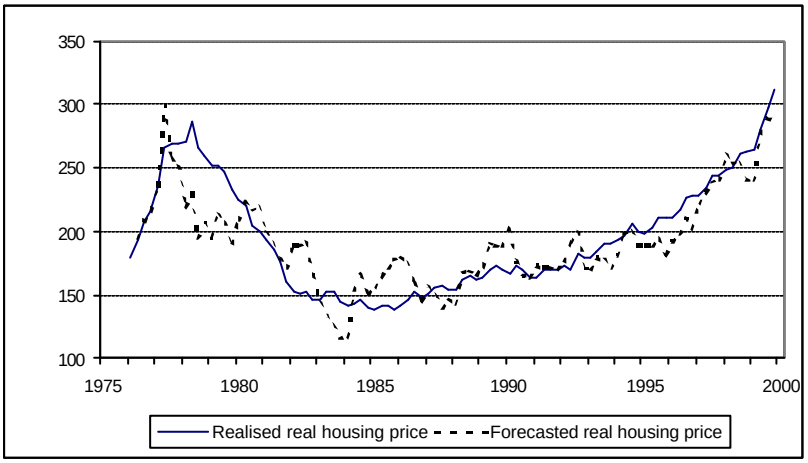
The overall evidence appears to support the hypothesis that housing prices and mortgage lending in the Netherlands are mutually dependent. Moreover, the evidence suggests that in the short run, housing prices may deviate substantially from their long-run growth path. This indicates that the Dutch economy is vulnerable to the type of boom-bust cycle which it befell in the 1970s and which hit the UK and Scandinavia in the 1980s and 1990s.

[20] One supply factor that did work was banks' solvability (measured as equity divided by the total balance sheet). However, we have misgivings about including this variable on theoretical grounds. Reduced solvability may lead to reduced mortgage lending, but more likely so in bad times than in good times (in good times banks may well prefer issuing new equity).

5.5 A dynamic forecast of the housing price

In order to investigate how well our model of the housing price performs out-of-sample, we executed a dynamic forecast with regard to the recent rapid increase in housing prices. First of all, we extrapolated two independent variables (*HOUSEH* and *DIH*) from 1998:Q2 in order to have a complete dataset until 1999:Q4.[21] Secondly, we estimated both the cointegrating equation and full ECM on the basis of the sample period 1977:Q2 - 1994:Q4. In order to be able to forecast for the period 1995:1 -1999:4 we needed to supplement the residuals from the cointegrating equation with the difference between the actual housing price and the housing price forecasted on the basis of the 1977-1994 cointegrating equation. The results of our forecast on the basis of the full ECM are shown in figure 2.

Figure 2 Actual real housing price and out-of-sample forecasted real housing price (thousands of 1995 guilders)

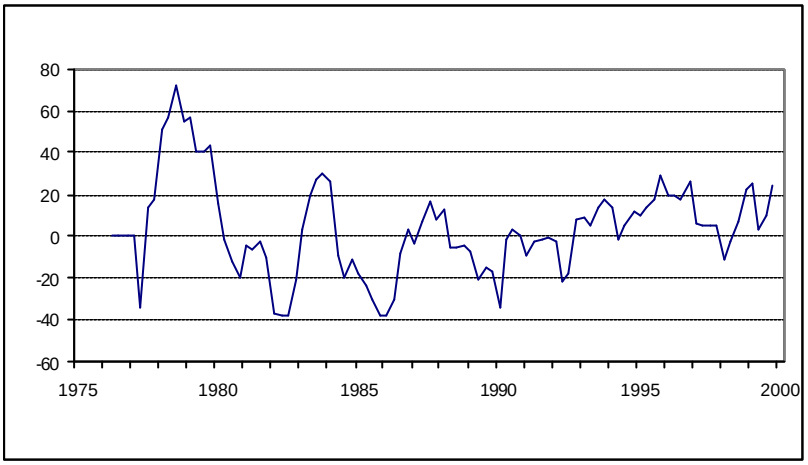


Explanatory note: the out-of-sample forecast is based on the sample period 1977:Q2 - 1994:Q4.

Within sample the model appears to give a reasonable forecast of the real housing price. A major exception is the housing price bubble in the late 1970s. According to our model, the down-turn should have occurred a number of years earlier than it did in reality. As a consequence the forecasted housing price significantly underestimates actual developments for about four years. With regard to the out-of-sample period we note that the forecasted real housing price follows the same trend as the actual real housing price, albeit on average on a slightly lower level (see also figure 3). The average difference in

nominal terms equals NLG 12,800 over this period. Our model therefore suggests that current housing prices are somewhat overvalued.

Figure 3 Difference between actual and out-of-sample forecasted real housing price (thousands of 1995 guilders)



6 Conclusions

Problems of asymmetric information are relevant to the mortgage market. In reaction to such problems banks may ration their mortgage credit supply. According to the credit view of monetary policy, in which credit is "special" to households, this can influence households' financial capacity when buying a house. Credit availability may thus influence housing prices. Since pledging collateral is one way of alleviating the consequences of asymmetric information, housing prices may in turn also influence credit availability.

To assess the relevance of this view for the Dutch economy, we estimated two separate models, one for the housing market and one for the mortgage market. We found that in the long run housing prices are influenced by variables such as income, the mortgage interest rate, demographic developments and the housing stock. Additionally, changes in bank lending criteria appear relevant. In the Netherlands, such changes may be proxied using the number of double income households, since banks started to take second

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21 Both the number of households (*HOUSEH*) and the double income households index (*DIH*) showed a very stable development during our sample period, so that extrapolating these time series appears acceptable.

incomes into account only around the beginning of the 1990s. Furthermore, mortgage lending was found to be dependent on the housing price as well as disposable income. The empirical work presented in this paper thus offers some support for the supposition that in the Netherlands housing prices and mortgage lending are indeed interdependent. Our empirical work further suggested that in the short run housing prices can deviate substantially from their long-run equilibrium value. The adjustment process to shocks to the housing market may take up to four years.

In EMU, housing prices are not considered of direct relevance to monetary policy decisions (asset prices are not accounted for in the ESCB's inflation target). However, the relationship between housing prices and mortgage lending may be of *indirect* relevance, since housing price developments may influence consumption and therefore inflationary pressure through equity withdrawal and wealth effects. Research suggests that the interdependence between the housing markets in Europe is (still) limited (Van Rooij and Vos, 1999). Thus, monetary policy decisions taken from the European perspective may not be optimal on the national level in case of diverging housing market cycles. Combined with the fact that according to our findings housing prices may deviate substantially from their long-term value, this implies that national authorities should carefully monitor developments on both the housing and the mortgage market and their effects on consumption and inflation. In this light, more emphasis should be laid on guaranteeing an even development of the housing market. Tax distortions and undue government support of house owners should, for example, be prevented. Also, the influence of mortgage lending on the financial fragility of households should be monitored and banks should be stimulated to adequately price the risks that are attached to granting mortgage credit. In so doing, idiosyncrasies on the housing markets can be kept to a minimum, thereby reducing the adverse effects for these national markets of a single monetary policy in the EMU.

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Appendix Data and sources

CPI	Consumer price index (OECD).
DIH	Number of double income households (Statistics Netherlands), divided by the total number of households, HOUSEH. From 1990 onwards on an annual basis. Interpolated to obtain quarterly data. (Before 1990 only available for selected years. However, in the empirical analysis a dummy is used to set *DIH* at zero before 1990. See comments in text).
FINSIT	Confidence index regarding consumers' financial expectations for the next 12 months (Statistics Netherlands). Until 1983 polls were held three times a year (January, May, and October). Quarterly data for this period obtained by means of interpolation.
H	Housing stock (Statistics Netherlands). Interpolated annual data.
HOUSEH	Number of households (Statistics Netherlands). Interpolated annual data.
ri_{eff}	Real effective 10-year mortgage interest rate. Constructed as the nominal 10-year mortgage interest rate (Statistics Netherlands) adjusted for the average marginal tax rate, t, and year-on-year changes in the consumer prices index, CPI.
rp_h	Real housing price. Constructed as the nominal housing price (Kadata) adjusted for inflation by means of the CPI.
rm	Real mortgage lending. Constructed as the change in the outstanding mortgage stock (De Nederlandsche Bank) adjusted for inflation by means of the CPI.
ry	Real disposable income per capita. Constructed as nominal per capita income (Statistics Netherlands) adjusted for inflation by means of the CPI. Interpolated annual data.
t	Marginal income tax rate for married couples (two children) earning two times the average income (Netherlands Bureau for Economic Policy Analysis). Quarterly data set equal to annual rate.