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The impact of house prices on household debt when controlling for home ownership

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The impact of house prices on household debt when controlling for home ownership

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Abstract

We analyze the effect of house price changes on debt secured on dwellings in Norway. To this end, we use both macro time series and micro panel data. With the intention of being both a cross-check and motivation for the micro analysis, we estimate a structural vector auto regression using macro variables. A key result of the macro analysis is that positive house price innovations have positive and persistent effects on households debt secured on dwellings.

Results from the micro data analysis suggest that the effect of house price changes on the borrowing decision differs from the effect on the instalment decision among existing home owners. These results are further investigated trough a two stage model where we control for income, collateral value and age. The model predicts that the size of both loans and instalments increase with income. Loan sizes increase and the instalments fall with increasing collateral value. The results support the existence of a wealth channel but do not provide support for a collateral channel.

Keywords: VAR, house prices, mortgage equity withdrawal, logit model, micro panel data

JEL-codes: C25 C32 D12 D14 E21

1 Introduction

In the past decade, Norwegian households have been offered several new loan products which have effectively increased the liquidity of housing wealth by improving the access of home owners to low-cost secured finance. To the extent that households have utilized this increased scope of mortgage

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equity withdrawal, it may have strengthened the effects of house price changes on household borrowing and consumption. The recent global financial crisis also demonstrates that financial innovations with a bearing on housing and credit market trends can ultimately have a huge impact on real activity. In this paper, we direct particular attention towards the effect of house price changes on mortgage equity withdrawal, and investigate the impact of house price changes on the debt of owner-occupiers that do not buy or sell a dwelling. To this end, we use Norwegian micro data comprising all tax returns for households in 2007 and 2008 coupled with information on regional house prices. Furthermore, as both a cross-check and motivation for the micro analysis, we start out by estimating a structural vector autoregression (SVAR) using macro variables covering the period November 1997 to April 2010. The structural VAR model highlights the dynamic responses in household debt and consumption following structural house price shocks, and also shed light on the importance of such shocks.

Mortgage equity withdrawal (henceforth MEW) is commonly defined as net new borrowing against residential property in excess of new residential investment. Defined in this way, extraction of housing equity can take place through several channels. When a housing transaction occurs, MEW can be obtained by a) over-mortgaging as the moving homeowner raises the mortgage by more than the price difference of the old and new dwelling; b) trading down as the home owner moves to a cheaper dwelling but reduces the mortgage by less; and c) last-time sales as a dwelling is not being bought in place of the one being sold. However, MEW can also take place in absence of housing transactions, by a) remortgaging as the current loan is repaid and replaced by a larger mortgage without increasing the value of the dwelling by the same amount as the debt increase, and b) by raising a further advance on an existing mortgage or taking on a second mortgage, without improving the dwelling to the same extent. The main objective of the micro analysis of this paper is to examine the effect of a change in housing wealth on the latter type of MEW that does not involve transactions of dwellings. Our macro VAR does not explicitly account for this kind of MEW, but includes household debt secured on housing and debt that is not secured on dwellings. Additionally, as durables are more likely to be purchased on credit than non-durables, the VAR contains car purchases to highlight the effect of house price shocks on an important durable. Moreover, a retail sales index (excluding motor vehicles) is also included in order to capture effects on a broader set of consumption goods.

Theoretically, a positive effect of rising house prices on (non-housing) consumption is considered to work through an owner-occupier wealth channel and/or a collateral value channel. The traditional wealth channel is in the literature regarded as an ambiguous effect in macro since capital gains for existing homeowners might be outbalanced by losses for prospective home buyers. For owner-occupiers, a higher house price can also be viewed as compensation for an increase in the implicit rental cost of living in their dwellings without affecting the homeowners' real wealth. Yet, there may be important differences between the marginal propensities to consume out of housing wealth of homeowners and renters with macroeconomic implications. Concerning the collateral channel, although a shift in housing wealth is a necessity also for this mechanism to have real effects, it is not a wealth effect but a channel that allows credit-constrained homeowners to smooth their consumption path. At the end of the day, the quantitative impact of housing wealth on consumption is an empirical question, and this relationship has to some extent been subject of empirical investigation. Fairly recent contributions to this literature investigate the dynamic response of consumption to a house price shock applying the VAR methodology using macro variables, see e.g. Elbourne (2008) and Giuliodori (2005). Overall, they find a significant and positive response in consumption to a positive house price shock in the countries under study. Other types of analyses are consistent with this result: By applying standard regression techniques using a panel of 14 countries and U.S. states of various time periods, Case et al. (2005) find a significant and quite strong effect of housing wealth upon consumption. A sizeable marginal propensity to consume out of housing wealth estimated in U.S. data is also confirmed by Carrol et al. (2006). Campbell and Cocco (2007) use micro data from the UK Family Expenditure Survey and regional house prices and carry out a microeconometric analysis of house price effects on non-durable consumption for various demographic groups. They find a statistically significant elasticity of consumption to house prices among older owner-occupiers and no significant effect among young renters. Other micro evidence of the effect of housing wealth on consumption is reported in Engelhardt (1996), Levin (1998) and Skinner (1989), among other.

This paper contributes to the existing VAR literature as we trace out the effect of house price shocks on both an important durable (car purchases) and general non-housing consumption measured by retail sales. We also identify effects of house price shocks on both the portion of household debt secured on housing and the portion that is not secured on dwellings.

Regarding the micro analysis, we contribute to the literature by explicitly examining effects of house price changes on MEW, focusing on the type of equity withdrawal which does not comprise housing transactions. Due to the shortage of micro data that combine information about debt behavior and house value development, there are only a few studies of MEW utilizing micro data (see e.g. Ebner (2010), Banks J, R. Blundell, Z. Oldfield and J. P. Smith (2004) and Schwartz et. al. (2008)). To our knowledge this is the first micro set where it is possible to identify households that owned a dwelling and neither sold nor purchased a dwelling in the same period.

The rest of the paper is organized as follows. In Section 2, we identify the macroeconomic effects of a house price shock. Both the VAR methodology and the empirical macro results are accounted for. The micro study is described in Section 3, which provides a brief description of the micro dataset in addition to the outcome of the analysis. Section 4 concludes and in the appendix we discuss robustness results concerning the specification of the VAR model.

2 Macroeconomic effects of a house price shock

As stated in the introduction, our primary concern is to investigate the role of dwellings as assets and collateral and study the wider economic impact of house price changes. To this end, we firstly identify structural house price shocks using a VAR model. Our VAR model comprises log of real house prices (ph_t), log of real lending secured on dwellings (ls_t), log of unsecured real lending (lu_t), log of a retail sales index (c_t), (as a proxy for broad consumption) and log of sales of motor vehicles (cd_t), (as a measure of an important durable).[2] Furthermore, in order to properly identify shocks to house prices, we control for business cycle effects by including the unemployment rate (u_t), and the real three month domestic money market rate (r_t). Moreover, although banks' losses on loans to households have historically been quite low in Norway, a widely stated hypothesis is that house price fluctuations mainly affect Norwegian financial sector solvency by influencing non-financial firms' default through the effect on household demand. To illuminate this financial (in)stability linkage, we also let log of firms' bankruptcies (b_t) enter the VAR model.

2.1 Identification

We define y_t as the (8x1) vector of variables discussed above; $y_t = [b_t, u_t, r_t, ph_t, ls_t, lu_t, cd_t, c_t]'$. Assuming y_t to be invertible, it can be written in terms of its moving average representation (ignoring any deterministic terms)

(1) $$y_t = B(L)v_t,$$

where v_t is a vector of reduced form residuals assumed to be identically and independently distributed, $v_t \sim \mathrm{IID}(\mathbf{0}, \Omega)$, with a positive semidefinite covariance matrix Ω. $B(L)$ is an 8x8 convergent matrix polynomial in the lag operator L, $B(L) = \sum_{j=0}^{\infty} B_j L^j$. Following the VAR literature, we assume that v_t can be written as linear combinations of the underlying orthogonal structural shocks, i.e. $v_t = S\varepsilon_t$, where S is the (8x8) contemporaneous matrix. The VAR can then be written in terms of its structural shocks as

(2) $$y_t = C(L)\varepsilon_t,$$

where $B(L)S = C(L)$. If S is identified, then the moving average representation in (2) can be derived since $B(L)$ is calculated from the reduced form estimation. To identify S, the elements in ε_t are normalized to have unit variance which implies that $SS' = \Omega$. With an eight variable system, this will impose 36 restrictions on the elements in S and we are 28 restrictions short of exact identification. The restrictions that render exact identification are imposed by using the Cholesky decomposition, i.e. imposing recursive zero restrictions on S making it lower triangular, as described in equation (3) below:

[2] The retail sales index is not a clear-cut non-durable index, yet it excludes motorized vehicles and comprises to a large extent goods that are used up when used once, or that have a fairly limited lifespan. However, it also contains goods usually considered durables. The variable for sales of motor vehicles also contains fuel, but most of the fluctuation in this variable is likely driven by vehicle sales. From January 2000, a monthly time series for sales of new cars is available, and the correlation between the latter series and the corresponding variable entering the VAR is 90 per cent.

$$(3) \qquad \begin{pmatrix} b_t \\ u_t \\ r_t \\ ph_t \\ ls_t \\ lu_t \\ cd_t \\ c_t \end{pmatrix} = B(L) \begin{pmatrix} S_{11} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ S_{81} & \cdots & S_{88} \end{pmatrix} \begin{pmatrix} \varepsilon_t^b \\ \varepsilon_t^u \\ \varepsilon_t^r \\ \varepsilon_t^{ph} \\ \varepsilon_t^{ls} \\ \varepsilon_t^{lu} \\ \varepsilon_t^{cd} \\ \varepsilon_t^c \end{pmatrix}$$

The primary shock of interest in this paper is the structural shock to house prices (ε_t^{ph}), but the identification procedure also identifies the remaining structural shocks in the system. The recursive structure of the Cholesky decomposition implies that the results will not be invariant to the variable ordering. Our baseline variable ordering corresponds to the one denoted in equation (3), and in the appendix we report results for alternative placing of the house price variable. The ordering in (3) implies that bankruptcies, unemployment and the interest rate do not respond simultaneously (within the same month) to a house price shock. The restriction on the money market rate is likely most controversial. Using quarterly data from 1983 to 2006, Bjørnland and Jacobsen (2010) found that (Norwegian) house prices reacts immediately to monetary policy shocks while a short term interest rate responds sluggishly to house price innovations, when applying an identification scheme that allows for simultaneous interdependence. This finding partly motivates our baseline variable ordering, and the discussion is further addressed in the appendix. The lending and consumption variables are allowed to respond contemporaneously to the shock in house prices.

2.2 Empirical results

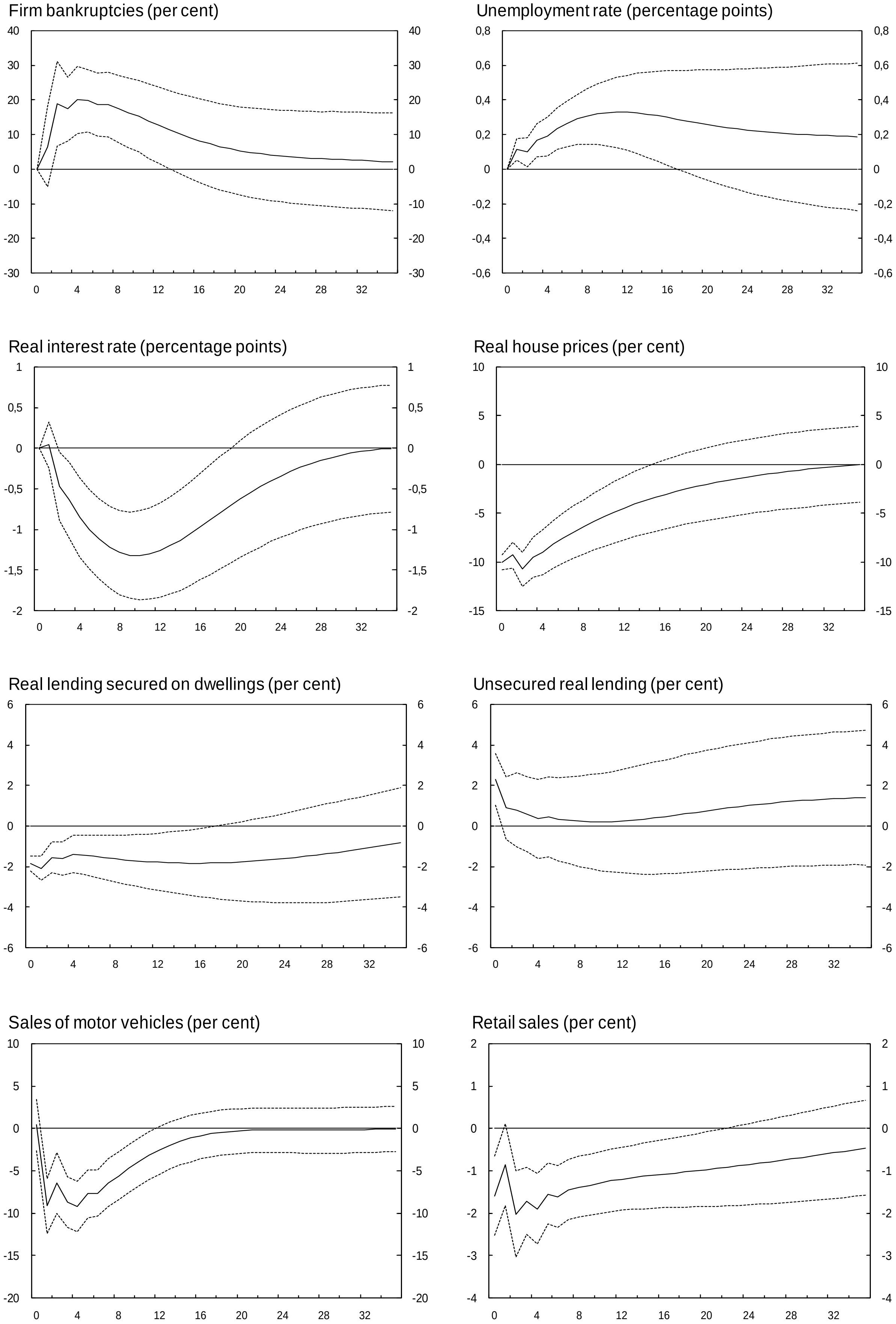
The model is estimated using Norwegian monthly data from December 1997 to April 2010.[3] All variables enter the VAR in levels, and none of them could (clearly) be rejected as non-stationary. However, we find evidence of three cointegrating vectors and confirm that the estimated VAR satisfies the stability condition: No eigenvalues (inverse roots of AR characteristics polynomial) lie outside the unit circle; hence the VAR can be inverted and analyzed through the MA representation.[4] The lag order is determined using the Schwarz and Hannan-Quinn information criteria and the F-forms of likelihood ratio tests for model reductions. In the baseline model we use three lags, and in the appendix we show results obtained when using alternative lag lengths.[5] With three lags, null-hypotheses of absence of autocorrelation and heteroscedasticity were not rejected, although some non-

[3] Monthly Norwegian house price data is available from January 1997. With an eight variable VAR, we did not have sufficient observations to estimate the model using 12 lags. However, it was possible to use 11 lags at the outset, which imply that we lose the first 11 observations as the models must be nested for test validity when testing lag reductions.

[4] We do not attempt to identify the cointegrating vectors; they enter the model only implicitly.

[5] The lag-order tests showed that two lags were acceptable when applying a one-percent critical level in the F-forms of likelihood ratio tests combined with the Schwarz and Hannan-Quinn information criteria. However, with two lags, the null-hypothesis of no autocorrelation was rejected and we therefore use 3 lags in the base model. Results obtained with 2, 4 and 6 lags are shown in the appendix.

Figure 1 Response to a negative house price shock. House prices fall by 10 per cent the first month



normality remained in the system. We included a trend and three impulse dummies, where the latter variables take the value 1 in one month and 0 otherwise, to take account of extreme outliers.[6]

Figure 1 plots the response following a negative house price shock, where the shock is normalized to lower house prices by 10 per cent in the first month. The responses are graphed with probability bands represented as .16 and .84 fractals, as suggested by Doan (2004).

Firm bankruptcies increase by up to 20 per cent in response to the house price shock, and the effect is significant until 14 months after the shock occurred. Consequently, this model provides evidence in favor of the thesis that housing market turbulence affects firms' solvency. Shocks to dwelling prices also influence the labor market; the unemployment rate increases by nearly 35 basis points and the effect does not turn insignificant until one and half years after the shock. There is also a clear response in the real interest rate, which is lowered by about 130 basis points 8-12 months after the shock, and then the effect gradually dies out. This movement in the (real) money market rate may be interpreted as a policy response, countering the effects of the markedly negative house price shock. The response is rather sluggish however, which may reflect that the monetary policymaker is primarily responding to rather slow movements in variables like e.g. unemployment. The unemployment rate is likely highly correlated with the output gap, which is a central objective for a monetary policymaker with a flexible inflation target.[7]

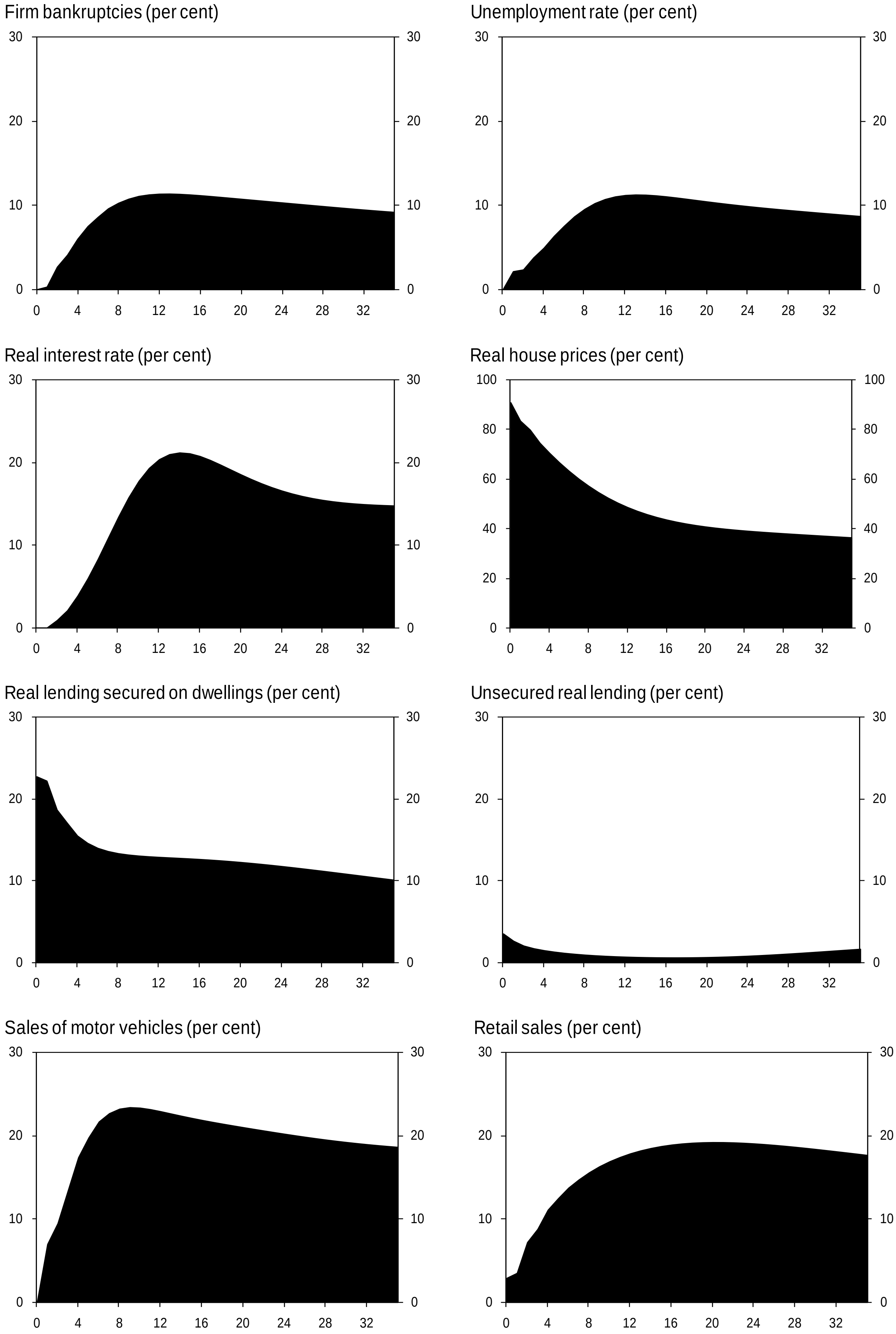
The two lending variables respond contemporaneously to a house price shock. Lending secured on dwellings falls immediately by about 2 per cent while unsecured lending increases simultaneously by around 2 per cent. This can reflect a substitution to unsecured loans, as loan-to-value ratios would rise making mortgages relatively more (risky and therefore) expensive. Moreover, a deterioration of housing values may also imply tighter lending standards with respect to mortgage loans. The effect of the shock on unsecured lending is significant only on impact, while the effect on secured lending is more persistent. The prolonged influence on secured lending can reflect both reduced loan demand by home buyers and a fall in mortgage equity withdrawal (MEW) by present owner-occupiers.

If lowered dwelling values make households more borrowing constrained, we would expect a negative effect on consumption. However, a negative shift in consumption could also be due to a wealth effect. Predictable house price changes should only have an impact on consumption through a collateral channel where consumers are borrowing constrained. However, structural house price shocks should be interpreted as unpredictable house price developments. Unpredictable changes in dwelling prices may work through a collateral channel and/or a wealth channel, where in the latter case consumers are not necessarily borrowing constrained. The house price innovation has in any case a clear effect on consumption: Retail sales respond immediately to the house price shock, and drop by a total of 2 per cent in the two months following the shock. Sales of motor vehicles respond somewhat more sluggishly, but fall by nearly 10 per cent a few months after the shock occurs. Clearly, the variable for

[6] Impulse dummies for January 2003, December 2004 and January 2007 were included. The first dummy accounts for a very strong increase in CPI due to a change in tariffs on electricity. The other two dummies control for outliers in the equation for cd_t, related to substantial changes in excise duties on vehicles that heavily affected car sales.

[7] Monetary policy conduct in Norway was operationally leaning on an inflation target from early 1999 when S. Gjedrem took office, and a formalization of an inflation targeting regime was announced in March 2001.

Figure 2 Variance decomposition. Contribution from house price shocks



an important durable reacts much more strongly to the shock than the broad retail sales index. As it may be widespread to finance car purchases by loans secured on housing, this could indicate that a collateral channel is at work as households become more borrowing constrained. Still, a stronger response in car sales relative to wide-ranging retail sales can also be due to different (wealth) elasticities.

While the impulse responses in Figure 1 show how the system reacts to a house price shock, the variance decomposition clarifies the relative importance of a structural shock. More precisely, the variance decomposition demonstrates the contributing share of a structural shock to the total variance of each variable. Figure 2 plots the percentage share that house price shocks explain of the variance of each variable over the horizon following the shock. Some months after they occurred, house price shocks explain about 10 per cent of the variance in firm bankruptcies and unemployment. The contribution to the real interest rate is stronger, close to twenty per cent a year after impact. The contribution to lending secured on dwellings is also about twenty per cent, but only in the short term as the contribution gradually declines. House price shocks explain on the other hand very little of the variance in secured lending. Concerning the consumption variables, the contribution is rather strong; nearly twenty per cent in the long term. Overall, house price innovations seem to have been an important driving force for fluctuations in macro variables in general from 1997 to 2010.

3. Existing home owners' debt behaviour – an empirical micro study

The purpose of this section is to shed light on MEW that does not involve housing transactions, by using micro data. Income statistics from Statistics Norway comprise all Norwegian households as of 31 December 2007 and 2008, see Appendix B. The data set enables us to identify households that owned a dwelling and neither sold nor purchased a dwelling in the same period. In the following, we will refer to these households as existing home owners. During 2008, prices for most types of dwellings fell in a majority of regions, yet increased for some types and in some regions. This provides a natural experiment where we can analyze the differences in debt behaviour among existing home owners according to whether the value of their home rose or fell. During this period, different households faced nearly identical lending rates, and we accordingly assume that changes in housing wealth left households' cash flow unaffected. We should therefore, at least approximately, be able to isolate the effect of changes in collateral value.

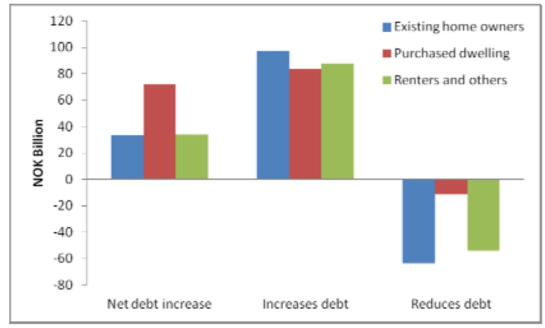
3.1 The debt and housing situation in Norway in 2008

According to income statistics there were a total of 2.1 million households in Norway in 2008. About 1.8 million of them (83 per cent) were indebted at year-end 2008, see Table 1. As we have defined the subset existing homeowners, they constitute 56 per cent of the indebted households. Among the existing home owners, 43 per cent increased their debt. This increase exceeded the debt instalment by the remaining part of the group, so the net debt increase amounted to NOK 34 billion. This comprises nearly 25 per cent of the total debt increase in the same period, see Figure 3. In the rest of this section we only direct attention towards effects of house price changes on existing home owners.

Table 1 Indebted households. 2008

	Households		Debt increase
	1 000	Per cent	Per cent
All	1 763	100	9
Existing home owners	995	56	3
Purchased dwelling	142	8	41
Renters and others	627	36	9

Figure 3 Change in debt. Indebted households 2008. NOK Billion



The sample used in this analysis is constructed by matching the subset of existing homeowners with the data set containing information about house price developments through 2008. There are 721 000 households, i.e. 73 per cent of existing homeowners that match, see Table 2. Among existing homeowners, house prices fell on average by 4 per cent during the sample period, and nearly 80 per cent of them experienced a fall in the value of their dwelling.

Table 2 Existing homeowners with information on house value. 2007-2008

		House value	
	All	rise	fall
Number of existing homeowners, 1000	721	149	572
Per cent of existing homeowners	100	21	79
Initial mean value of house, NOK 1000	2 354	2 359	2 353
Value increase, 2007-2008 , NOK 1000	-93	35	-127
Value increase, 2007-2008, per cent	-4.0	1.5	-5.4

3.2 Does debt behaviour among existing homeowners depend on whether they experience a fall or rise in the value of their dwelling?

To analyse differences in debt behaviour due to changes in housing values, we divide existing homeowners in two groups, according to whether their housing wealth increased or declined. The differences in debt behaviour may be due to underlying differences between the two household groups. We investigate this in Table 3. In the selected key indicators there seems to be no major differences between the two existing homeowner groups.

Of existing homeowners that experienced a house prise rise in 2008, 45.8 per cent increased their debt. In comparison, 41.7 per cent of homeowners who saw a fall in their housing wealth took on more debt. This indicates that the probability of raising a loan is higher for homeowners experiencing a rise in their housing wealth compared to those who see their housing wealth decrease; the difference in debt behaviour between the two groups is statistically significant.

Table 3 Key statistics of existing homeowners. 2008

	House value	
	Value rise	Value fall
Age of main income earner	49	51
Mean of initial income, NOK 1000	543	536
Mean of initial value of dwelling, NOK 1000	2 359	2 353
Initial debt, NOK 1000	1 104	1 092
Initial interest expenses, NOK 1000	57	57
Loan to income ratio, per cent	204	204
Interest to income ratio, per cent	11	11
Loan to value ratio, per cent	47	46

Table 4 Frequency table. Change in housing value vs. debt. Existing homeowners. 2008

		Loan	Instalment	Total
Value fall	Frequency	238704	333500	572204
	Per cent	33.09	46.23	79.31
	Row Pct	41.72	58.28	0
	Col Pct	77.74	80.48	0
Value rise	Frequency	68351	80914	149265
	Per cent	9.47	11.22	20.69
	Row Pct	45.79	54.21	0
	Col Pct	22.26	19.52	0
Total	Frequency	307055	414414	721469
	Per cent	42.56	57.44	100
Chi-Square		804.19	Prob.	<.0001

Moreover, there is a difference in the size of loans and instalments between the two groups. Existing homeowners with rising housing wealth took on more debt, amounting to NOK 245 000 on average, while homeowners with falling housing wealth increased their debt by NOK 217 000 on average, see Table 5. Clearly, the difference in mean is statistically significant. Furthermore, the average down payment of homeowners with increased housing value was higher than the homeowners facing a reduced housing value. Overall, the data provides evidence that homeowners with strengthened housing wealth are more inclined to borrow than those with deteriorating housing wealth. Additionally, given that households with increasing dwelling values borrow, the size of the loan is larger.

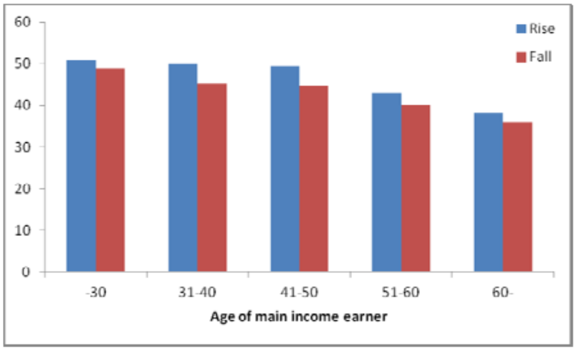
Table 5 Mean debt increase in households that lived in the same house through 2008, NOK, T-test

	Number of households (1000)		Mean debt increase (NOK 1000)		Difference in mean	t-value
	Increased value	Reduced value	Increased value	Reduced value		
All households	149	572	45	23	22	10.12
Increases debt	68	239	245	217	29	13.73
Reduces debt	81	334	-125	-117	-9	-2.57

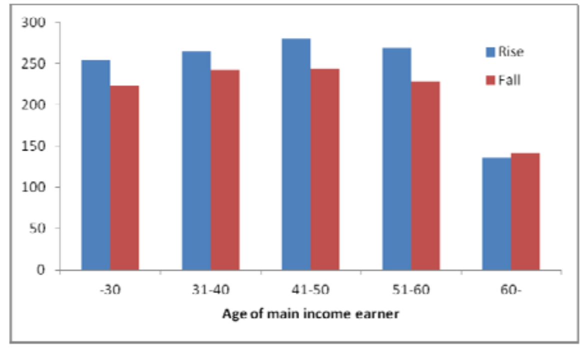
The result that existing homeowners with increased housing wealth take on more debt compared to those experiencing a house price fall, is robust over most age and income groups. Exceptions from this result are the findings for the oldest households and those with lowest income see Figure 4. During the 2000s, new loan products have especially been marketed towards older owner-occupiers with traditionally low LTV ratios. The rise in the availability of MEW products in the past few years can be viewed as a structural change, possibly influencing our finding regarding senior homeowners. More precisely, in the period under study, the raising of loans among senior owner-occupiers may have predominantly been driven by the rapid increase in MEW accessibility for this particular group.

Figure 4 Debt behavior of households by age and income

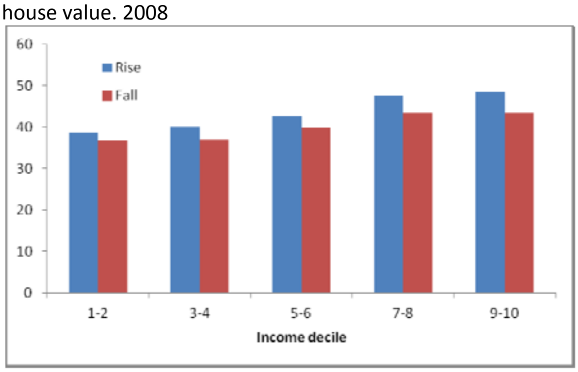
a. Percentage of households raising debt by age and house value. 2008



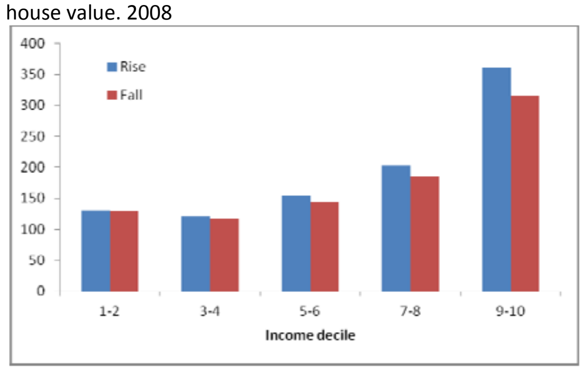
b. Mean debt increase by age and house value. Households that increase debt. 1000 NOK. 2008



c. Percentage of households raising debt by income and house value. 2008



b. Percentage of households raising debt by income and house value. 2008

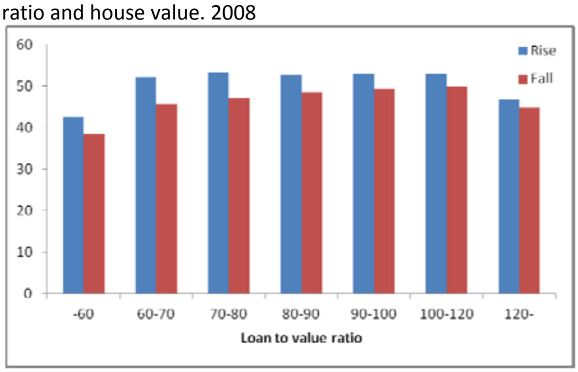


3.3 Is borrowing behaviour working through the collateral channel?

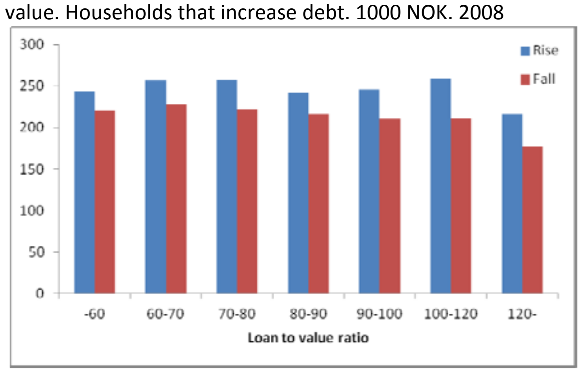
One hypothesis explaining MEW is that when housing values increase, homeowners who are restricted by LTV constraints imposed by lenders are then allowed to increase their borrowing. However, we find no evidence in the micro data of this hypothesis. As displayed in Figure 5, most of the debt increase is accounted for by households with low LTV ratios.

Figure 5 Debt behavior and loan to value ratios.

a. Percentage of households raising debt by loan to value ratio and house value. 2008



b. Mean debt increase by loan to value ratio and house value. Households that increase debt. 1000 NOK. 2008



3.4 A simple model approach

Based on the observation that raising a loan is a far more infrequent act for households than regular down payments, we will now assume that the borrowing decision is a two-step procedure. In the first step we assume that existing homeowners decide whether they will increase their debt or make an instalment. In the second step, conditional on their first choice and whether the value of their house has increased or decreased, they decide the size of the loan or the size of the instalment.

The choice of whether to borrow or install is modelled as a logit model (see Ben-Akiva and Lerman (1985)). Let p denote the probability that household i will borrow. The logodds is then linear in the parameters.

(4) $$log\left(\frac{p}{1-p}\right) = \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k$$

The results of the estimation are reported in Table 6. All estimates are significant at a 99.9% level.

Table 6 Results of the logit estimation

Variable	Explanation	Estimate	Standard error
Value rise	Change in value of house if its value increases, 0 otherwise	0.0024800	0.0001440
Value fall	Change in value of house if its value decreases, 0 otherwise	0.0003940	0.0000260
Margin	Income after tax – standard consumption – interest expenses	-0.0002900	0.0000099
Remaining collateral value	Initial value of house – initial debt	-0.0000800	0.0000017
Young	Main income earner 35 years or younger	0.0275000	0.0070000
Midle-aged	Main income earner between 36 and 55 years	0.0076800	0.0044300
		Without Covariates	With Covariates
	AIC	1 000 167	986 603

As Table 6 displays, the probability of borrowing increases when housing values rise and decreases when housing values fall. Yet the effect of changes in housing wealth is asymmetric; the impact on the probability viewed in absolute value is smaller when house prices drop compared to the corresponding effect of higher house prices. The coefficient affiliated to the margin is negative. It is not clear what coefficient sign one should expect in the latter case. On the one hand, a household with high income has a higher debt servicing capacity, but on the other hand, it might not need to borrow due to high income. The result implies that homeowners with low margins are more inclined to raise loans. The expected effect of higher remaining collateral values is also ambiguous. Higher collateral values improve homeowners' ability to borrow, yet unused housing equity indicates that they have not exploited the possibility of increasing borrowing. The negative coefficient confirms our reported finding above that borrowing does not seem to depend on the working of a collateral channel. Concerning the age coefficients, the signs are as expected; the probability of borrowing falls with age. (The group with age of main income earner over 55 years is the reference group).

To interpret the results, let us compare three young homeowners. Concerning the first homeowner, the value of the dwelling is unchanged. The second homeowner experiences a house price rise of 1 per cent (relative to the average housing value of all young homeowners), while the third is facing a corresponding price fall of 1 per cent. As the average housing value of a young household is NOK 1,77 million, a 1 per cent change corresponds to NOK 17 700. The model predicts that a 1 per cent rise in house prices will increase the probability of borrowing by 1.29 percentage points compared to the predicted probability where the price in unchanged. The probability of borrowing is more sensitive to a house price increase than a decline. A 1 per cent price fall will reduce the probability of borrowing by 0.20 percentage point, see Table 7.

Table 7 Predicted log odds and probability of borrowing

House value	Log odds	probability of borrowing
Unchanged	-0.0781	48.05
1% fall	-0.0862	47.85
1% rise	-0.0266	49.33

Table 8 Step 2. OLS estimation. Standard errors in parenthesis

	Rising house value		Falling house value	
Variable	Borrow	Install	Borrow	Install
Margin	0.29200	-0.51754	0.12715	-1.17541
	(0.00613)	(0.00696)	(0.00239)	(0.00587)
Collateral	0.03308	0.10380	0.04418	0.36153
	(0.00098)	(0.00118)	(0.00047)	(0.00086)
Young	176.58510	-103.77791	184.48540	-70.36483
	(4.43557)	(5.72430)	(2.36454)	(5.95275)
Middle-aged	147	-141	158	-261
	(3.00161)	(3.75822)	(1.36087)	(3.27826)
R-squared	0.24470	0.12670	0.22820	0.35150
No. households	68 351	80 914	238 703	333 500

In the next step we divide the existing homeowners into four groups depending on whether house prices rose or fell, and whether they chose to raise loans or install. We then carry out a simple OLS regression on the amount of debt increase or instalment in each group, see Table 8.

The estimated coefficients reported in Table 8 are overall rather different, and the results suggest that borrowing and instalment are diverse decision processes. For instance, the margin coefficients have different signs and sizes. Households with higher margins borrow more given that they borrow, and make larger instalments given that they repay. These findings are consistent with the results of section 3.2. The parameter values of the age dummy variables are also credible. Young households borrow more and install less than middle-aged households. However, middle-aged households make larger down payments than older households, the latter being the reference group.

Let us again examine the example of three young homeowners, where both the margin and collateral value are assumed to equal the corresponding averages of young owner-occupiers. The initial house value is unchanged. The house price as of 31 December 2008 is increased (reduced) by 1 per cent for the four household groups. We assume that a change in housing values will only affect the collateral value. Table 9 reports the predicted effects in the collateral value. As seen from the parameters, installment is most sensitive to the strengthening of collateral.

Table 9 Collateral values among young households. NOK 1000.

	Rising house value		Falling house value	
	Borrow	Install	Borrow	Install
Unchanged	769	785	517	559
1% rise	747	763	496	538
1% fall	791	806	537	580

If we combine the results of the first and second step estimations, we can predict the total effect of a one per cent rise or fall in house prices, displayed in Table 10. As an example, given that the value of the house at the end of 2008 is one per cent higher than in the observed average, the combined effect is that the predicted debt growth will increase from NOK 57 300 to 63 700. Consequently, debt growth during the period increases from 3.68 per cent to 4.10 per cent. A 1 per cent raise among the existing home owners that experienced a price fall has the strongest effect. In this case the predicted total debt increase in the group is 8.6 per cent higher than for unchanged house prices.

Table 10 Predicted borrowing among young households. NOK 1000

	Rising house value		Falling house value	
	Borrow	Install	Borrow	Install
Predictions from OLS				
Unchanged	258.5	-128.8	231.1	-112.8
1% raise	259.2	-126.6	232.0	-105.4
1% fall	257.7	-131.0	230.2	-120.2
Probability predictions from logit				
Unchanged	0.480	0.520	0.480	0.520
1% raise	0.493	0.507	0.493	0.507
1% fall	0.478	0.522	0.478	0.522
Combined predictions				
Unchanged	57.3		52.4	
1% raise	63.7		61.1	
1% fall	55.0		47.4	
Predicted debt growth				
Unchanged	3.68		3.37	
1% raise	4.10		3.92	
1% fall	3.53		3.05	

4. Concluding remarks

In the past decade, mortgage equity withdrawal, which does not necessitate a housing transaction, has become rather widespread in Norway. Previous empirical studies using Norwegian data have provided evidence of house prices being an important driving force for household debt trends (see e.g. Jacobsen and Naug (2004) and Anundsen and Jansen (2011)). Our macro structural VAR analysis confirms this result. A sudden and unexpected drop in house prices pushes down household debt (secured on dwellings) and the effect is both immediate and persistent. Consumption variables also respond negatively to a house price fall, and the impact on an important durable such as motor vehicles is particularly strong. We also find that house price shocks explain a substantial part of fluctuations in macro variables in the estimation period from the late 1990s to 2010. To shed further light on mortgage equity withdrawal we turn to household and housing panel data.

Examining the micro data we confirm the hypothesis that changes in house values affect the debt decisions of existing home owners. Moreover, we find evidence that the effect of changing house prices on the borrowing decision is different from the effect on the instalment decision. It appears that households that make instalments on their loans are less sensitive to changes in house prices than households that borrow.

We present a simple two stage model where we control for income, collateral value and age. In the first step we model the probability of borrowing. The effect of a price rise is stronger than the effect of a price fall. In the second step we investigate the effect on the size of the loans or instalments conditioned on whether the prices increase or decrease. The model predicts that the size of both loans and instalments increase with income. The loan sizes increase and the instalments fall with increasing collateral value.

We combine the two stages in a prediction for young households and find that the effect of a price rise is stronger than the effect of a price fall, and that the effect of a price rise in household that experienced a price fall is stronger than the effect for those where the prises rose.

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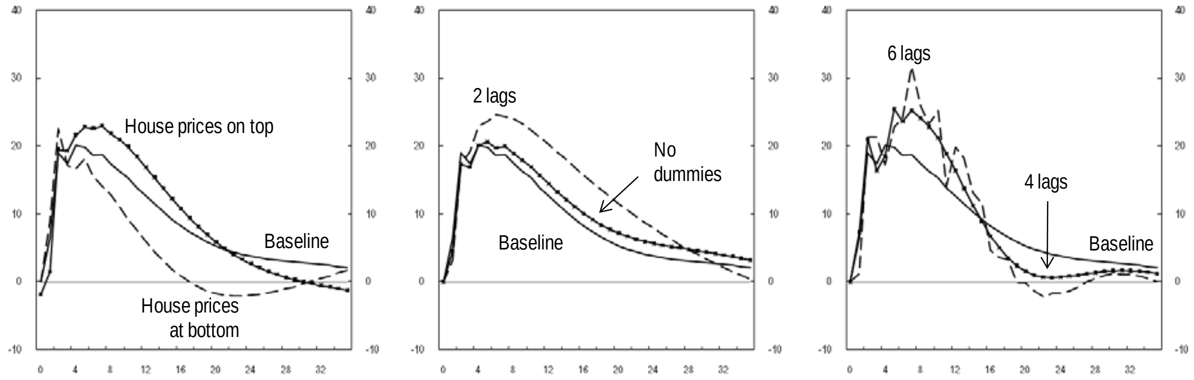
Appendix A – Robustness tests of the structural VAR

In this appendix we report results based on various changes with respect to the baseline VAR model accounted for in Section 2. In addition to our baseline model, we estimated 6 alternative model versions. The first alternative model is identical to the baseline model except that the house price variable is placed on top of the variable ordering, cf. equation (3) in Section 2. This implies that the remaining variables can respond simultaneously to a house price shock, while house prices can only react to other shocks with a lag. The second alternative version represents the opposite; the house price variable now enters the system at bottom. Accordingly, house prices can respond contemporaneously to all shocks while the remaining variables cannot react immediately to house price shocks. The third alternative version has the same variable ordering as in the baseline case, but the model differs as the three impulse dummies are left out of the VAR. The last three model versions are also identical to the baseline model but instead comprise 2, 4 and 6 lags, respectively.

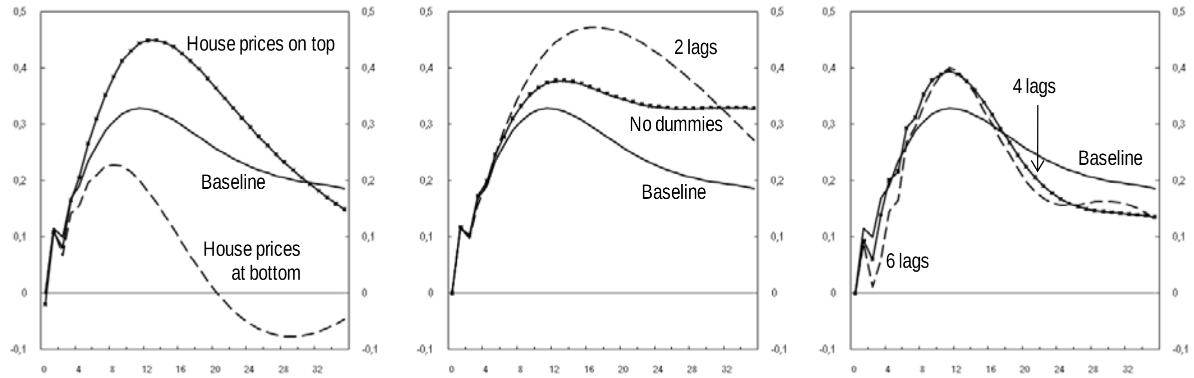
Overall, the responses plotted in Figure A1 demonstrate that the baseline results are fairly robust across different model versions, especially in the short term following the shock, where results in general are significant. Yet, some results differ from the baseline. If house prices are not allowed to respond simultaneously to an interest rate shock while the opposite holds (alternative version 1), then the immediate interest rate response to the negative house price shock is positive, although the shape of the response is similar to the baseline and the response turns negative after a few months. However, by letting house prices respond contemporaneously to monetary policy shocks (baseline and alternative version 2), one attains credible interest rate responses, consistent with the results in Bjørnland and Jacobsen (2010), where simultaneous interdependence between the two variables was allowed for in the estimation. Furthermore, the alternative version 2, that does not allow the lending variables to respond immediately to house price innovations, provides unreasonable responses with respect to the two lending variables. Credible responses in the lending variables thus require a variable ordering where they can react simultaneously to house price shocks, as in the alternative version 1 with house prices on top and the baseline ordering. In summary, in order to obtain reasonable and credible responses in the interest rate and lending variables, the baseline version places house prices below the interest rate and above the lending variables. Concerning the remaining variables, the placing of the house price variable seems to be of less importance. Moreover, the short term response in each and all variables is quite robust using the other model versions, i.e. alternative versions without impulse dummies and with 2, 4 and 6 lags.

Figure A1 Robustness tests. Responses to a house price fall by 10 per cent

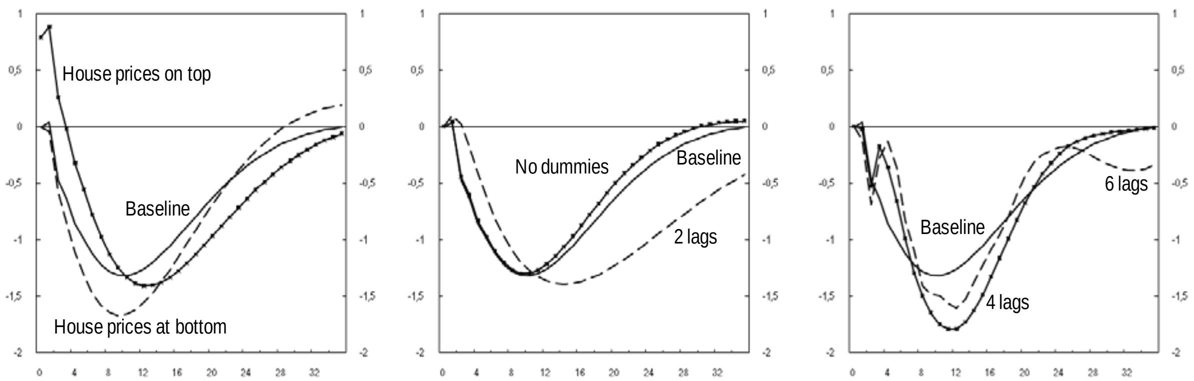
Firm bankruptcies (per cent)



Unemployment rate (percentage points)



Real interest rate (percentage points)



Real house prices (percentage points)

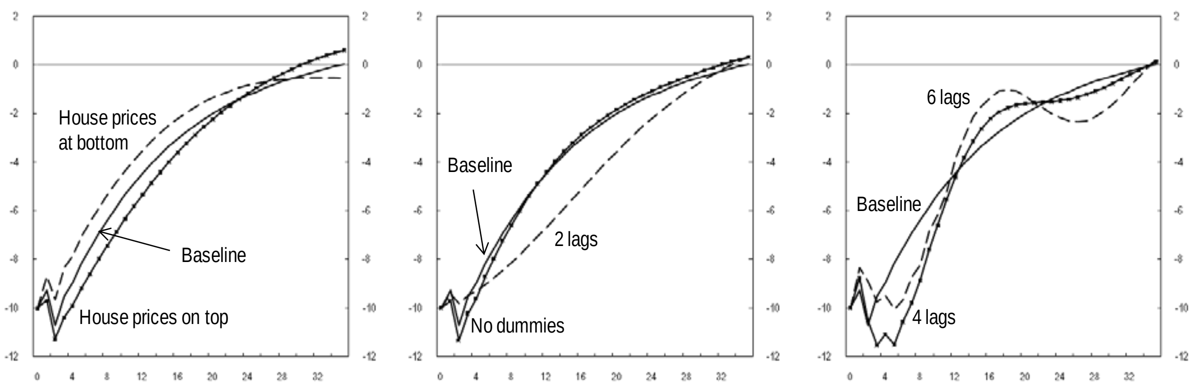
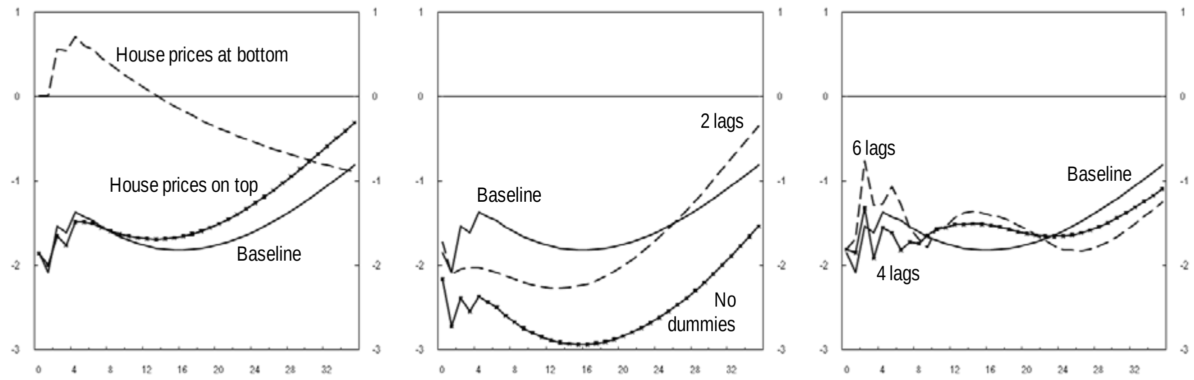
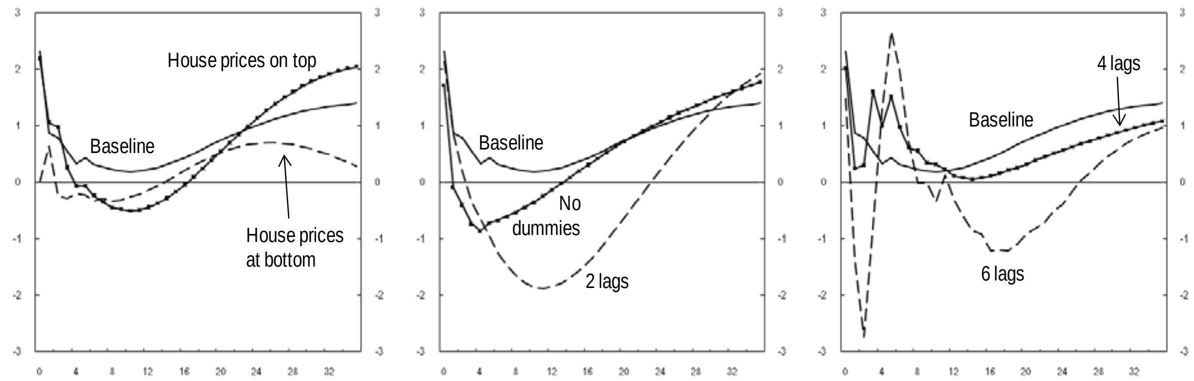


Figure A1 Robustness tests. Responses to a house price fall by 10 per cent

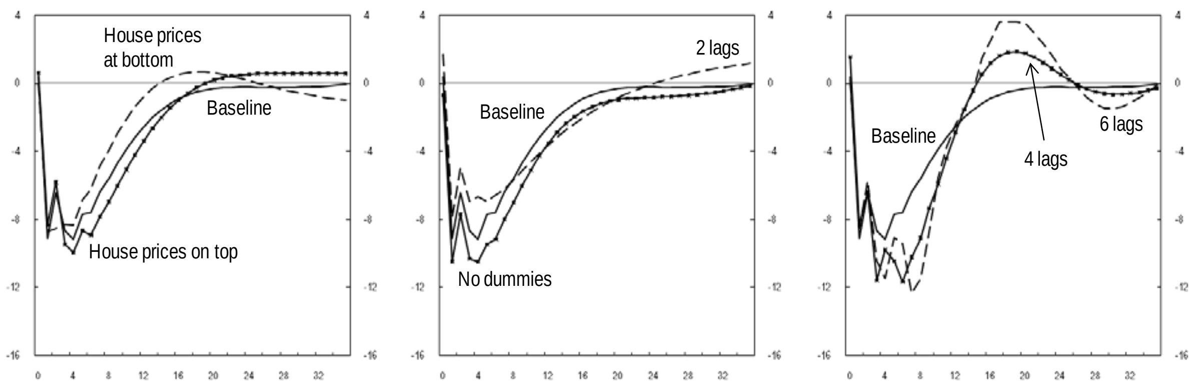
Real lending secured on dwellings (per cent)



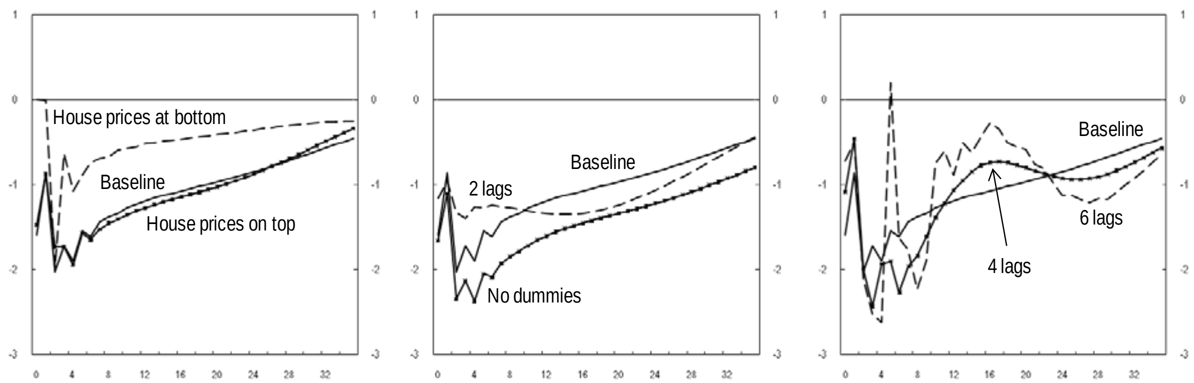
Unsecured real lending (per cent)



Sales of motor vehicles (per cent)



Retail sales (per cent)



Appendix B The micro data

Income statistics for households from Statistics Norway[8] is compiled by linking different administrative registers and statistical data sources for the whole population as at 31st December of the fiscal year. In this analysis we use observations from end- 2007 and end-2008 for every person in the population, registered at both dates, to calculate changes in debt, income and tax value of dwellings. Information about persons is aggregated to households through a household number. A household is defined as persons living in the same dwelling. Home ownership and identification of same home owners is done based on changes in tax values of housing.

Information on standard consumption is from the National Institute for Consumer Research[9], and applied according to family composition and size.

The housing data including estimated market value is from the Dwelling stock statistics from Statistics Norway[10] . The market price is estimated for different regions and types of dwelling[11].

The sample used in this analysis is same home owners merged from the Income statistics merged with the housing data from Dwelling stock.

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