An Econometric Demand-Supply Model for Swedish Private Housing

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Abstract

A housing market model for Sweden has been estimated on semiannual data for 1970-97 by separately modelling the demand and the supply sides, specified in error correction form . On the demand side in the short run house prices adjust to the changes in the real after tax long interest rate, financial wealth, the employment rate, rents and, finally, population. There is an underlying long run relationship between real house prices and the following ratios: debt to income, debt to financial wealth, private housing stock to income, the stock of rental housing (flats) to the private housing stock, the real after tax real long interest rate. The supply side, based on a Tobin=s q-index, the short interest rate and stock market returns, generates the investment flow which determines the evolution in stock. The results indicate that even in a turbulent period, Swedish house prices and housing investment are tracked quite well with this specification. The importance of the simulations and their usefulness to Swedish policy makers is discussed. According to our model, many factors were instrumental in producing the house price boom of the late-1980s. Initial debt levels were low as were real house prices, giving scope for rises in both, and these became more important as a result of financial liberalization, though partly offset by higher real interest rates. We also discuss the controversy over the causes of the 1991-1993 recession in the context of the 1991 Tax Reform. Tests of model adequacy indicate that the housing price and Tobin q housing investment models are stable and robust and satisfy intuitive theoretical prerequisites.

Keywords: House prices, error correction, steady state, Tobin=s q, simultaneous model

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1. Introduction

The objective of the paper is to develop a dynamic and long run model for the Swedish housing market. Demand and supply sides are modelled for the purpose of forecasting and medium to long term assessments. Housing markets are highly volatile, and modelling both prices and investment simultaneously has been a challenge for economists and econometricians. It is an important task, since housing wealth constitutes about two thirds of personal wealth. The model developed in the paper is also used as an analytical tool to discuss the controversy over the causes of the 1990s recession, in the context of the 1991 tax reform (91TR). We also conduct some dynamic policy simulations to assess the responsiveness of house prices and investment to shocks from the long interest rate, income, and household debt

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The paper is structured as follows: Section 2 reviews earlier studies. Section 3 presents a framework for analysing house prices, both the demand and the supply models. Section 4 describes the econometric methodology used in this study. Sections 5 and 6 present the empirical results on house price and housing investment equations. Section 7 discusses the controversy of the causes of crisis in the Swedish housing market. In section 8 some policy simulations are carried out and their usefulness to the Swedish policy maker discussed. Section 9 highlights the main functioning of the model and explains the mechanism underlying the simultaneous demand and supply solution. Section 10 outlines the house price forecast for the year 1999 - 2000 and Section 11 concludes. The appendix defines the data used in this study.

2. Earlier studies

Since the seminal work by Hendry [1984] there has emerged a flora of empirical macro stimates house price functions. Fluctuations in house prices have been analysed in terms of an inverted demand function for houses, conditional on last period's housing stock. In the short term, the housing stock is taken as fixed and only house prices react disturbances, but house price changes induce changes in construction activity in accordance with Tobins [1969] q.

In the long term construction achieves adjustment of stock supplied to its long term demanded level. Tobins [1969] q theory, is adopted in order to model housing investment and using a perpetual inventory relation, the long-term changes in the housing stock. House prices are commonly derived as a reduced form from separate housing demand and supply equations. Studies in this category are the those by Mayes [1979], Nellis and Longbottom [1981], Bradley [1981], Hendry [1984], Tse [1999] ,and finally Meese and Wallace [1997].

Swedish house prices are studied by Heiborn [1994], in which she analyses how the quantity of housing demand can be explained by the size of different age cohorts. Her study indicates that there is a positive effect of demographic demand on house prices. Another study on Sweden is by Hort [1997] using a dynamic capital asset market model in which an error correction model estimates real house prices as a function of total income, user and construction costs. The results indicate that the volatility in house prices can be traced back to fundamental demand and supply conditions.

3. A framework for analysis

3.1 The demand side

Households can be regarded as maximising their utility by consumption of housing and non housing goods subject to their budget constraint. Their utility function is given by

$$U = U(H, HF, X),$$

where H and HF are housing services consumed from owner-occupied and rental housing respectively and X is non housing goods and spending is constrained by disposable income. Maximising utility subject to the budget constraint is interpreted as yielding:

$$\frac{H^D}{Y} = f\left(\frac{PH}{P}, (R*(1-M) - (?\frac{P}{P})), \frac{DE}{Y}, \frac{DE}{WF}, \frac{HF}{H}\right) \qquad [1]$$

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where, H^D denotes the demand for housing services (stock), Y is disposable income, M is the marginal tax rate on interest deductions, PH/P is real house price, PH is the nominal house price index and P is the consumption deflator, HF is the stock of rental housing (flats), DE is the household debt, WF is the household financial wealth, $R * (1 - M) - ?P/P)$ is the after tax, after inflation, long-run government bond rate and inflation $(?P/P)$ is defined as the annual change in P.

Solving [1] for house prices, we get the inverted demand function:

$$\frac{PH}{P} = g\left(\frac{H^D}{Y}, \frac{HF}{H}, (R*(1-M) - \frac{?P}{P}), \frac{DE}{Y}, \frac{DE}{WF}\right) \qquad [2]$$

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The anticipated signs of the partial derivatives are indicated in the equations.

3.2 The supply side

Applying Tobins q theory to the housing market, construction activity is determined by the profit incentive represented by the ratio of the asset prices of existing structures, to the cost of new construction. Average Tobins q is defined here as an index (1991 = 1)

$$q = \frac{PH}{PB}$$

of market price *(PH)* to *PB,* is the construction price index. In long-equilibrium, the value of Tobin=s q converges to 1, implying that asset prices converge towards construction costs, but in the short run q may vary from 1. Our q-index would however converge to some other constant where Tobin=s q = 1, since our q = 1 merely signifies the base year (and also happens to be the sample mean value of our q index) approximately. In equilibrium, investment equals depreciation of the capital stock (if net investment is zero), see Jaffee [1994], or adjusted for a constant growth rate. The augmented Tobin=s model of housing investment can be written as:

$$\frac{IH}{GDP} = h(\underset{(+)}{q}, \underset{(-)}{RS}). \qquad [3]$$

where *IH* is housing investment, GDP is the gross domestic product, and *RS* is the short-term interest rate, reflecting the cost of financing investment in the construction industry .

In the long run $H^D = H = H^S$ [4]

Equations [2] and [3] are the basic demand and supply equations respectively. Finally, the housing stock evolves over time with investment through the perpetual inventory relation

$$H^S = IH + (1 - d) * H_{[-1]}, \qquad [5]$$

where *H* is the housing stock in hand and *d* is the rate of depreciation of the stock (*H*). Equations [2] and [3] are estimated separately and a reduced form is derived by equating the identity $H^D = H^S$ The full model is finally simulated using equations [2], [3], [4] and [5], where we want to determine the price and the quantity. (See Section 10 on simultaneous model solution, and Exhibits (14-18).

The house price function is expressed in ratio form to highlight the long term features of steady state, that is, all ratios are constant if numerator and denominator expand at the same constant rate (of growth inflation) and the income elasticity of demand for stock is unity. The long-run relationship to be tested is in log linear form. In the error correction equation real house prices depends negatively on real interest rates, household debt / financial wealth ratio [1], and the stocks of both small homes and flats (rental stock)[2], and positively on the debt / income ratio[3].

In long run on the demand side, real housing prices begin to diverge from their long run relationship, the four ratios along with the level of the real long interest rate act in the error correcting mechanisms driving house prices towards equilibrium. There is similar error correcting mechanism on the supply side, i.e. when investment begins to diverge from its long run relationship (e.g. in response to the price deviation), Tobins q (*PH/PB*) and *RS* act as error correcting mechanism driving housing investment towards equilibrium. The two mechanisms thus interact.

The short term dynamics on the demand side are represented by the following variables: the yearly change in after tax long term interest rate, the acceleration in financial wealth and the employment rate, the yearly change in total population and the yearly change in rents (representing user cost). Lags in housing investment together with yearly changes in Tobins q, share prices and a moving average of the

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1 An increase in indebtedness or a drop in holdings of financial assets, would raise the risk of financial distress, thus prompting the consumer to shift his demand away from durables and housing thus reducing house prices. The financial wealth income ratio could have been used alternatively. This would merely change the sign of the coefficient in a log model and hence provide us with a different interpretation ie. we would expect different responses from liquid and illiquid assets, see Miskin [1977]

2 Given the private housing stock, an increase of price in the rental market induces substitution, affecting the kind of housing desired (e.g. single ownership dwellings may get replaced by rental apartments. This adjustment continues until both markets (stocks and flows) are again in joint equilibrium, with new construction yielding normal profits.

3 Usually increases in debt are considered to be an indicator of consumer optimism and strong demand. People buy houses with debt financing to large extent, which tells us that real house prices and debt could be positively correlated.

short-term interest rate constitute the short term dynamic variables on the supply side. For a detailed description and sources of the data set, see data appendix

4. Econometric methodology

Simple dynamic models based on >error correction= feedbacks are important in linking equations formulated in levels and with those formulated in differences of the orginal variables. Further, an error correction mechanism (denoted ecm) has many interesting dynamic and econometric properties and appropriately specified, can ensure that an estimated equation reproduces as its steady-state solution the economic theory from which it was derived, thus facilitating rigorous testing of theories.

As a preliminary step to co-integration analysis, the order of integration of the house price model data set is to be tested. Several procedures are available (see Dolado et al. [1990], for a survey); in the present analysis, the Augmented Dickey-Fuller (ADF) integration test is employed. The results of the ADF test are presented in Exhibit 1.

[EXHIBIT 1 HERE]

Co-integration results, using the well known Johansen and Juselius [1988] procedure, are presented in Exhibit 2. If the variables are found to be balanced (integrated and co-integrated) an error correction model can be formulated. An unrestricted autoregressive distributed lag model (ADL) is finally estimated in this study.

[EXHIBIT 2 HERE]

5. The demand side results - real house price

The estimated specific model, using the general to specific approach, is reported in Exhibit 3 on the next page. The standard error of the regression is less than 2% and 95% of the total variance in the annual log change in real house prices is accounted for. From the diagnostic statistics, the residual of the estimated equation appears to be white noise. The Breusch-Godfrey [1978, 1978] Lagrange Multiplier test statistic for autocorrelation is obtained by regressing the residuals on the explanatory variables and the lagged residuals up to lag (p) and is distributed $?^2$ (p). ARCH, Engle [1982] is the Lagrange multiplier test for heteroscedasticity, obtained by regressing the squared residuals on the explanatory variables and the explanatory variables squared and is distributed as $?^2$ (q), where q is the number of regressors and the squared regressors in the test regression. Normality $?^2$ (2) refers to the Jarque-Bera [1980], test for normality of the residuals, with a correction for degrees of freedom. Reset is Ramsey=s test [1990] for correct specification performed by testing the relevance of adding the squared predicted values in the orginal model. Following Steel [1987], the general instrument variable approach and a variable additional test is carried out in this study for testing for weak exogeneity. Weak exogeneity of the regressors is required for efficient inference in our single-equation ecm model. Reaction functions (marginal processes) for income, household debt, interest rates and housing stocks are searched. To obtain a a well specified marginal processes, several zero-one impulse dummies proxying for the shifts over time (mainly due to credit deregulation 1986 and tax reform 1991) were included in the equations. A simple way to check the weak exogeneity of the regressors mentioned earlier, limited to the case in which the parameters of interest are the long-run coefficients, is to test for the significance of the ecm terms in the four marginal models using traditional student-t test. In case the error correction terms are not significant, then the variables can be considered weakly exogenous. For details see Carone [1995].

Generally the diagonostic tests indicated that this model specification was satisfactory to the unknown data generating process.

The adjustment coefficient for the level of real house prices (*PH/P*) indicates that in cases of departure from equilibrium, 32% of the shock is corrected within one year. The signs of all of the long and the short-run dynamic variables are in agreement with prior theoretical expectations and significant.

The specific model is an annual change model, as it may be of interest to forecast house prices on a yearly basis at NIER. In Exhibit 4 and Exhibit 5 the preferred equations are presented for the period 1970 - 1997 both in levels and in annual percentage changes. Exhibit 6 illustrates an out of sample forecast for the period 1991 - 1997.

[EXHIBIT 4 HERE]
[EXHIBIT 5 HERE]
[EXHIBIT 6 HERE]

Exhibit 7 plots some evidence on parameter stability for the long-run parameters. As shown all the parameters become stable over time.

[EXHIBIT 7 HERE]

Exhibit 3 The demand side results [1970 - 1997] $D_2 \ln(PH/PC)$ =

Regressor	**Coefficient**	**Student t - values**
CONSTANT	0.76	3.74
$D_2 \ln (PH/PC)_{[-1]}$	0.35	3.79
D_2 {avg(2,R*(1 - M)}	-3.33	3.72
$D_2 (D_2 \ln (WF)_{[-1]})$	0.12	3.73
$D_2 (D_2 \ln(E))$	2.78	5.65
$D_2 \ln (H)_{[-1]}$	-3.19	2.50
$D_2 \ln (HF)_{[-1]}$	-2.74	6.90
$D_2 \ln (POP)_{[-1]}$	7.07	2.90
$D_2 \ln (RENTS/P)_{[-1]}$	0.51	3.22
$\ln(PH/P)_{[-2]}$	-0.32	6.73
$\ln (DE/Y)_{[-2]}$	0.76	8.03
$\ln (DE/WF)_{[-2]}$	-0.20	5.79
$\ln (H/Y)_{[-2]}$	-1.07	5.95
$\ln (HF/H)_{[-2]}$	-0.65	7.03
DS (Seasonal)	-0.07	2.80
{R*(1 – M)- ? P/P)} $_{[-2]}$	-0.44	1.99
R^2	0.95	
R^2 (adj)	0.93	
Standard error	1.93	
Durbin Watson, Durbin H	(1.90), (0.96)	
MODEL DIAGNOSTICS		**CRITICAL VALUES AT 5%**
LM test $?^2$ (1)	0.03	3.84
LM test $?^2$ (2)	5.54	5.99
LM test $?^2$ (3)	6.85	7.81
LM test $?^2$ (4)	8.88	9.49
RESET	0.01	3.18
J-BERA NORMALITY	0.24	5.99
ARCH	0.96	9.49

Note: In the table above special notation is used for natural logs and changes. The operator D_j stands for a j - period difference, with $D^1 = D$ for simplicity, and ln(x) = log(x) for short. Thus $D^j \ln(x) = \text{Log} (x / x_j)$ is a j - period difference in the logs. For semiannual data j = 2 in the dependent variable: and $D_2 \ln(x)$ are annual rates of change. D (D_j ln(x)) then is the change in annual rate of change. Items indicated >avg= are n period averages in the particular variable. LM is the Breusch (1978) and Godfrey (1978) Lagrange multiplier test. The equilibrium elasticities are as follows: DE/Y = 2.4, DE/WF = -0.6, H/Y = -3.3, HF/H = -2.0, R*(1 - M) - ? P/P) = -1.4. The F -Values for the Chow structural break test are as follows 1985: = 2.5 and 1986 = 3.1. Possible reasons for the indication of structural shifts is that the Swedish economy was in a deregulation phase of financial markets. Tests on exogeneity are not reported here but available on request.

6. The supply side results - housing investment

Exhibit 8. The supply side results [1970 - 1997] D_2 ln(IH) =

Regressor	**Coefficient**	**Student t – values**
Constant	-0.64	3.65
D_2 ln(IH) $_{[-1]}$	0.62	5.64
D_2 ln(IH) $_{[-2]}$	-0.41	3.03
D_2 ln(IH) $_{[-3]}$	0.42	4.03
D_2 ln(AKT / P)	-0.20	3.24
D_2 ln(PH /PB)	0.38	2.32
D_2 (avg,2(RG -? P/P))	-3.52	3.05
ln(IH / GDP) $_{[-2]}$	-0.23	5.65
ln (PH / PB) $_{[-2]}$	0.24	2.00
91TR	-0.28	7.18
RG $_{[-2]}$	-1.14	2.09
R^2	0.88	
R^2 –adj	0.85	
Standard error	0.06	
Durbin Watson	2.07	
MODEL DIAGNOSTICS		**CRITICAL VALUES AT 5%**
LM test $?^2$ (1)	0.18	3.84
LM test $?^2$ (2)	2.53	5.99
LM test $?^2$ (3)	3.42	7.81
LM test $?^2$ (4)	8.62	9.49
LM test $?^2$ (5)	7.46	11.07
LM test $?^2$ (6)	12.17	12.59
NORMALITY $?^2$ (2)	1.17	5.99
ARCH $?^2$ (4)	3.58	9.49
RESET F (2,50)	0.06	3.18

Notes: From the diagnostic statistics, the residual of the estimated equation appears to be white noise. The Breush-Godfrey [1978, 1978] Lagrange Multiplier test statistic for autocorrelation is obtained by regressing the residuals on the explanatory variables and the lagged residuals up to lag (p) and is distributed $?^2$ (p). ARCH, Engle [1982] is the Lagrange multiplier test for heteroscedasticity, obtained by regressing the squared residuals on the explanatory variables and the explanatory variables squared and is distributed as $?^2$ (q), where q is the number of regressors and the squared regressors in the test regression, Normality $?^2$ (2) refers to the Barque-Bera [1980], test for normality of the residuals, with a correction for degrees of freedom. Reset is Ramsey=s test [1990] for correct specification performed by testing the relevance of adding the squared predicted values in the orginal model. The long-run equilibrium elasticities for q = 1.04 and the semi-elasticity for interest rate is 4.9.

The housing investment function with diagnostics is reported in Exhibit 8 on the following page. The standard error of the regression is 6% and 88% of the total variance in the annual log change in housing investment is accounted for. The signs of most of the short-run dynamic variables and the long run variables are in agreement with prior theoretical expectations.

[EXHIBIT 9 HERE]

Exhibit 9 presents plots for housing investment based on the estimated investment function. The 91TR tax reform dummy plays a significant role in the specification of the investment equation. The supply-side of the housing market responded sharply to the scale of the downturn in demand. According to Englund et al [1995], new construction fell dramatically from a peak of 70,000 dwellings in 1991 to 12,000 in 1995. The share of single family houses out of all new construction fell from 50 per cent in the 1980s to 25 per cent in 1993 and 30 percent in the first quarter of 1995. Fluctuations of this magnitude have important consequences for the Swedish national economy in terms of the direct impact on the house building industry and the knock-on-effects for investment and aggregate demand in general.

Thus on theoretical grounds one would expect to find that low levels of real house prices, relative to construction costs, would discourage investment because of the unfavourable effect on builders= expected profits. During this period of crisis (1990-1994) in the real estate market, this is what our estimates imply, although the other variables in the investment function round out the picture (see further below).

According to the OECD Economic Survey [1998], the recent recovery in house prices has not been sufficient to make up for the faster developments in construction cost since 1990. The recent upswing in housing investment can according to the report be linked to a temporary subsidy for the construction of new houses and housing investment. This scheme of subsidies were terminated in December 1996, which consequently lead to a fall in housing investment in 1997. The current recovery in housing investment has occurred in concert with continued persistent rise in real house prices.

7. Controversy of the causes of the crisis in the Swedish housing market

Prior to the 91TR tax reform Swedish housing had been among the most subsidized in the world. Rent allowances were paid directly to low income households to lower their housing costs. These allowances increase the demand for housing space, which creates pressure for higher rents and asset prices and thereby greater production. Mortgage interest subsidies had (not among our model variables) been provided to purchasers of newly produced homes in the form of mortgage interest rates that are below market levels. Finally tax benefits were provided by allowing mortgage interest payments to be tax deductible. These tax benefits induce a larger stock, lower rents and lower asset prices, just as with mortgage interest subsidies. See Jaffe [1994].

In 1991 "The Tax Reform of the Century" was implemented. One of the main goals of the 91TR was to reduce the distortions in housing. Net capital income was taxed separately from earnings at a flat 30 per cent rate. In addition the property tax rate of 1.2 per cent was gradually increased to 1.5 per cent in 1993, which replaced the tax on imputed rental income of owner-occupiers. Both for owners and renters interest subsidies were reduced. The value added tax (VAT) on building material was increased by 12 per cent in uniformity with other goods and services. In order to offset the increase in VAT a 10 per cent investment subsidy was implemented, which was gradually reduced and eliminated in 1993. For details on the 91TR reform see cf. Englund [1995]. Our tax reform dummy represents all of these aspects crudely.

The volatility in the Swedish housing market and the controversy over the causes of the recession are diverse. According to Giavazzi et. al [1996], asset prices tended to correlate inversely with the government debt-GDP ratio, while the real interest rate featured a strong positive correlation with the government debt-GDP ratio. These gyrations in asset prices are associated with dramatic developments in monetary and exchange rate policy - the peak in real interest rate coincides with the currency crisis, and so does the trough in real stock prices - but, to a certain extent, they may also be determined by fiscal policy. They argue that asset prices may be one of the channels through which fiscal impulses have affected private demand.

Agell et al. [1996] estimate that 12-15 percentage points of the 30% fall in house prices were due to the effect of 91TR, and 8% was caused by the fall in real GDP. The implementation of the 91TR was accompanied by a severe economic downturn. Between 1991-1993, GDP fell by more than 5%, unemployment (including those enrolled in various market programs) rose by 12%, asset prices fell dramatically and residential construction activity came virtually to a standstill. (See Agell et al. [1996] for details). Their simulations using Poterba's [1984] perfect foresight model suggests a drop in prices around 10-15% with the announcement and implementation of 91TR . They argue that the severity of the recession is probably due to the fact that macroeconomic policy was firmly devoted to nonaccommodation. In addition they conclude that the timing of 91TR was unfortunate. However it is difficult the disentangle the effects of 91TR from those of the severe economic recession.

Berg et al. [1995], point out a positive relation between capital gains on houses and consumption, and this is the basis for their argument that a capitalization effect in the housing market through which 91TR affected consumption. In contrast Agell et al. [1995a], have another view that the after-tax real interest rate cannot have had a large impact on consumption owing to its small interest rate sensitivity. According to them the 91TR affected consumption via its impact on the price of assets.

According to the analysis of Söderström [1993] the debt deflation process seems to have prevailed in the Swedish economy at least through 1993. The idea that asset market behaviour could have substantial effects on real economic activity is not new: as early as 1933, Irving Fisher claimed that debt deflation contributed importantly to the great depression due to real-financial linkages in the economy.
Our view is that the deregulation of the credit market in 1985 was simultaneously followed by both a stock market and house price boom. During this period the construction industry undertook a fair amount of investment. There were two peaks in real house prices in Sweden, one in 1979 and the other one 1990. There was an 38% increase in asset prices between 1986 - 1989. This was partly driven by the financial deregulation of the credit market, beginning in 1985. As a result household demand for credit increased as former liquidity constraints were relaxed. Borrowing against property for consumption purposes became easier and homes could be bought with a smaller down payment (this aspect is captured by the debt to income ratio, is a major driver in the model). This eventually resulted in financial distress when the Swedish consumer could not readily pay his bills in the downturn. When indebtedness was high, the consumer had large contractual payments for the debt service, and other financial obligations, that increased the likelihood of financial distress, thus decreasing the demand for tangible assets, see also Mishkin [1977]. This aspect is captured by the debt to financial wealth ratio (the solvency aspect).

According to Barot and Takala [1998], Swedish economy began to slide into recession in the 1990s. First, escalating interest rates due to a rising budget deficit, then rising unemployment signalling greater uncertainty about the future, brought a radical decline in housing demand. Since the 1990's real house prices have dropped by an average of 15 per cent across the country. From our estimates (Exhibit 3), we get the following effects from the 91TR: the short-term effects derived from the nominal long term interest rate which accounts for 3.3 per cent fall in real house prices, 2.8 per cent is due to the increase in unemployment. The long-term effect via after tax real interest rate is approximately 1.4%, the financial distress captured by the debt to financial wealth ratio captures 0.1% of the fall in real house prices. Real rents for rental apartments increased by 20 per cent between 1990 - 1992, see Englund et al. [1995]. This explosion in rents is partly due to reduction in interest subsidies that was embedded in 91TR, which induced substitution from rental markets (flats) to small homes. This process accounts for 2 percent fall in real house prices according to our model. The final 3.3 per cent fall in house prices is explained by decreased income which raised the housing stock to income ratio. The sum of the short and long-terms results into approximately 13 per cent fall in real house prices. The results are in line with Englund et al. In Sweden financial liberalization and the surge in borrowing came later than in the

UK; but the sharpness of the boom in house prices-and the severity of the subsequent fall - was even greater than in the UK.

8. Simulations - the price model alone

To address the sensitivity of housing prices we run four scenarios for 1970 -1997.

[1] Permanent increase in disposable income by 5 percentage points, with stock unchanged.

[2] Permanent increase in long nominal interest rate by 5 percentage points.

[3] Permanent increase in housing stock by 5 percentage points.

[4] Permanent increase in household debt by 5 percentage points.

[1] A permanent increase in disposable income by 5 percentage points, (e.g. as a result of decreases in taxes or increases in transfers) gives an increase in house prices by 5 percentage points. The interpretation is that high disposable income acts as a signal about the future higher income and hence about creditworthiness, thus stimulating demand for houses and hence increasing house prices. From the policy point of view the policy maker can stimulate the demand for owner occupied homes by decreasing tax on income or increasing transfers.

[EXHIBIT 10 HERE]

[2] The effects of monetary policy on housing prices arise through Central Bank influence on the nominal interest rate. An increase in the long government nominal interest rate by 5 percentage points, a hypothetical policy measure of the Central bank decreases house prices by 5 percentage points as it increases the borrowing costs and reduces the demand for housing on this account.

[EXIBIT 11 HERE]

The nominal interest rates reflect the effects of monetary policy under various degrees of regulation of both the housing and money market. The after tax interest rate incorporates the effects of 91TR via the marginal tax rate. In the long term, the prospects for the housing market in terms of the volume of sales, the rate of new building and house prices are fundamentally dependent on what happens to interest rates, given the high sensitivity of the market to interest rate changes. These changes impact upon both the demand and supply sides of the market. As income continues to grow ahead of house prices, a major revival in the housing market depends upon a reduction of mortgage interest rates. The conclusion of this simulation is that easy monetary policy can be an important force behind excessive asset price inflation and vice versa.

[3] An increase in the housing stock by 5 percentage points as a result of government investment subsidies or (new housing construction responding to high Tobins q) decreases house prices by 7 percentage points as expected. For future stimulus to the construction sector investment subsidies can increase the housing stock, whereas reduction in excessive subsidisation reduces it.

[EXHIBIT 12 HERE]

[4] Wealth effects are triggered by changes in interest rates. Lower interest rates facilitate borrowing in order to finance the booming purchases of houses. Before 1985 mortgages were generally rationed, at least in principle. A surge in new credit availability (reflected by the debt to income ratio in the model) generated an increase in the demand for housing. Since the supply of housing is inelastic in the short run, the increase in demand would lead to rise in house prices.

The impact of liberalisation in the housing finance market strongly suggests that in the adjustment period following an easing of credit restrictions we would expect to see much lowered saving, higher house prices, deterioration in the current account and significant equity withdrawl. The adjustment period may prove to be very long-with forward-looking individuals who may have bequest motives, the response to the easing of credit restrictions can be drawn out over decades. House prices will converge to a new equilibrium slowly and non-monotonically, i.e. with oscillations.

Policy makers in Sweden should be aware of the kind of instabilities of adjustment which can resemble those in the wake of financial liberalisation and the time-frame of the transition to new steady states. Monetary policy affects the valuation of financial assets in the economy. Looser monetary policy leads to an increase in debt stock and vice versa. This is illustrated by policy experiment of increasing household debt by 5 percentage points which would increase house prices by 10 percentage points.

[EXHIBIT 13 HERE]

The natural policy conclusion is that without financial mortgage controls the interest rate instrument can be necessary to prevent any boom from recurring. However it is difficult to speculate on the ways in which housing finance may change within the European single market.

The most important lessons for policy makers from our analysis are:

(1) The sharp rise in house price after 1985, tended to be followed by gradual declines over a

prolonged period. This stems from the fact that supply responses to changes in the relative prices of houses are likely to be very small in the very short run but will build up over time which ultimately dampen, the kind of overshooting in prices which results from short-run stickiness in the stock of housing. The demand for housing is sensitive to a large range of macro variables for many periods ahead, and hence house prices are susceptible to large and sudden jumps.

(2) For the Swedish policy makers the simulations shed light on responsiveness to both fiscal and monetary measures. From the accuracy of the model as indicated by (Exhibits 5 and 9) it would be roughly possible to draw qualitatively correct conclusions for the Swedish housing market about the set of measures necessary to aim at a set of policy targets in the future from the magnitude of the policy responses illustrated.

9. Simultaneous model solution

The main purpose of this section is to analyse the properties of the real estate model for the household sector as revealed by full the dynamic responses including investment. The closed model has a demand function, supply function and an identity as discussed earlier. The equilibrium long-run impact of the broader Swedish economy on the real estate market for the household sector can be analysed within the simple framework adopted, which is similiar to DiPasquale and Wheaton [1992].

In the short run it is often assumed that the supply of stock is fixed and asset prices are determined merely by demand factors. Let us assume that in the Swedish economy there is a growth in income, signalling increases in future income. This would lead to an increase in employment and production. Households would be willing to buy small homes and seek more rental housing flats and this would mean that the household debt (effective demand) would increase. With the fixed supply this would result in an increase in rents, boost demand for owner-occupied homes further which would in turn lead to higher asset prices, which would generate a higher level of Tobin's q . This would give incentives for the construction sector to expand, increasing investment. A higher level of investment would augment the stock and would eventually lead to a fall in prices.

The estimated error correction adjustment coefficient (indicating the speed of adjustment) on the demand side is -0.32 which is in line with other international studies. The speed of adjustment on the supply side -0.23 is slower due to lags and inertia in the construction sector. It is apparent that it takes time for the quantity to adjust to equilibrium.

There are, however several reasons to expect that the housing market will often be characterised by significant lingering deviations from long-run market-clearing price. The large transactions costs which are typically involved in buying a home, will cause significant adjustment lags on the demand side of the market. As a result, economic agents will only adjust slowly toward their desired stock of housing following a change in exogenous demand-side variables. On the supply side of the market, adjustment of the stock of dwellings is also generally held to be quite slow. Over the very short term, since the level of housing completion is small relative to the total stock of housing, it is often argued that the supply of housing is almost completely fixed. Against this, over the medium to long-run, firms in the construction sector will make their production decision based on the expected profitability of house building activity. Over the medium to long-run, therefore, the supply of dwellings is thought to be quite, although not perfectly, elastic.

The results of the simultaneous model solution are presented in the Exhibits 14 to 18. The overshooting in the early 1970s on the demand side, might have to do with our omissions in treatment of price controls and the regulated market. During the post deregulation period, with the exception of the slight deviation of the model solution for the historical period, looks promising as it captures both the boom and the bust. This implies that the model outlined and the accuracy of it could be an important tool of guidance for the policy maker as illustrated by the policy simulations.

[EXHIBIT 14 HERE]

[EXHIBIT 15 HERE]

On the supply side there is both under and over shooting in the early 1970s. However the model solution converges to the actual investment figures from the 1980s. This is mainly due to the regime of regulations (1970-1985) which distorted the interaction of demand and supply in the housing market. In addition housing production requires relatively long planning and construction periods.

[EXHIBIT 16 HERE]

[EXHIBIT 17 HERE]

The simulated stock derived from [5] follows the actual stock promisingly well, indicating the accuracy of the model.

[EXHIBIT 18 HERE]

10. The house price forecast and projections 1999-2000

This section house prices are forecasted for the period 1999-2000 based on re-estimation through 1998. The assumptions behind the forecast are based on the NIER November forecast 1998 (Analysunderlag and Konjunkturläget, November 1998). The projection on house prices is conditional on the future course of explanatory variables whose development is not explained within the model. It is assumed that disposable income grows at 2.5% for 1999 and 2.2% for the year 2000. The consumption deflator grows at 1.2% for the projection years. The long government bond interest rates are assumed to be at 4% level.

Given forecasts on consumption (C) and income (Y) for the period 1999 - 2000 we define total savings (S) = $Y - C$. Having defined total savings S we define financial savings for the period 1998 - 2000, using the identity $WF = WF_{[-1]} + Y - C - SRL$ (real savings). Household debt and financial wealth variable for the period are projected by the financial model (FIMO) at NIER. As debt is the end year stock the yearly figures can be interpolated into half years. The assumptions of a steady increase in demand factors for the period 1999 - 2000, indicate annual percentage growth rates in real house prices of the magnitude 8.3% and 8.4% for the years 1999 and 2000.

[EXHIBIT 19 HERE]

[EXHIBIT 20 HERE]

11. Conclusions

House prices are commonly derived as a reduced form from separate housing demand and supply equations. This study specifies a full macro theoretical model within a stock - flow context, i.e. the system of equations describing the demand for stock, and supply of investment. The model has deliberately been kept as simple as possible in order to highlight its salient features. The strategy applied is Hendry's general to specific modelling, applying a sequential testing procedure. The fit of the separate demand and supply sides tracks well the actual developments in the respective variables and illustrates how accurate a theoretical model corresponds to statistical data.

There are several lessons for the conduct of macroeconomic policy from our analysis of the effects in the housing markets. The reduction in the volatility of new housing markets could be attempted either directly through targeted monetary and fiscal policies towards homeownership, or, indirectly, through public subsided new building, including the socially rented sector, being phased to operate with a counter-cyclical bias.

This study has also sought to explain both the depth and the longevity of the recent downturn in the Swedish housing market for the household sector, and discusses the controversy over the causes of the crisis, in context of the 1990-91 tax reform. The dynamic simulations illustrate the importance of both fiscal and monetary policies for house prices, and can be useful to the Swedish policy maker in the future. The underlying mechanism behind the simultaneous model solution corresponds to the functioning of the Swedish housing market. Given an expected low supply of rented property (and cooperatives) and a steady increase in demand factors (and a reluctance to produce more single family houses) the model forecasts 8.3% and 8.4% price increases for the years 1999 and 2000. Subsequently, the prices level out. This study indicates that the volatility in both house prices and housing investment can be sought in the fundamentals representing the demand and the supply sides in accordance with common theoretical conceptions and experience of how the housing market works..

Integration and cointegration

Exhibit 1 Integration tests using the ADF

Variable	With Constant	With Constant & Trend	Conclusion
ln[AKT/P]	-2.75	-3.01	I[1]
ln [HF]	-0.37	-3.28	I[1]
ln [H]	-2.67	-2.53	I[1]
ln [WF]	-0.28	-1.90	I[1]
ln [E]	-2.61	-1.27	I[1]
ln [POP]	-0.30	-2.27	I[1]
ln [PH /P]	-2.25	-3.20	I[1]
ln [DE / Y]	-2.19	-3.18	I[1]
ln [DE / WF]	-1.88	-1.38	I[1]
ln[H / Y]	-1.75	-0.87	I[1]
ln [HF / H]	-0.31	-2.86	I[1]
R	-2.16	-3.04	I[1]
RS	-2.00	-3.25	I[1]
ln (RENTS / P)	0.96	-1.20	I[1]
ln(IH)	-1.24	-2.91	I[1]
ln(IH / GDP)	-0.95	-2.89	I[1]
ln(PH / PB)	-0.89	-2.19	I[1]
ln(PH)	-1.61	-3.08	I[1]
ln(PC)	-2.69	-0.02	I[1]
ln(DE)	-2.05	-2.07	I[1]
ln(RENTS)	-1.74	-1.50	I[1]
ln(RENTS/PC)	0.33	-1.65	I[1]
ln(PB)	-1.69	-0.80	I[1]
Critical value 5%	-2.92	-3.50	

Notes: The ADF test has been carried out with maximum 2 lags. The stock of dwellings (H) and the employment rate (E) have 4-7 lags in the dependent variable to prewhiten the residuals, whereas the other variables have maximum 2 lags . The results indicate that all the variables are I (1). See variable list on the definitions of variables.

Exhibit 2 Cointegration

H_0: Rank Null	Alternative	Max eigenvalue	95% Critical Values	Eigen Values Trace	Critical Values
r = 0	r ? 1	132.5**	39.4	318.5**	94.2
r ? = 1	r ? 2	98.8**	33.5	186**	68.5
r ? = 2	r ? 3	45.13**	27.1	87.19**	47.2
r ? = 3	r ? 4	28.93**	21.0	42.05**	29.7
r ? = 4	r ? 5	10.98	14.1	13.12	15.4
r ? = 5	r ? 6	2.15	3.8	2.15	3.8

Note: The critical values are at 5% and 1% significance level. The asterisks * and ** denote significance at 95% and 99% significance level. However on the grounds of the low power of these tests VECM (Vector error correction model) is not estimated. The Johansen method proceeds by first testing for no cointegration. If this hypothesis cannot be rejected, the procedure stops because the variables are not cointegrated. If however, this hypothesis is rejected, it is then possible to test the hypothesis that there is at most 1 cointegrating vectors. If this hypothesis is also rejected then the hypothesis for two or more cointegrating vectorss until a hypothesis cannot be rejected. It is expected that there is a cointegrating vector, including all six variables, as mentioned earlier. According to the trace and the maximum eigenvalue statistics, definitely one, and possibly two cointegration vectors were identified. The other cointegrating vector would be representing the household debt variable. One of the potential long-run vector for the demand side can be formulated as follows:

*ln (PH/P)= C + 0.20*ln(DE/Y)-0.58*(DE/WF)-2.94*ln(H/Y) - 0.12* ln(HF/H)+*

*1.90*R*(1-M)- ? P/P ;* where *C* is the constant.

The supply side long run cointegrating vector can possibly represent Tobin=s q.

H_0: Rank = p	-Tlog(1-μ)	using T-nm	95%	-Tlog(1-μ)	usin T-nm	95%
p == 0	214.9**	207.1**	14.1	215.6**	207.7*	15.4
P < = 1	0.7104	0.684	3.8	0.71	0.68	3.8

The standardized ß eigenvectors ln(*IH/GDP*) = *C* + 4.13 * ln(*PH/PB*) ; where C is the constant. At least, the Johansen test will provide a reasonably good indication if the variables in each equation have a long - term equilibrium relationship.

Exhibit 4

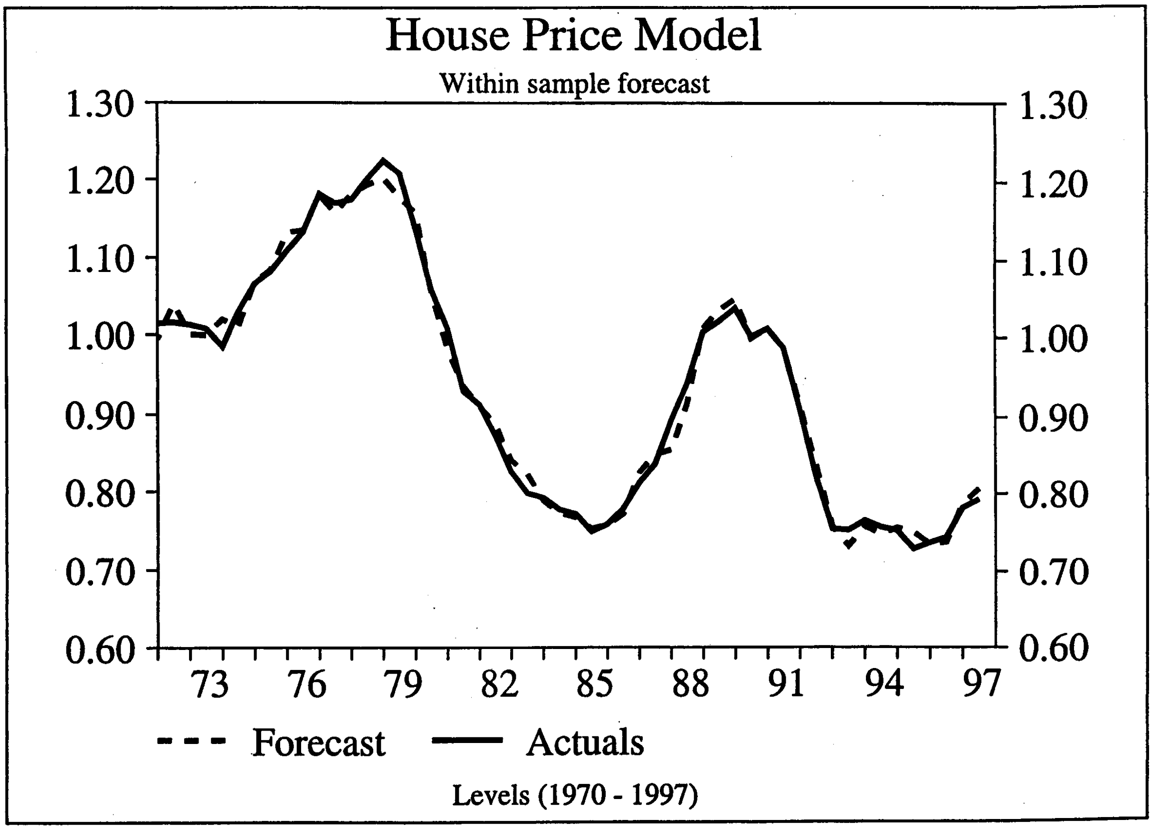
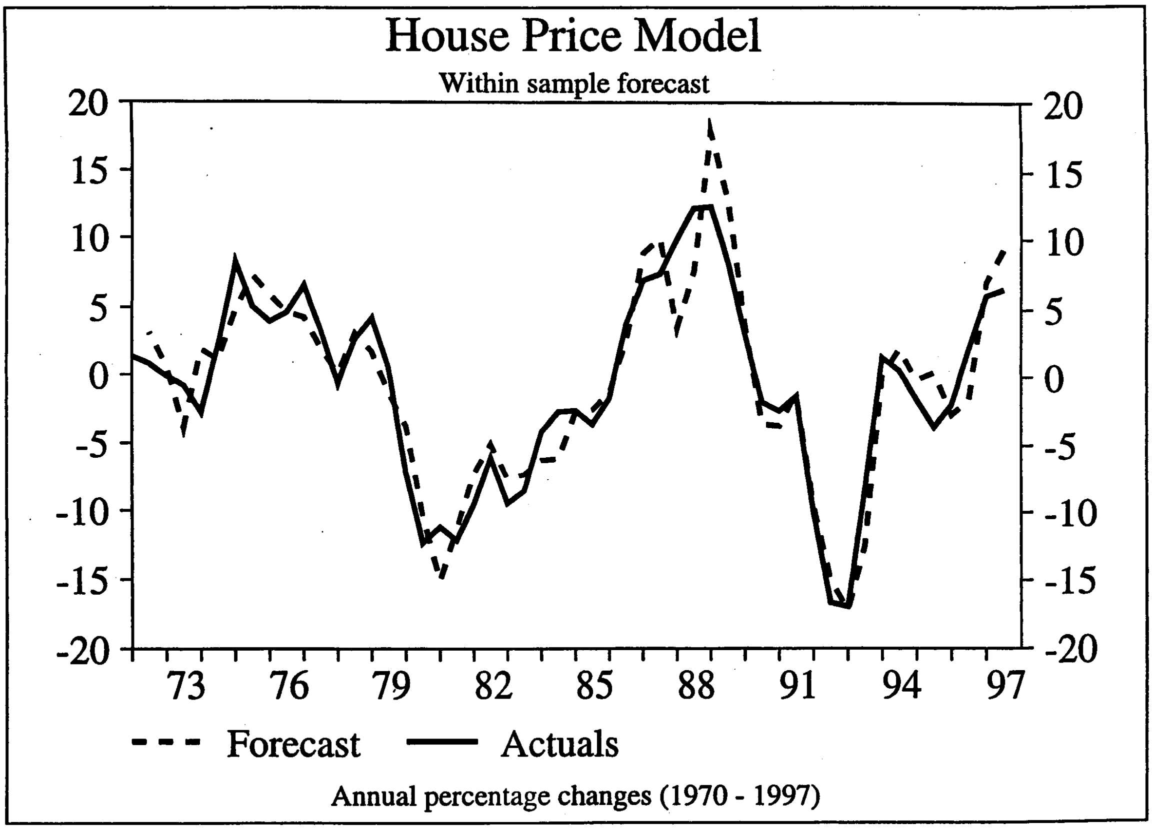


Exhibit 5



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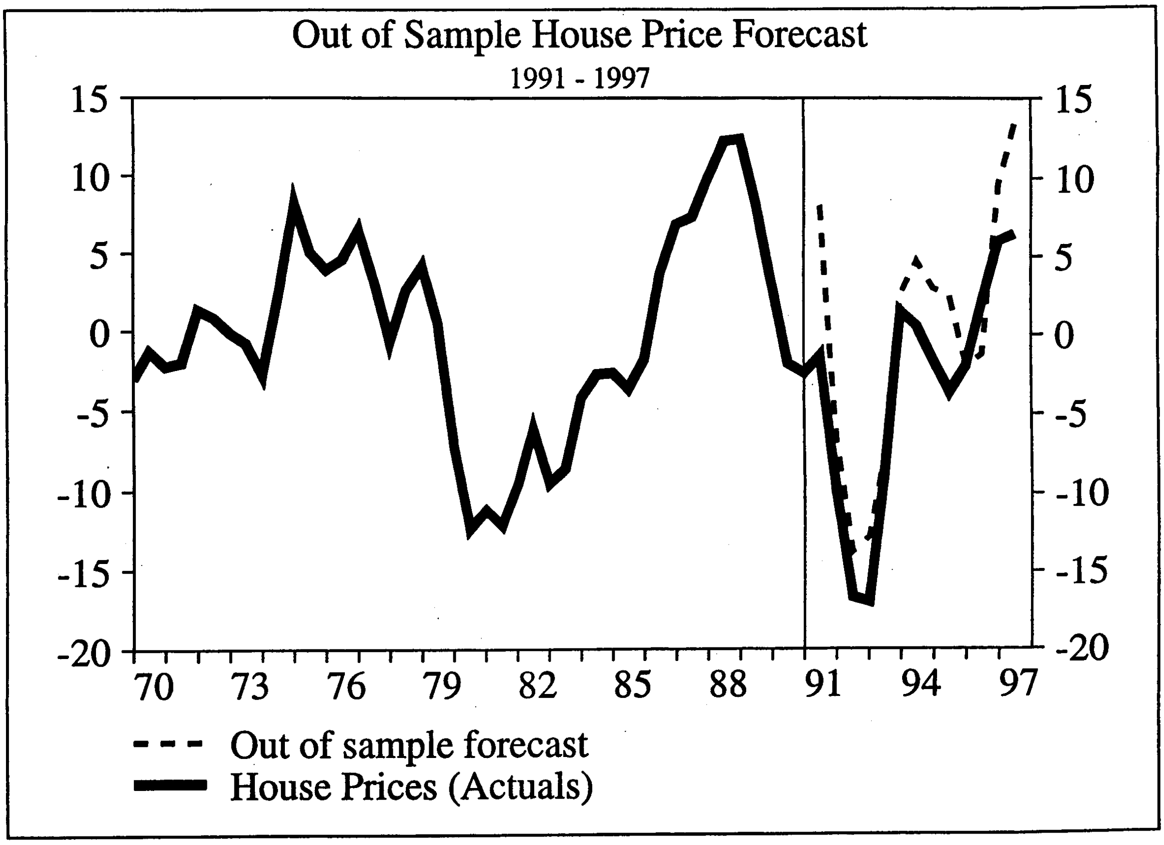

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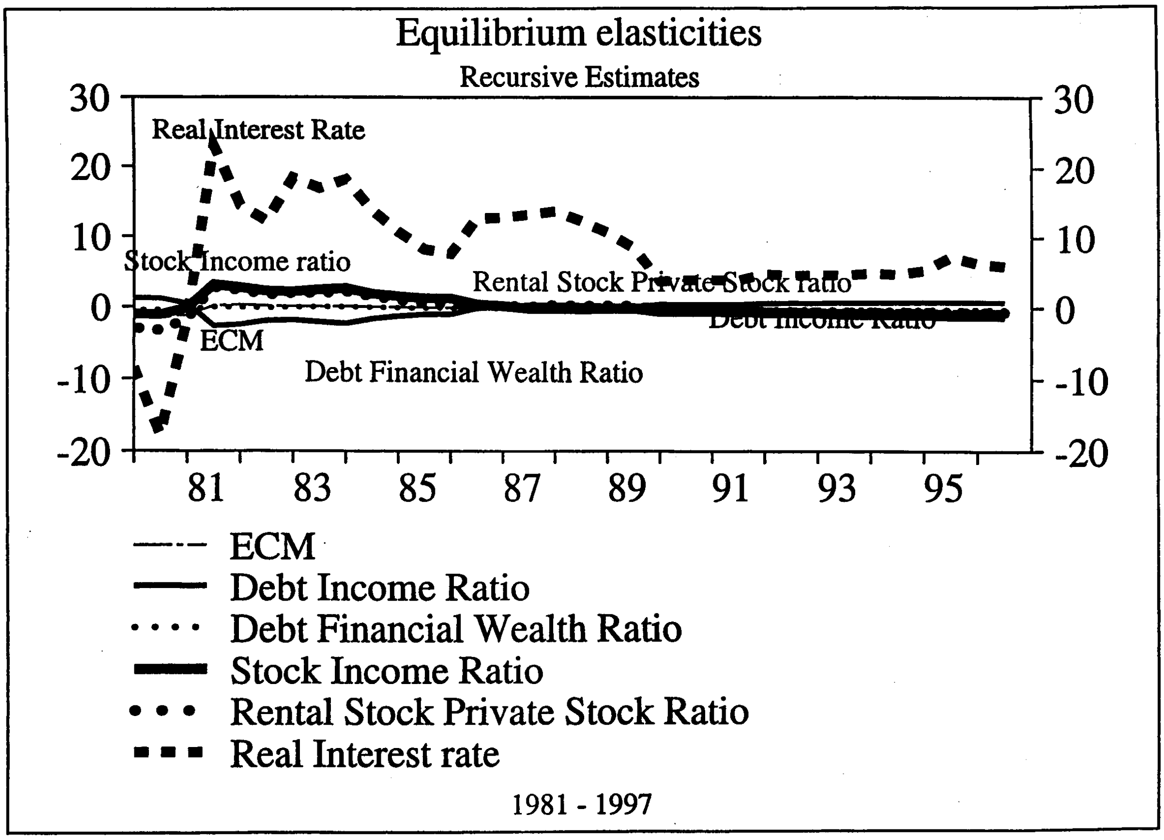

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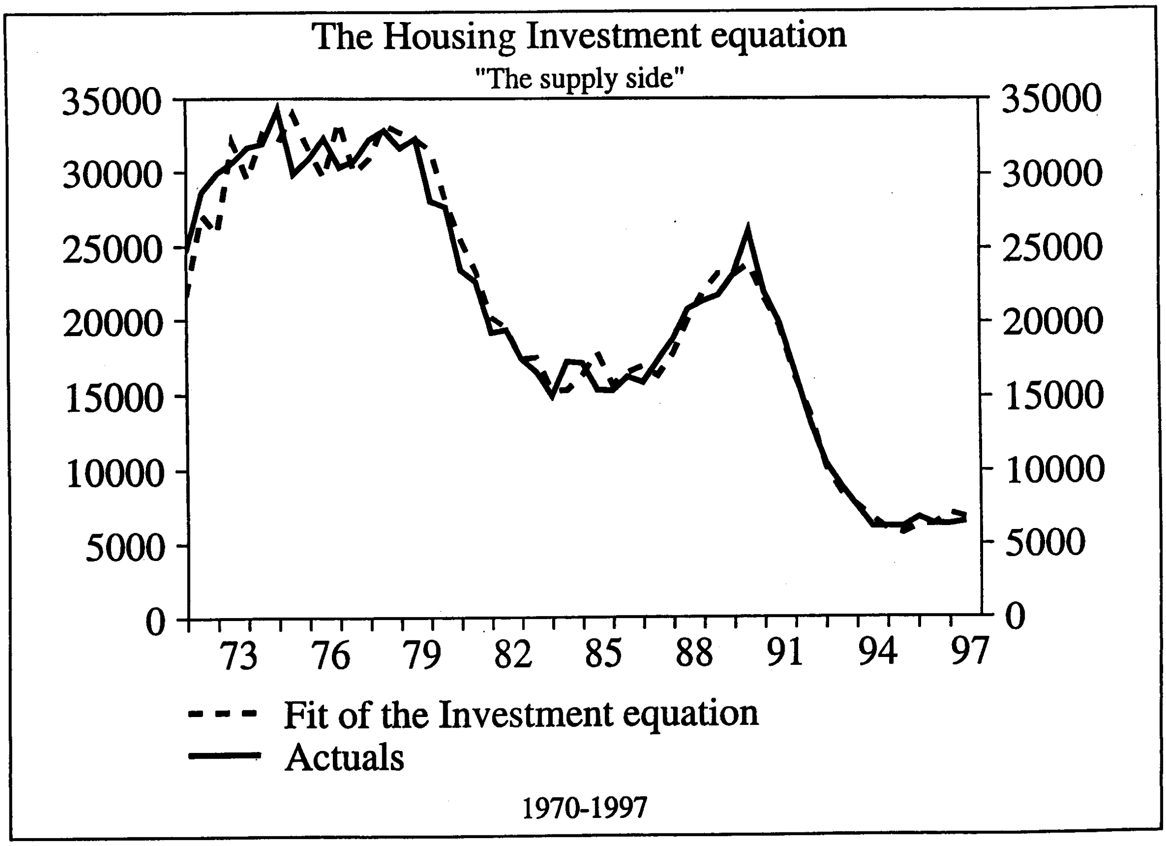

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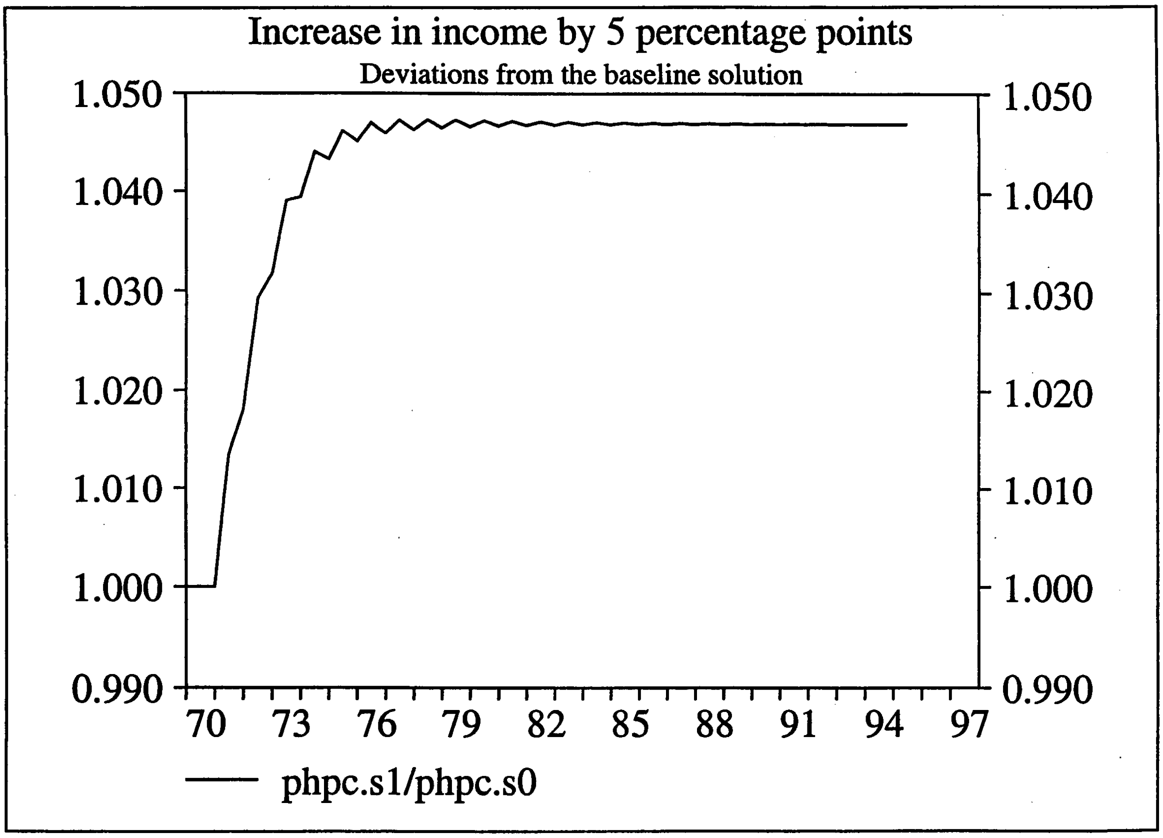

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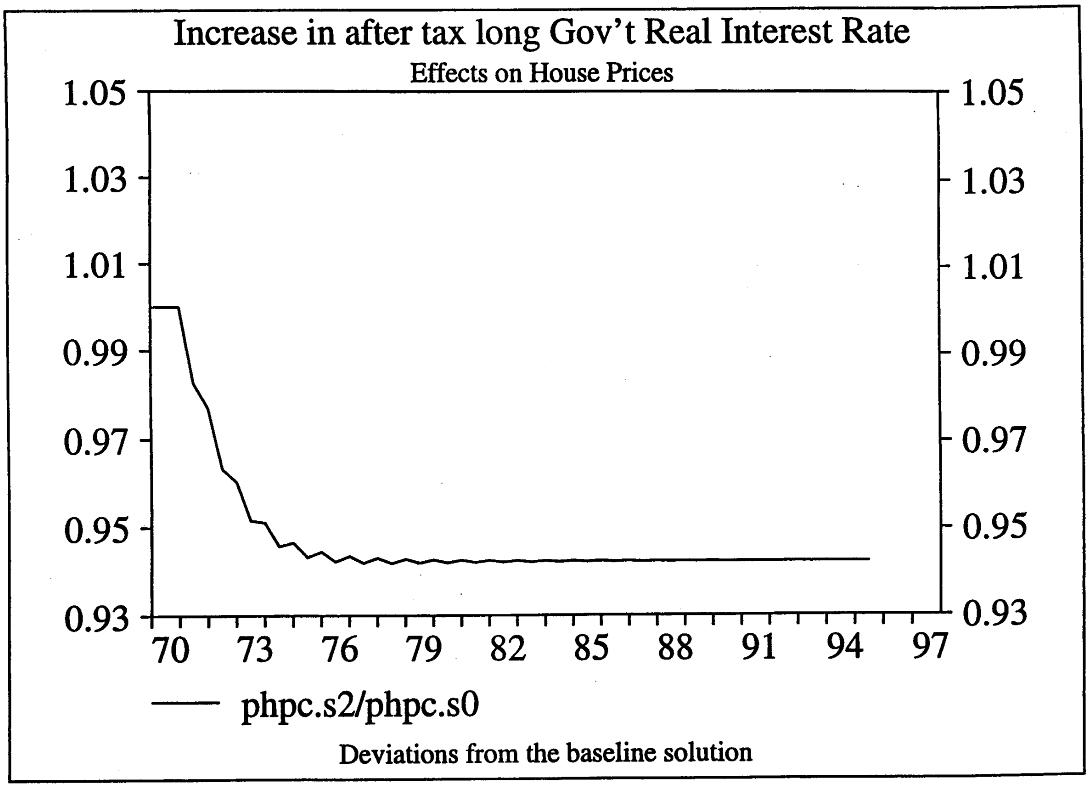

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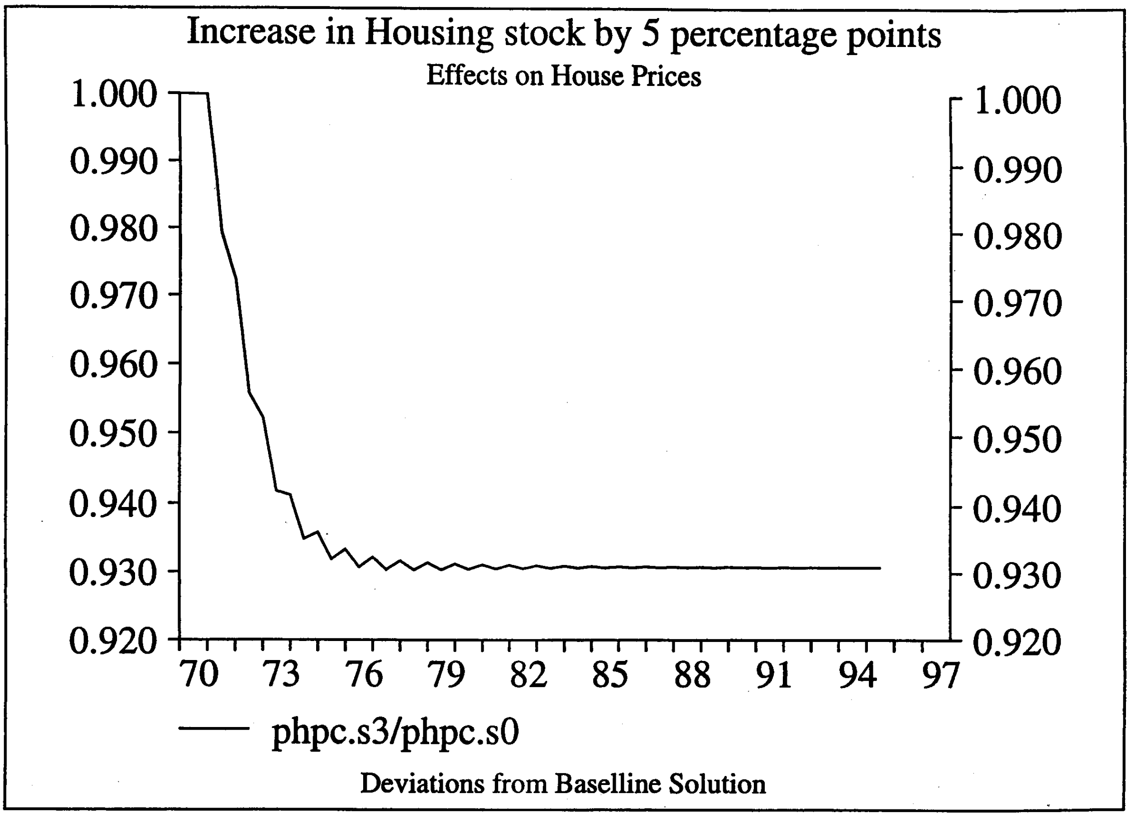

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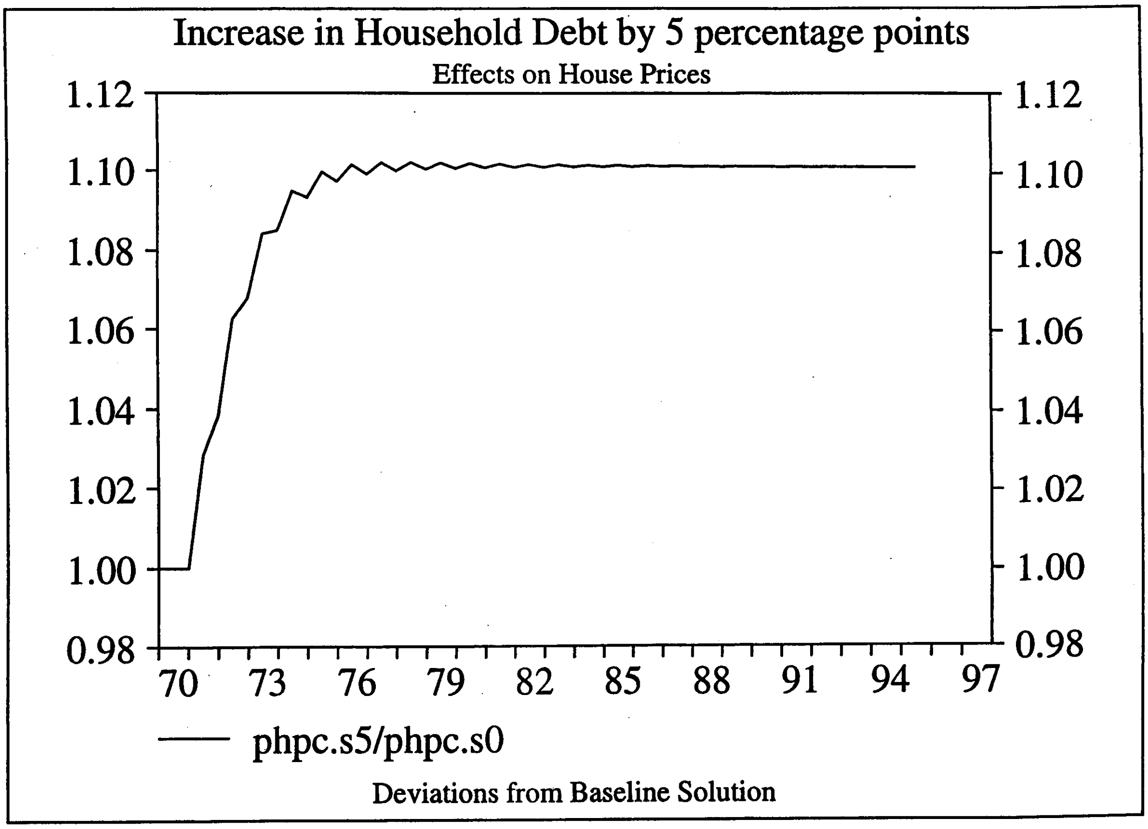


Exhibit 13

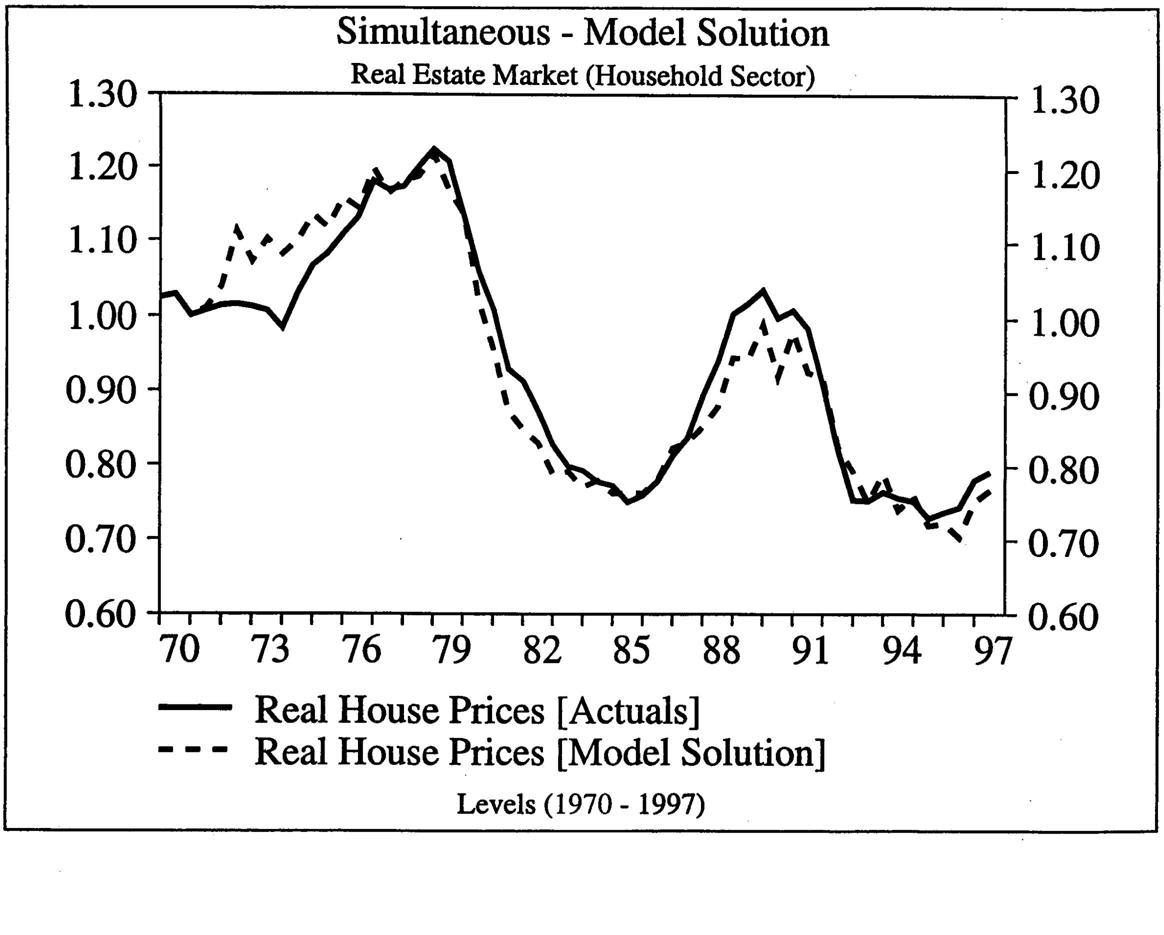
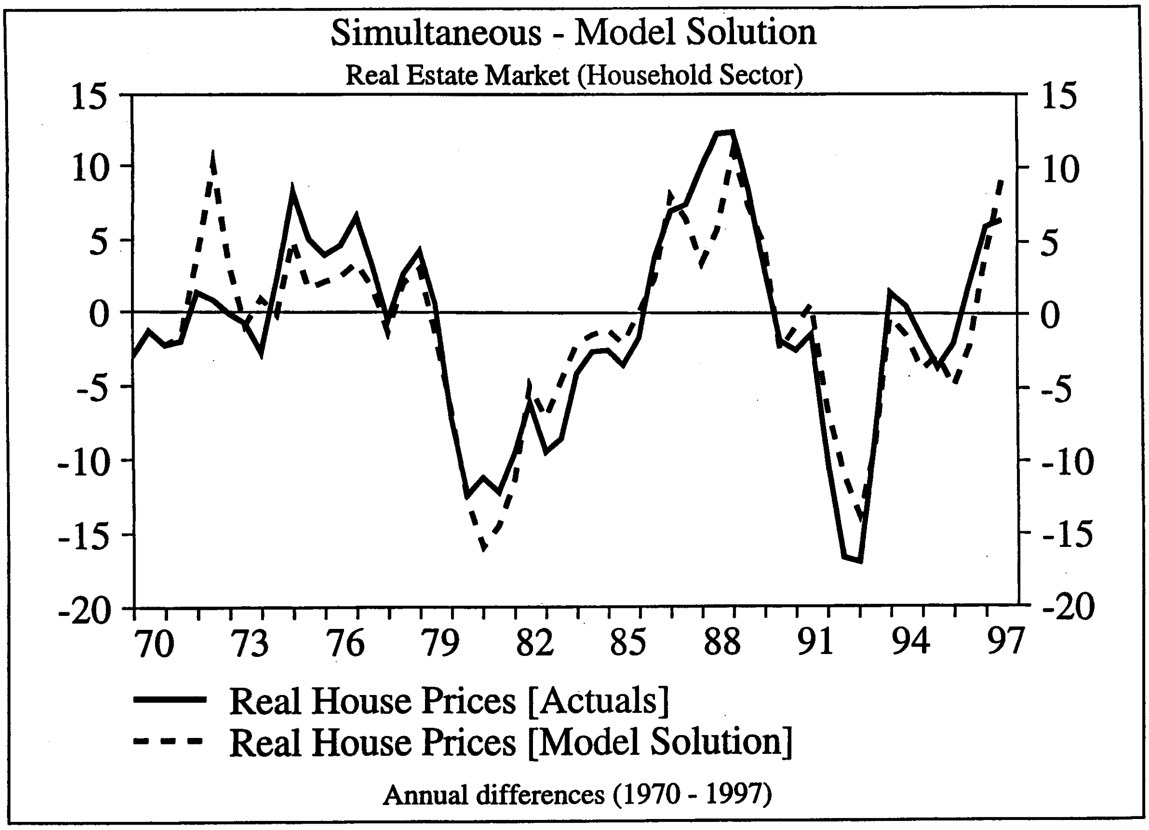


Exhibit 14



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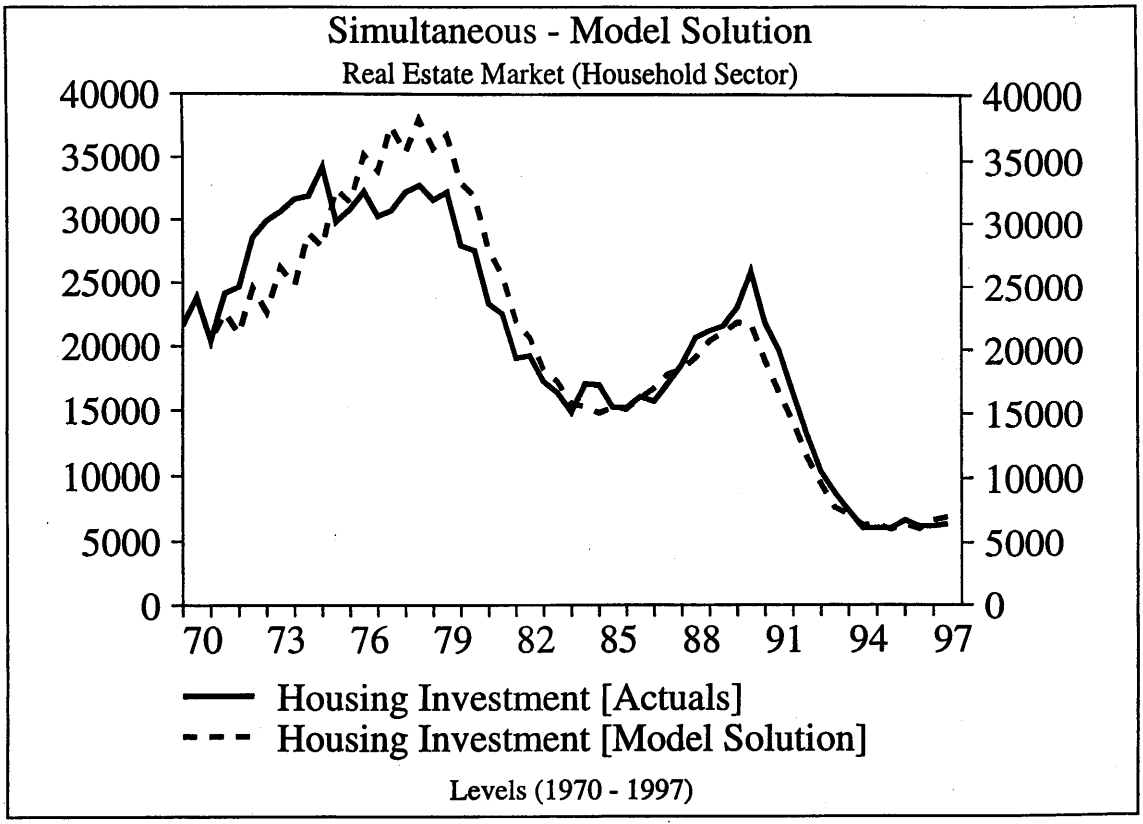

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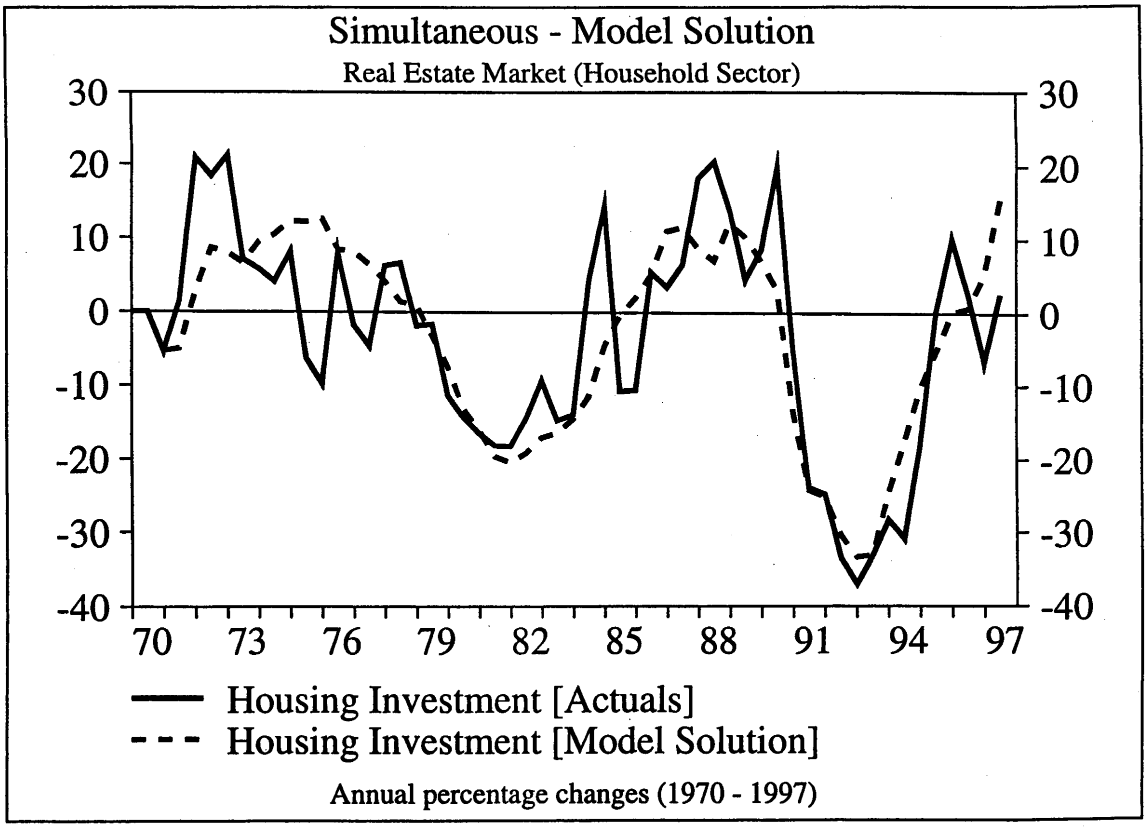

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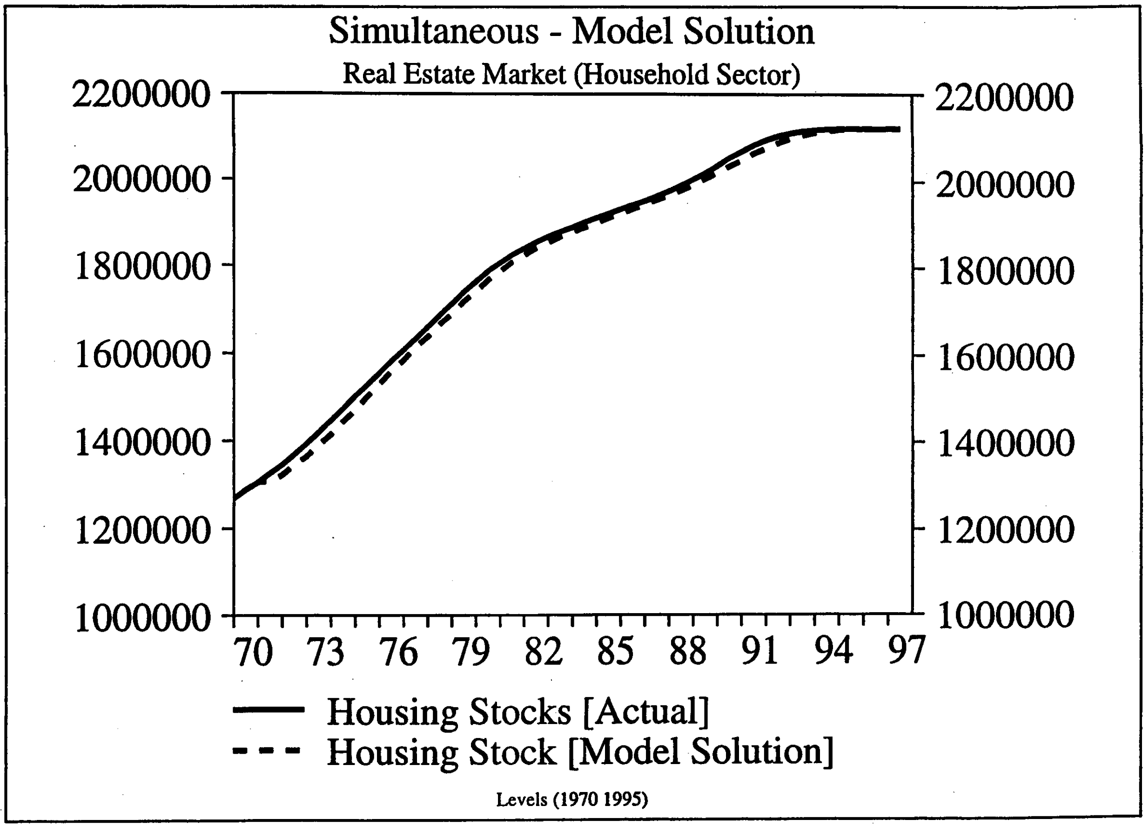

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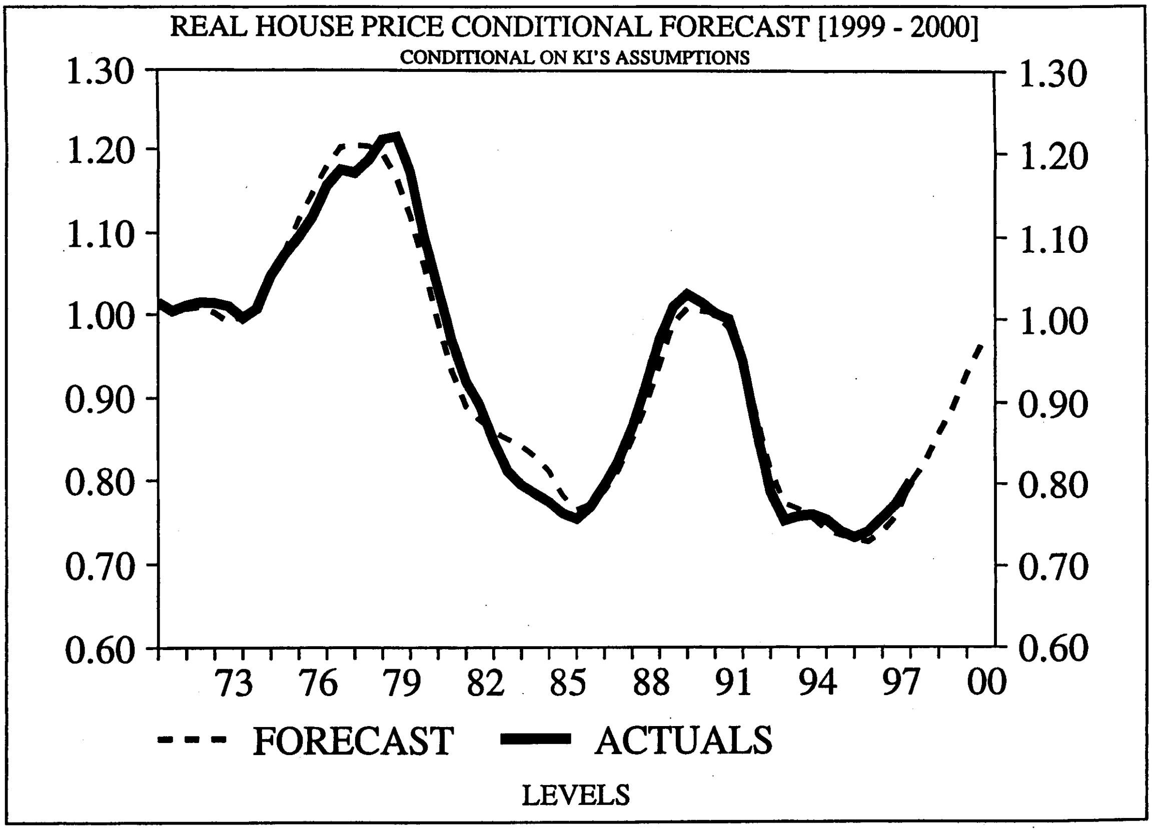
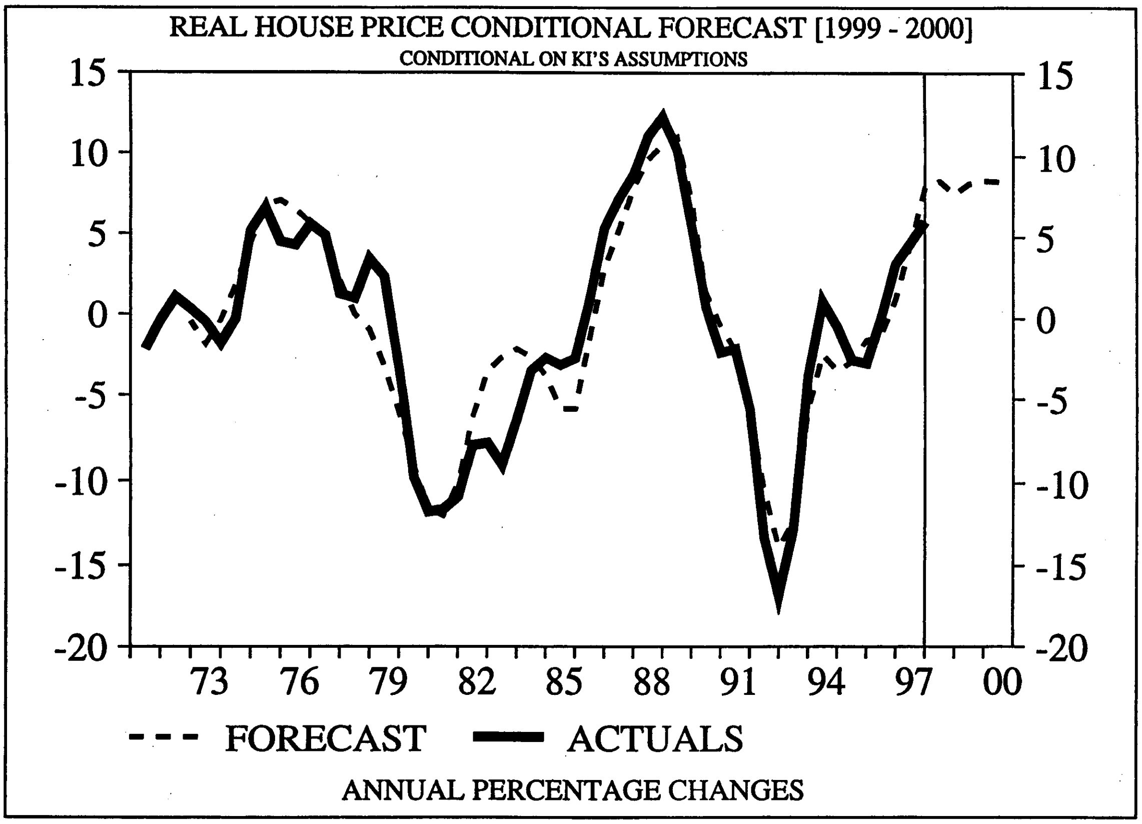


Exhibit 19



Data Appendix

1. *PH*: Nominal house prices. PH (1991 = 1) is the weigted mean of (fastighetsprisindex) of primary and leisure homes (fritidshus). The market price index covers only direct ownership including second homes, not indirect ownership.
2. *P*: dnotes the consumption deflator (1991 = 1).
3. *Y*: is real disposable income.
4. *WF*: is households net financial wealth defined as the sum of notes, coins, bank deposits and the National Saving Scheme (Allemanssparande),, bonds and treasury discount notes, private insurance savings, listed and non-listed shares and other assets, minus total direct debt.
5. *DE:* is household debt. The annual stock figures for household financial assets and liabilities were from Financial Accounts Sweden, (Financial Accounts 1970 - 1997).
6. *H*: is the stock of private homes i.e. the sum of stocks of primary and second homes computed according to the perpetual inventory stock method approximately equal to Statistocs Sweden=s gross stock. In the perpetual inventory stock, all construction of so called Asmall homes@ including secondary homes are treated as owned by households. Apartments (or flats) are regarded as rental Housing.
7. *HF*: is the stock of rental housing. The perpetual stock is our measure interpolated from the bench marks based on Statistics Sweden=s previous stocks, which have since been revised. For details of of computations of the stocks, see Kanis and Barot [1993].
8. *R*: Long government interest rate (5 years).
9. *RS*: Short interest rate.
10. *AKT:* is the general price index for shares as reported by Statistics Sweden.
11. *M*: Marginal tax rate on interest deductions leading 1 year.
12. *RENTS*: Rents on housing.
13. *E*: Employment rate (regular / labour force inclusive programs), in thousands.
14. *IH*: gross investment in private (small) homes in 1991 prices.
15. *PB*: is the building cost index in 1991 prices.
16. *GDP*: gross domestic product in 1991 prices.
17. *91 TR*: is the 91 Tax Reform Dummy.
18. *DS* : Dummy, 1 in the first half year and 0 for the second half year.

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